# Implementing a 'real industry technology learning systems' module in agronomy within higher education systems

Amy Cosby[1], **Richard Flavel[2]**, Tina Botwright Acuña[3], Wendy Fasso[4], Sue Gregory[1] and Mark Trotter[5]

[1] School of Education, University of New England, Armidale, NSW 2351, www.une.edu.au, acosby2@une.edu.au
[2] School of Environmental and Rural Science, University of New England, Armidale, NSW 2351
[3] School of Land and Food, University of Tasmania, Hobart, TAS 7001
[4] School of Education and Arts, Central Queensland University, Rockhampton, QLD 4700
[5] Institute for Future Farming Systems, Central Queensland University, Rockhampton, QLD 4700

## Abstract

The SmartFarm Learning Hub (the Hub) is a collaborative project between seven universities, which aims to increase the knowledge and skill base of students studying agricultural technology at a tertiary level. The recognised skills shortage in the agriculture industry is exacerbated by the failure of universities to keep pace in educating students in the latest agri-tech systems. The Hub will develop real industry technology learning systems (RITLS) using real-farm data, which is regularly updated to remain relevant, and commercially available systems that can be used in tertiary teaching to increase graduate capability and readiness for employment within the agricultural industry. We report on one agronomy relevant case study RITLS based on the ProductionWise® precision agriculture data management platform. These modules will be evaluated by students and this feedback will be used to improve them for future use. Reported are the evaluation of responses from students to the questions based on the Threshold Learning Outcomes (TLO), which form the Learning and Teaching Academic Standards Statement for Agriculture (AgLTAS). Initial feedback demonstrates that the majority of students are obtaining the desired skills and knowledge as a result of completing the ProductionWise® learning module, however, modification can be made to the activity to strengthen the student's sense of achievement of the TLO's.

## Keywords

Tertiary education, ProductionWise®, AgLTAS, agri-tech teaching.

## Introduction

Concerns have been raised that the content of agricultural science and agribusiness degrees at universities are not meeting the needs for the jobs available or those that will be created in the coming years in the industry (Senate Standing Committees on Education, Employment and Workplace Relations 2012). In order to remain competitive in a global market, agricultural businesses in Australia need to continue to innovate and adopt new technologies (Commonwealth of Australia 2015). To ensure this occurs, the agricultural workforce must have adequate skills and knowledge of agricultural technologies and systems that can increase efficiency, sustainability and profitability. It has been reported that there is already a skills shortage in agriculture, estimated at four jobs available for every tertiary agricultural graduate (Pratley and Botwright Acuna 2015).

A collaborative project between seven universities (University of New England, University of Tasmania, University of Central Queensland, University of Southern Queensland, University of Melbourne, University of Sydney and New Mexico State University), the SmartFarm Learning Hub (The Hub) (www.smartfarmhub.com) will host a variety of learning modules that use Real Industry Technology Learning Systems (RITLS) that can be utilised in tertiary teaching. The Hub aims to increase the skills capability and knowledge of students by exposing graduates directly to industry and to the latest advances in agri-tech and therefore improve their employability in the agricultural industry (Trotter et al. 2016). Incorporating RITLS into tertiary teaching using real-farm data (and also live data) will provide students with the skills and knowledge needed to apply commercially available agri-tech systems to make informed decisions when solving agricultural problems in their employment.

The learning modules developed as part of the Hub are available via Creative Commons Attribution-ShareAlike licence (https://creativecommons.org/licenses/by-sa/4.0/legalcode) allowing education institutions across Australia and globally to utilise them. There is a variety of RITLS that will be available on the Hub that can be used in agronomy units at a tertiary level including Pastures from Space®, PASource, ProductionWise®, Feed Demand Calculator and the Rainfall to Pasture Growth Outlook Tool. Each learning

module is being developed in an action research cycle to ensure that they deliver an optimised learning experience for students (Reason and Bradbury 2001). Students are asked to complete an online survey to evaluate the learning module. Reported in this paper are preliminary results from the project based on the delivery of one RITLS, ProductionWise®.

## Methods
### Case Description
The ProductionWise® learning module was developed at the University of New England (UNE) by Dr Richard Flavel, and taught to a cohort of third year agronomy students in August 2016. Sixteen students studying Rural Science, Agriculture and Agribusiness degrees at UNE completed the survey allowing a preliminary evaluation of the learning module to occur. The module will be updated as changes are made to ProductionWise® system to ensure it remains relevant.

ProductionWise® is an online crop management tool developed by GrainGrowers for farmers (GrainGrowers 2017). The learning module completed by students required them to use the mapping and CropTracker tools available to model the expected performance of the then current winter crops and explore the impacts of management decisions on these modelled yields. This tool can be used to critically investigate the complex interactions between management decisions, crop physiology and environmental factors such as available soil moisture, fertiliser applications and thermal drivers. Students were provided with scenarios that they might expect as an agronomist and were asked to provide explanation and recommendations to manage the cropping system in the context of a farming enterprise.

At the conclusion of the practical, students were invited to complete an online survey through SurveyMonkey®. They were asked thirty-four questions gauging their opinion on a variety of aspects of the practical such as whether they perceived the learning outcomes were achieved, the learning experience's applicability to future employment, technical aspects of the program, system usability scale and general demographic questions. The information derived from this dataset will be used to improve the learning module for future cohorts. This dataset will be used to compare the perceptions of future student cohorts who complete the updated module.

The questions which focused on learning outcomes were derived from the Threshold Learning Outcomes (TLO) which form the Learning and Teaching Academic Standards Statement for Agriculture (AgLTAS) (Botwright Acuña and Able 2016; Botwright Acuña et al. 2014). These were developed using a consensus approach to address the need for skilled graduates in agriculture with academic, industry and student input (Botwright Acuña et al. 2016). Students were asked to respond to questions based on the AgLTAS TLO's using Likert scale questions (Likert 1932).

## Results and Discussion
The results of this study provide valuable insight to the progress being made in the project and to also inform in the refinement of the ProductionWise® learning module. Figure 1 displays the student responses to the five survey questions on the AgLTAS TLO's. With 88% of students "strongly agreeing" or "agreeing", it is clear that the practical was perceived to improve student knowledge of contemporary issues in agriculture (Figure 1a). Students also found that the ProductionWise® practical increased their ability to choose a suitable tool to solve an agricultural problem (Figure 1b). However, when asked whether the practical advanced their understanding of how to solve dynamic problems, half of the class were "neutral" (31%) or "disagreed" (13%) (Figure 1c). There is the opportunity to restructure the scenarios in the practical to ensure students are required to outline their approach to using ProductionWise® to solve the scenario.

The results of the survey indicate that the ProductionWise module could be better aligned with the TLOs. Additional emphasis on how the practical is relevant to the scientific and business components of agriculture could take place with 38% of the class having a "neutral" response to this question (Figure 1d). The inclusion of a question on how the decisions made using ProductionWise® saved the farmer money is one possibility. Nearly half of the students had a "neutral" response to whether the module equipped them to communicate what was learnt (Figure 1e). The addition of a task that requires students to outline how they would communicate the outcome of the scenario to a grower could address this issue. Some examples of how to achieve this TLO through assessment are also outlined in the "Good Practice Guide: Threshold Learning Outcomes for Agriculture" (Botwright Acuña and Able 2016), which could be drawn upon when modifying the learning module.
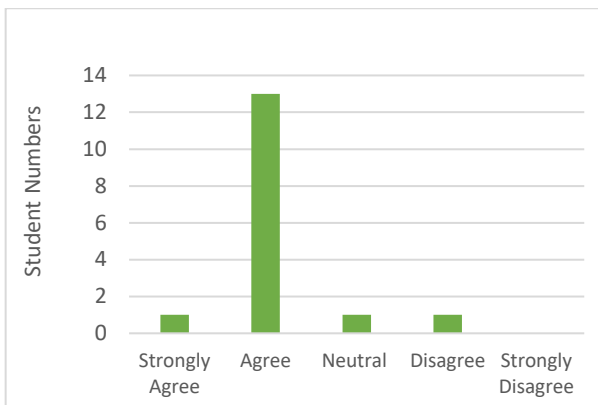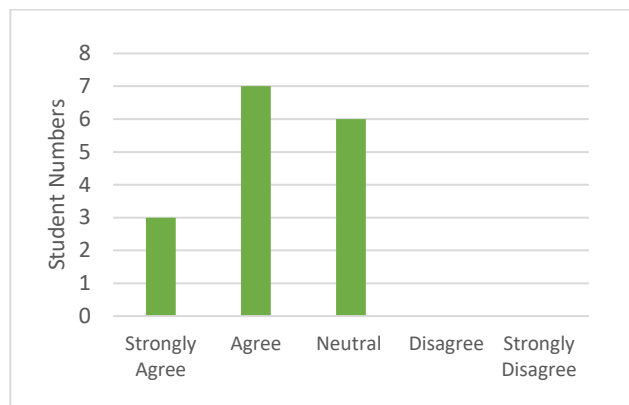
**a) The module improved my knowledge of contemporary issues in agriculture.**
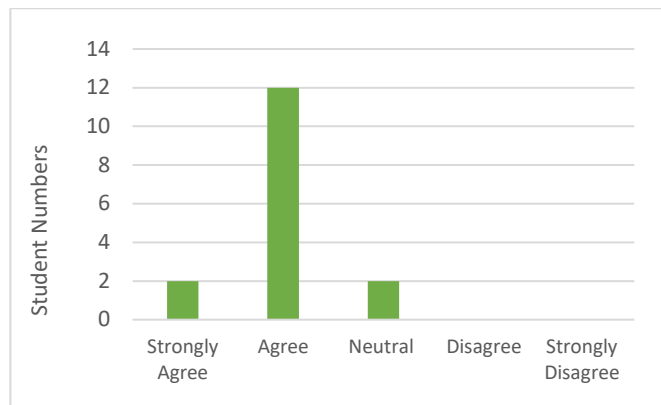


**b) The module helped me understand how to select and apply an appropriate tool to solve an agricultural problem.**
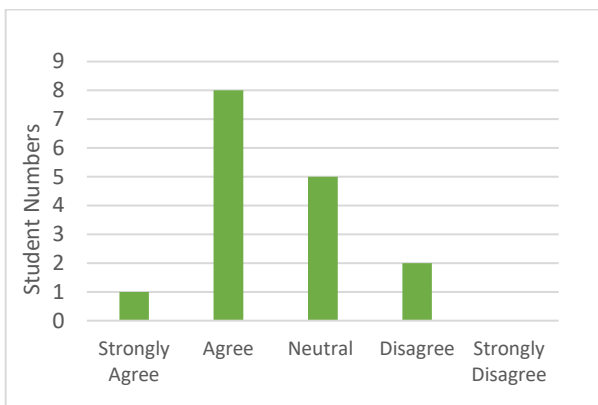


**c) The module increased my understanding of current opportunities in agriculture to solve dynamic complex problems.**



**d) The module explained the role and relevance of agriculture or its related sciences, or agribusiness in society.**
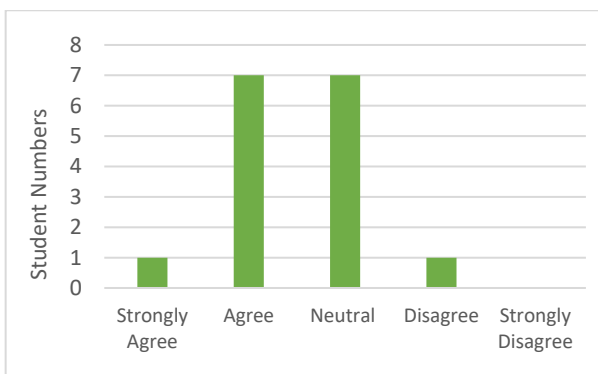


**e) After completing the module I am better equipped to communicate with a range of audiences what I learnt.**

**Figure 1. Results of preliminary study looking at student responses to Learning Outcome questions after completion of ProductionWise® learning module.**

To ensure students are prepared for careers in the agricultural it is important they are exposed to RITLS. One student commented, "Programs like this are increasingly used in agriculture it is important we know about them and how to use it."

By using ProductionWise®, a tool that is already available to the industry, students are exposed to real world challenges and scenarios they need to solve. The rapid flow of environmental information and simulation tools that form part of ProductionWise® enables students to make informed decisions and identify the mechanisms and patterns that drive the cropping system. Students gain a familiarity with the complexities of the system and

when they graduate, have experience in what to look for in diagnosing constraints and improving productivity. When considering the importance of incorporating the use of RITLS to achieve AgLTAS TLO's into his teaching, Dr Richard Flavel observed, "One of the key outcomes as a lecturer in a field so closely aligned with industry is to produce graduates competent in contemporary scientific theory, but importantly, graduates that are ready to go in the paddock".

## Conclusions
The ProductionWise® module allowed the majority of students to achieve the desired TLO's on completion, however, there is room for optimising these modules. As part of the action research cycle each of the learning modules, including ProductionWise, will be enhanced based on student survey responses and delivered to a different cohort of students in 2017. The completion of a RITLS module, such as ProductionWise®, complements a larger program of content that is designed to convey a broad range of skills to solve problem based scenarios, common to many of the crop species and situations encountered in the field. At UNE part of this larger program includes a mandatory 12 weeks of work placement in different agricultural industries and varying geographical locations, which assist students to build industry networks. There are fourteen other RITLS covering a wide variety of topics in the process of development as part of the project. Collated data will be used to address the research questions posed in this preliminary study. Selected RITLS will also be transformed as part of the project so they can be taught to high school students as a method of encouraging them to consider studying agriculture at a tertiary level.

## Acknowledgements

## References

Botwright Acuna T, Kelder JA, McDonald G and Able A (2016). Implementing the threshold learning outcomes for agriculture at university. Journal of Teaching and Learning for Graduate Employability, 7 (1), 2-21.

Botwright Acuña TL and Able AJ (Eds.) (2016). Good Practice Guide: Threshold Learning Outcomes for Agriculture. Office for Learning and Teaching. Sydney, NSW.

Botwright Acuña TL, Able, AJ, Kelder J, Bobbi P, Guisard Y, Bellotti W, McDonald G, Doyle R, Wormell P and Meinke H (2014). Learning and Teaching Academic Standards Statement for Agriculture. Office for Learning and Teaching, Sydney, NSW.

Commonwealth of Australia (2015). Agricultural Competitiveness White Paper. Canberra. Retrieved from (http://agwhitepaper.agriculture.gov.au).

GrainGrowers (2017). Home. Retrieved from (https://productionwise.com.au/#main).

Likert R (1932). A technique for the measurement of attitudes. Archives of Psychology.

Pratley J and Botwright Acuña T (2015). From adversity comes strength – repositioning education in agriculture. In: Proceedings of 17th Australian Agronomy Conference. pp. 20-24. Hobart, TAS.

Reason P and Bradbury H (2001). Handbook of action research: Participative inquiry and practice: Sage.

Senate Standing Committees on Education, Employment and Workplace Relations (2012). Higher education and skills training to support agriculture and agribusiness in Australia. Commonwealth of Australia, Canberra.

Trotter M, Gregory S, Trotter T, Acuna T, Swain D, Fasso W, Roberts J, Zikan A and Cosby A (2016). SMARTfarm Learning Hub: Next Generation Precision Agriculture Technologies for Agricultural Education. In: 13th International Conference on Precision Agriculture, 31 July -3 August 2016. St Louis, Missouri, USA.