The Nature of Agricultural Industry School Partnerships: A Case Study

Molly O'Dea[a] (0000-0002-2316-4281), Amy Cosby[a,b] (0000-0003-2199-7607), Jaime Manning[a] (0000-0003-4785-4313), Nicole McDonald[a] (0000-0001-7751-3574) & Bobby Harreveld[b] (0000-0001-5485-2004)

Corresponding author: Molly O'Dea (molly.odea@cqumail.com)
[a]Agricultural Education and Extension Cluster, Institute for Future Farming Systems, CQUniversity Australia, Rockhampton Queensland 4700, Australia
[b]Centre for Research in Equity and Advancement of Teaching and Education (CREATE), School of Education and the Arts, CQUniversity Australia, Rockhampton Queensland 4700, Australia

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Abstract

This research analyses the perspectives of all key stakeholders in an agricultural industry school partnership (ISP), including industry partners, which are rarely identified in the literature. Understanding this range of perspectives provides people who deliver and participate in ISPs with a greater understanding of how to deliver quality partnerships that benefit students, educators, and the agricultural industry. This research aimed to explore the nature of one agricultural ISP in Gippsland, Australia, by understanding the structure, key principles identified by participants, and how the outputs met the teacher and industry partners' objectives. A qualitative case study utilising surveys and semi-structured interviews with the teacher and three industry participants, semi-structured interviews with the Principal, an education department employee and industry managers, and pre- and post-surveys with students, were used to collect data for this narrative analysis. The findings demonstrate that the ISP has a complex ecological structure. Key principles identified by participants included having a facilitator, clear communication and collaboration, funding, the ISP being engaging and flexible, acknowledging industry partners, and reinforcing the learnings. Teacher and industry participants' objectives were met, including: increasing student and teacher knowledge of agriculture, and for one industry partner, knowledge of how to deliver relevant content.

Introduction

Research analysing the perspectives of all key stakeholders in an agricultural industry school partnership (ISP), including students, educators, the education system, and industry partners and their businesses, is lacking (O'Dea et al., 2022; 2023a, 2023b). Understanding this range of perspectives is valuable to ensure quality partnerships are designed that benefit students, schools, and the agricultural industry. This research seeks to address this gap in the literature through a case study of one of the 57 agricultural ISPs delivered as part of CQUniversity Australia's Raising Aspirations in Careers and Education (RACE) Gippsland project which ran from 2020-2023. The ISP explored in this case study was selected as it provided an example of a common case where data could be collected from a range of stakeholders (Yin, 2014). To understand all stakeholders' perspectives the authors sought to understand the nature of the agricultural industry school partnership. To explore the ISP's nature, or inherent features, the ISP has been theorised as an ecological system, through application of Bronfenbrenner's (1976) Ecological Systems Theory (EST). This theory provides a framework to understand the ISP's structure. The key principles for successful partnerships, and the educator and industry partners' objectives were also explored to provide a holistic understanding of the case from the

participants' perspectives. This study aimed to answer the following research questions (RQs):

1. What is the nature of the agricultural industry school partnership?

    1.1 How was the agricultural ISP ecologically structured?
    1.2 How are the key principles identified by teacher and industry participants operationalised throughout the agricultural ISP?
    1.3 How do the outputs from the agricultural ISP meet the teacher and industry participant's objective?

In order to understand the ISP studied, the authors define ISPs as agreements between schools and industry professionals to work together. In the case of the agricultural ISP studied here, as part of these agreements, schools and industry professionals work together to increase students' awareness and aspiration for a career in the agricultural industry. The term ISP, or similar terms such as school industry partnership, school business partnership, and employer engagement (Flynn, 2015), are rarely defined. However, many government reports, research articles, and industry publications discuss and/or promote ISPs, including Australia's National School Reform Agreement, which recognised that "a high quality schooling system is also supported through partnerships with the broader community and employers" (Australian Government Department of Education and Training, 2021, p. 4). Many examples of ISPs are available, which range from one-off incursions and/or excursions, like this study (Education Services Australia, 2018) and partnerships with teachers (Morris, Slater, Boston, Fitzgerald, & Lummis 2021), through to formalised, long-term arrangements (Flynn, 2015).

The ISP explored in this study was informal and short in duration. Delivered in Gippsland Australia, the ISP was between two separate year five/six science classes (25 students in each class, total of 50 students), their science teacher, three local agricultural industry partners, and a facilitator, who was also one of the researchers. This partnership was delivered in 2023, spanning three weeks, and formed a component of a unit of work for the students which focused on electrical energy. The ISP focused on energy in the dairy industry. An overview of the partnership activities is provided in Appendix A.

Whilst ISPs are common, research investigating these partnerships is lacking (O'Dea, et al. 2022). Further, there is a gap in research exploring these types of partnerships as a whole system, considering all stakeholders (O'Dea et al. 2022; Flynn 2015). Only two studies, by Flynn (2015) and Leonard (2011), have been found to investigate ISPs as a whole system, taking an ecological approach to understanding the influences and interconnections within the partnerships, though neither study explores short-term partnerships, nor have an agricultural focus, as in this study. However, the ecological approach taken by Flynn (2015) and Leonard (2011) was shown to provide a deep, holistic understanding of the ISPs they explored, demonstrating that the EST is highly relevant to this study.

Ecological systems theory

This theory provides a framework to understand the interconnections between stakeholders in complex systems (Bronfenbrenner, 1976). Bronfenbrenner (1976, p.5) originally developed the EST to understand influences on the developing child and describes ecological systems as a 'nested arrangement of structures, each contained within the next'. By applying this logic to ISPs, building on Bronfenbrenner's work, and other studies applying this theory to ISPs (Flynn, 2015; Leonard, 2011), we derived the following summary of the EST's five systems:

(1) Micro-system – stakeholders directly involved including teachers, students, facilitators, industry partners.

(2) Meso-system – stakeholders once removed from micro-system stakeholders e.g. principals, industry managers, students' families.

(3) Exo-system – social structures encompassing the ISP with indirect influence e.g. education department and industry bodies.

(4) Macro-system – overarching systems including agricultural, educational, and political.

(5) Chrono-system – influences over time.

Methodology

Research design and data analysis

Case study research is 'an in-depth description and analysis of a bounded system' (Merriam, 2009, p.40). A descriptive case study design was selected to provide a holistic understanding of the nature of agricultural ISPs. The case, or unit of analysis, studied was bounded by the single agricultural ISP described above, which was selected as it is typical of the ISPs conducted during the program (Merriam, 2009). An in-depth analysis of this case is valuable as it enables a more holistic understanding of an agricultural ISP, from the perspectives of education and industry stakeholders from the micro, meso and exo-system levels, which has not previously been undertaken. Qualitative data, from surveys and semi-structured interviews was analysed via narrative analysis (Merriam, 2009). Narrative analysis was undertaken, where data was inductively analysed for perspectives related to each of the RQs, with this data coded with the aid of *NVIVO* as a management tool (Creswell & Poth, 2016; QSR International Pty Ltd, 2020). The participants' perspectives were then organised and written into the following "analytic abstraction of the case" (Creswell & Poth, 2016, p. 200) that highlights the participants' experiences in relation to the RQs. All names have been replaced with a pseudonym. This research design aligns with the EST, framing this research, and the researcher's constructivist perspective, by building knowledge from the participants' experiences (Creswell & Poth, 2016). This research has been approved by the CQUniversity Australia Human Research Ethics Committee, approval number 22822.

Participant recruitment and selection

Hand-picked sampling, where a sample was selected "with a particular purpose in mind" (O'Leary, 2017, p. 210), was used to select participants from the RACE Gippsland project who could contribute to this case study. The teacher was originally recruited to participate in the ISP through social media promotion of the RACE Gippsland project, and industry partners were recruited through known contacts of RACE Gippsland project team members and RACE Gippsland project partners. Participation in the ISP and research were voluntary, and all participants had no obligation to be involved. A description of each participant is provided in Table 1. The school that participated was located in a small rural town with an approximate population of 2,500. The major industries supporting the town are dairy and beef farming, and timber production. The school catered for students from Foundation to Year 6 with a population of approximately 125 students. The school offered programs in line with the Victorian

Curriculum, which included science classes, but did not offer agriculture as a stand-alone subject.

Table 1 – participant descriptions

Participant type and pseudonym	Age (yrs)	Gender	Connection to agriculture	Time in current position	Time in industry (yrs)	Previous ISP participation	Other details
Teacher - Nelly		Female	-Distant, occasionally keeping up to date -Has one or more family members working in the agriculture industry.	No response	5	Yes, related to agriculture, health, climatology, science, zoology	-5 years teaching experience all at current school. -Includes food and fibre concepts in teaching program: wool and vegetable gardening, wants to add more
Principal - Holly	55	Female	-	2wks	16	-	-Positive perception of agriculture -Previously worked in agriculture, on dairy farms, growing horticultural produce
Students (n=50, 44 participated in data collection) – pseudonym n/a	10-13 (year 5/6)	19 male, 19 female, six unknown (left blank)	66% (n=25) answering yes, 21% (n=8) no, and 13% (n=5) I don't know, when asked "does anyone in your family, or a family friend have a farm or work in agriculture?" (n=38).	-	-	-	
Facilitator - Millie	26	Female	-	-	-	-	-Member of the RACE Gippsland project team. -Organised and participated in the ISP.

Participant type and pseudonym		Age (yrs)	Gender	Connection to agriculture	Time in current position	Time in industry (yrs)	Previous ISP participation	Other details
								-Conducted interviews and related research. -Background working and studying in agriculture and education.
Industry partners	Gordon	45	Male	-	15yrs	28	Yes, site tours	-Senior technical officer and farm manager, with bachelor degree.
	Tim	34	Male	-	1yr	3		-Senior technical officer, with bachelor degree.
	Valerie	45	Female		1.5yrs	29	Yes, incursions and excursions to a range of agribusinesses	-Worked for a dairy industry organisation. -Completed Year 10 and industry relevant certificates.
Industry manager	Kelly (Valerie's manager)	50	Female	-	1.5yrs	1.5	Yes, in other industries	
	Jordan (Gordon and Tim's manager)	60	Male	-	5yrs	35	Yes, site tours	
Education Department - Mandy		Between 40-49	Female	-	5yrs	20	-	-Role related to career pathways.

Data collection

Survey and interview questions were developed from previous instruments used in the field of agricultural education and through reviewing relevant literature (Australian Government Department of Education, Employment and Workplace Relations, 2013; Cosby, Manning, Fogarty, McDonald & Harreveld, 2022; Cosby, Manning & Trotter, 2019). A semi-structured interview and survey was completed by Nelly before and after participating. Due to time constraints, Gordon completed a semi-structured interview prior to participating, and the initial and final survey questions and semi-structured interview afterwards, and Tim and Valerie each completed one semi-structured interview and the initial and final survey questions after participating. Holly, Mandy, Kelly, and Jordan each participated in a semi-structured interview after the program was completed. Fifty year 5-6 students were involved in this ISP. Students had the opportunity to complete a hard-copy survey before (n=38) and after (n=33) participating.

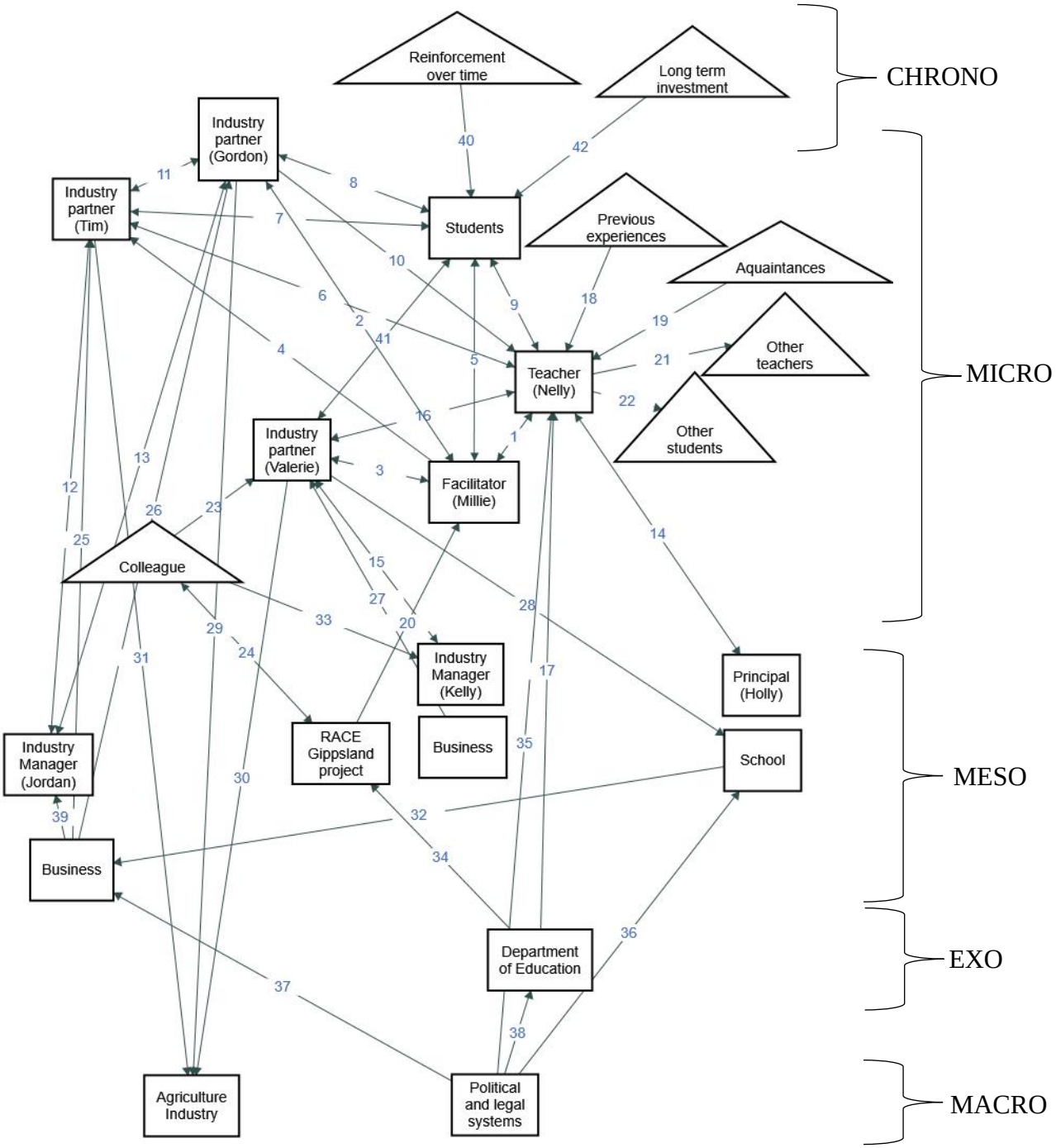
To answer the RQs, demographic information was collected from all participants. Teacher and industry participants were asked in semi-structured interviews what influenced them to participate, how they found participating and the structure of the program, if it was successful, what barriers exist in participating, what their objectives were, and if these were met. The industry managers, principal and education department employee were asked in semi-structured interviews about their perspective of ISPs including benefits, barriers, key principles, and influences. Student surveys included questions related to their perception and knowledge of agriculture, and open-ended questions to ask about their experience.

Results

Ecological Structure

To answer RQ1.1, the ecological structure of the partnership, distilled from interviews, is presented in Figure 1, with specific interconnections described below. Each line between components of the structure is labelled with a number to easily identify each interconnection. Arrows are used to indicate the direction of influence, for example interconnection 36 depicts the political and legal systems influencing the Education Department, where as interconnection 8 depicts Gordon influencing students and students influencing Gordon. These numbers are provided in brackets following the discussion of each interconnection to enable readers to easily refer back to Figure 1.

Figure 1 – ISP ecological structure. Squares indicate ISP components. Triangles indicate other influences on ISP components. Each interconnection is labelled with a number.



Micro-system

The industry partners wanted to participate to help students (7,8,41). Valerie had 'that passion for mentoring, so it gave me the opportunity to help younger people'. Tim thought 'it's not just good for them [students], it's good for you to tell them what you do' and Gordon was interested in showing students what the organisation does, and 'exposing the requirements of agriculture and where products come from'. Valerie, Gordon, Tim, and Millie were connected with Nelly through the delivery of activities (1,6,10,16).

Numerous influences to participate were highlighted by Nelly, including her pre-existing interest in agriculture (18). She stated, 'I'm interested in this industry, and all the topics around it'. She 'found it [the program] through Facebook, and people know my interests, so that's why they… sent it to me' (19). Previous positive agricultural experiences, including visiting the excursion site, and knowing Gordon, meant Nelly 'was comfy [comfortable] with it [the excursion]' (10).

Once connected with the facilitator, Millie also became a large influence on Nelly's involvement (1). Nelly stated 'you [Millie] encouraged me to do it. And the excursion just wouldn't have happened if you didn't do it'. Millie planned and helped deliver the incursion and excursion to students (5), which reduced some of Nelly's barriers to participating (1), which included 'expertise, organisation, time, funding'. These barriers were overcome through the project (20), as funding for transport and a facilitator who was able to organise the activities, and experts to participate, was included. Gordon, Tim, and Valerie also all found value in having a facilitator (2,3,4).

Gordon and Tim were influenced to participate as 'it's sort of part of my role here' (Gordon) (12,13) and due to the proximity of the school, with Gordon stating: 'being a local school gave me a bit more motivation…to do it' (8,10). Gordon also highlighted interconnections with teachers, noting 'now that the teachers have been here (to their agricultural business), or have seen the place… [there is] the opportunity for them to bring other students' and also to tell other teachers about their experience who could then bring their students (21,22). Gordon and Tim worked together to provide the tour (11).

Valerie and Kelly were influenced to participate by a colleague (23,33) who had 'good interactions with you guys (RACE Gippsland team) earlier' (Valerie) (24).

Meso-system

Valerie 'was interested in participating to learn more about the schools in our area, and how they are teaching... agriculture to the… students' (28). Gordon and Tim wanted to participate for workforce reasons for their business (25,26). Working with children checks (WWCC) and differing requirements between schools were discussed, with Gordon stating 'you're limited to who you can involve with that' because not everyone has a working with children check, raising barriers for others in the business participating (32). Jordan highlighted that due to his management role, he influenced Gordon and Tim to participate (12,13). Participating in these activities formed part of Valerie's role, linking back to her manager, Kelly, and the business (15,27). Jordan raised business planning documents which included aspirations for greater interaction with the education sector, as an influence that enabled their organisation to participate in ISPs (39).

Nelly highlighted an interconnection with her principal (14), who 'is a bit anti-excursions'

due to bus costs, risk management, and the time it takes because ‘there’s so much else to fit in the timetable’. Timetabling constraints were also highlighted by Mandy. Holly also noted that funding for excursion transport and keeping the excursion within a three-hour time slot helped to overcome these barriers (20).

Exo-system

Links between the micro-system and exo-system were raised when Nelly highlighted red tape, including risk management planning, at the Department of Education level as a barrier (17). She explained that ‘if something had gone wrong, it's on my head, like, no matter what I've done in terms of the risk management planning’. She continued to say that ‘having you (Millie) back me up made it easier and I was more willing to do it’ and also noted she had time to complete the paperwork ‘because you [Millie] did the rest’ (1). Whilst the Department of Education created barriers to participating, it also enabled participating through funding the project (34). Mandy discussed that structural changes to the education system which would ‘give flexibility in the timetable … for industry immersion’ would be ‘extremely valuable’ though she recognised it would be challenging to make these major changes and she was ‘not really sure what the solution is just yet’.

Macro-system

The industry participants highlighted a desire to improve the agriculture industry as a whole, rather than on an individual business level (29, 30, 31). Valerie, Gordon, Tim, and Kelly all discussed workforce, with Valerie saying that for ‘the industry, what we hope to get out of it is some future employees’. They also wanted to improve people’s perceptions of the industry, as indicated by Gordon who wanted to ‘give a better impression to people who haven't been exposed to… what it's really like’.

Nelly raised red tape as an issue for herself (35) and the school (36), and Gordon discussed this as a barrier for more employees in the business participating (37). This hints to the political and legal systems impacting ISPs, resulting in the inclusion of red-tape at the macro-system, in addition to the exo-system. This is also interconnected with the Department of Education who are connected to the development and administration of these policies (38).

Chrono-system

Lastly, several references were made to interconnections with the chrono-system. This includes all industry partners being motivated to participate to engage potential future employees, even though students could be up to seven years from completing their secondary education; a long-term investment (42). Nelly discussed the need for the content to be ‘reinforced again’ over time for students (40).

Key principles

The following section highlights eight key principles distilled from interviews to answer RQ 1.2.

Facilitate ISPs at the micro-system level

The ISP was facilitated by a RACE Gippsland team member, who participated as a micro-system stakeholder and organised suitable industry partners, planned activities, and coordinated a bus for the excursion. The importance of a facilitator was highlighted by everyone interviewed. Having a facilitator made it easy for Nelly, 'it just would not have happened at all if you [Millie] hadn't been doing this'. Nelly added that 'your [Millie] organisation was amazing. And I didn't really have to do much at all which is great, because teachers are just way too busy'. Nelly also noted the importance of having a facilitator with the right knowledge and experience, 'your [Millie] teaching knowledge is invaluable'. She stated that her barriers are 'expertise, organisation, time, funding'. These barriers were overcome through the project (20), which provided funding for excursion transport and a facilitator who was able to organise the activities, and experts to participate. Holly also saw value from facilitators making new connections for teachers, 'because you don't know what you don't know'. Mandy highlighted the importance of 'having key deliverables', 'great stakeholder relationships', and 'understanding the school context' and the complexities that surround this, all of which a facilitator could assist with. Tim said, 'it's good to have yourself [Millie] as a facilitator to sort of go, oh, and what about this and prompting sort of thing'. Gordon and Tim indicate that having a facilitator with a teaching background, who can manage behaviour issues, and knows what level to pitch the content at, is beneficial. Valerie agreed that 'having that person to…be the facilitator has been handy' and helps her to get a better return on the time she invests in ISPs.

Clear communication between stakeholders & collaboration with other stakeholders

Valerie stated that 'communication and collaboration, were probably the key things because without those things, that would have just been an absolute shambles'. Kelly also saw 'really good communication' as key to success, including 'understanding expectations' and 'having the same goal' with time bound milestones. For Gordon, touching base on the phone with Nelly the day before was useful to confirm the plan. Nelly didn't need to be involved in any meetings with the industry participants beforehand 'because you [Millie] were the person to know all parties…that enabled you to organise everything that had to be done'. Clear communication and collaboration were discussed at micro- and meso-system levels, and the implementation of these principles was supported by the facilitator.

ISPs require funding

For Nelly, having funding for ISP activities at the micro-system level was important: 'if it wasn't free to get the bus… the principal would have thought twice about it'. Holly agreed, and when asked about barriers said, 'the biggest one is cost'.

Deliver engaging activities for students

Nelly highlighted that 'hands on' activities would engage her students the most. Whilst on the excursion, Gordon and Tim took students on a tour of their facility, rather than sitting in a classroom. Gordon said, 'the walking I think was good because it wasn't just sitting there and listening'. Jordan raised 'that the group turning up wants to be there' as a key principle. He thought that 'as a school that's probably the case, as [for] some individuals I'm not always sure' and that is nice when students 'want to be there… want to learn and understand'.

ISP stakeholders and activities need to be flexible

Offering a flexible program, in terms of day of the week and duration of activities, allowed Nelly to participate. She said that 'certain teachers don't like their daily timetable interfered with' and 'being able to do a half day or three hour… rather than a whole day' was fantastic 'because the whole day would be a whole other timetabling issue'. Flexibility was also raised by Mandy, due to the often-inflexible nature of school timetabling.

Acknowledge industry partners

The industry partners did not receive any funding to participate in this program and did so voluntarily. Gordon and Tim raised that 'an understanding of the time it takes to do' (Gordon) and 'to acknowledge that' (Tim) could improve industry partners' experiences. Jordan agreed that 'a token of appreciation' such as 'a bottle of wine' is 'well received by whoever's running the event'. Mandy stated 'we've tried to advocate for remuneration of some sort' but did not elaborate on where the funds could originate. She identified that there was currently no funding available.

Student learnings need reinforcement

When asked if the activities were useful in highlighting future career and study pathways to your students, Nelly responded with 'yes I think it was, but it would need to be… reinforced again…otherwise it'll get forgotten'. She agreed that it would likely need further follow ups to have career aspiration impacts. Kelly also highlighted more than one interaction between industry partners and students as important, stating 'the building of relationships, though, has been really important… I think it's good to have… more than one connection point'. Mandy thought that industry connections are 'done really well where a school had a time allocation for careers'. This dedicated ongoing time can allow for reinforcement of information. Whilst student learning takes place in the micro-system, this principle connects to the chrono-system, by demonstrating the need for reinforcement over time.

Objectives & Outputs

This ISP had two different outputs: the incursions and the excursion. This section discusses Nelly, Gordon, Tim, and Valerie's objectives, and whether these were met by the incursions and excursion delivered, to answer RQ 1.3. Student data is included where applicable to provide evidence of these objectives being met or not.

Teacher

Nelly's objective was 'to make their [students] learning more practical, and to be able to show them how it can apply to a working life'. Nelly thought the ISP met this objective 'because it added to… that strand of science that we did. And…having another person in another field of expertise was really good, and having the kids be able to ask you guys questions in their area of interest'.

Industry partners

When asked what his objectives were, Gordon responded 'I hadn't really done alternative energies and power [subject of focus for this ISP] to such a young age group. So, I think it was good just to get an understanding of what the topic should be and how you do that'. He thought that the excursion output where alternative energies and power during the tour were presented on 'worked fine'. He explained that he now had a clearer understanding of how to deliver this content which will result in 'a better job next time.'

Tim was ‘hoping to get a laugh out of the kids’, but laughingly he said, ‘don't think we quite got there’. He also aimed to communicate ‘what we do, that's appropriate to that audience’. Tim thought he was able to do that. In the final survey, students were asked what their industry mentor taught them. Several responses indicated that Tim met his objectives, with students able to comment on specific terminology and activities undertaken by this business, including: ‘how they keep the milk cold’, ‘how to produce milk’, ‘about methane’, ‘how they can tell the cows are hurt by the tag’, ‘power is crucial for farmers’, ‘they help other farmers’ and ‘wind turbines’.

Valerie’s objective was ‘to bring a positive awareness about the dairy industry and what it can offer’. She ‘wanted to make sure that their teachers and students knew that there was a range of opportunities and careers available within the dairy industry and that it might not be quite as bad as what other people make it out to be’. She thought the ISP met this objective, as the content discussed was ‘all relevant…to… the parts of our industry’ and ‘it was just…to put a positive spin on it, and I think we did a great job’. Students indicated that they learnt about a range of careers throughout the ISP, this included: milker, scientist, farmer, electrician, and artificial insemination technician. No students indicated that they might like to do any of the jobs that they listed that they had learnt about in the future, however they increased their awareness, meeting Valeries’s objectives.

Discussion

Bronfenbrenner (1979, p.41) described that ‘in ecological research, the properties of the person and of the environment [in this case the ISP] must be viewed as interdependent and analyzed in systems terms’. This ISP was viewed as a whole, complex system, with interconnections within, and between systems, aligning with the ecological principle of interdependence (Bronfenbrenner, 1979, Flynn, 2015). This demonstrated how each stakeholder is dependent on others, for example in the microsystem, to meet the industry partners objectives they required access to students, and the teacher was dependent on a facilitator to overcome barriers to participating. In addition, interdependency was found among stakeholders in and between other systems, such as industry partners (micro-system) and their managers who allowed participation (meso-system), and the teacher (micro-system) and Education Department (exo-system) due to red tape concerns.

Stakeholders from this complex, interdependent system, identified key principles to deliver successful agricultural ISPs. Eight key principles were identified and met, except for acknowledging the industry partners, or having scope to reinforce learnings over time. Synergies between the principles identified and ecological principles exist. Other principles are identified in the literature but were not identified in this case, including balance of power and commitment (Flynn, 2015), likely due to the short duration of this ISP.

By comparing the first key principle identified, that ISPs need facilitating at the micro-system level, to the literature, similarities are found. This includes alignment with previous studies that show a facilitator was important due to reducing teacher time barriers, and having knowledge and experience to ensure the activities ran smoothly, much like this study (AiGroup, 2017; O’Dea, et al. 2022, 2023a, 2023b). By applying

Bronfenbrenner's (1979) second proposition to ISPs, a more developed, or longer-running ISP may be able to maintain a program of activities, whereas an undeveloped, or newly-formed, ISP may require more instigation and direction by stakeholders outside of the core ISP group. This aligns to this case, which is newly formed, and hence, required strong input from a facilitator.

The second and third key principles related to clear communication and collaboration, are also commonly identified in the literature for effective partnerships (Hands, 2005; O'Dea et al., 2022). This also links to the ecological principle of interdependence, described by Flynn (2015, p.181) as 'the relationship and communication between the various levels within the whole ISP system'. The ISP needs stakeholders to communicate and collaborate effectively to arrange activities which meet the objectives and requirements of each party (Flynn; 2015; Hands; 2005). In this case, the facilitator acted as a conduit between the teacher and industry partners, with only one phone call with direct communication between the teacher and one industry partner.

The fourth key principle, ISPs require funding, links back to the first key principle, as facilitators often require funding. In addition, funding requirements highlight the barriers teachers face, including time and resources, which researchers, including Cosby, Manning & Trotter (2019) find exist in other agricultural education programs.

The fifth principle, deliver engaging activities for students, is often not explicitly identified as a key principle, though it is often implicit in principles related to enhancing student learning outcomes (Australian Government Department of Education, 2013). Hands-on learning, preferred by the teacher, is often used to increase engagement and has been effective with career engagement (Yilmaz, Jianhong, Custer, & Coleman, 2010). Activities undertaken as part of ISPs, such as hands-on work-related activities, are conducive to this style of learning (Torii, 2018).

The sixth principle related to flexibility, is also an ecological principle identified by Capra (1994), who discuss this in terms of system structure and adapting to fluctuations, though participants in this study highlight specific circumstances where flexibility is needed such as school timetabling. Other researchers, including Hands (2005), similarly discuss flexibility, though she provides further examples such as changing student needs and avoiding stagnation, which was less applicable to this case due to the short duration.

The seventh principle, acknowledge industry partners, was not met in this case, other than a simple thank you. This principle was not found to be explicitly raised in the literature, though may be implicit in principles related to shared vision and return on investment where stakeholders identify and agree on benefits and risks (Flynn, 2015; O'Dea et al., 2022).

Lastly, the teacher highlighted that the learnings from the partnership need reinforcing, this concept of multiple exposures spaced over time is shown to produce better long-term retention (Hattie, 2012). This links with the ecological principle of sustainability, identified by Flynn (2015), demonstrating that for the outcomes to be sustainable, multiple exposures to the industry partners over time may be needed.

The incursion and excursion met participants objectives, except for Tim making the students laugh. The teacher's objectives for more practical, relevant learning with experts

was met from partnering with industry professionals. Likewise, the industry participants' objectives to understand how to deliver the specific topic, to share what they do, and spread positive awareness of the dairy industry were made possible due to partnering with the students and teacher. Bronfenbrenner (1979) proposed that ecological systems involve reciprocal relations between participants, and this case study demonstrated this. This reciprocity again highlights the interdependency between stakeholders, identified as an ecological principle by Flynn (2015).

Implications for practice

Knowledge with implications for those designing and participating in ISPs was constructed through this research. ISPs are complex, and the EST can be used as a framework for those designing ISPs, such as the facilitator in the micro-system of this case, to understand who the stakeholders are and consider their needs and influences. Key principles were identified which can be considered by those implementing (e.g. facilitators) or participating (e.g. teachers or industry professionals) in similar partnerships. Participants' objectives and experiences provide a deeper understanding of the potential outcomes, such as increased agricultural knowledge and career awareness, from similar ISPs.

Limitations and directions for future research

As interviews were conducted by an insider-researcher, social desirability bias is possible, though steps were taken to limit this including providing a range of perspectives, and building relationships where participants felt comfortable to speak freely. As this research is limited to a single ISP, future research that explores a wider range of agricultural ISPs is recommended to build a greater knowledge bank of potential ISP designs and delivery methods, and outcomes. Research exploring the perspectives of educators and industry professionals who are not willing to participate is also recommended to design ISPs which enable greater participation, to increase student exposure to the industry.

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References

Australian Government Department of Education, Employment and Workplace Relations. (2013). *Realising potential: Businesses helping schools to develop Australia's future.* https://www.dese.gov.au/school-work-transitions/resources/realising-potential-businesses-helping-schools-develop-australias-future.

Australian Government Department of Education and Training. (2021). *National School Reform Agreement Future Ready: A student focused national career education strategy.* https://www.education.gov.au/quality-schools-package/resources/national-school-reform-agreementhttps://schooltowork.dese.gov.au/sites/default/files/2019-07/future_ready_a_student_focused_national_career_education_strategy.pdf.

AiGroup. (2017). *Strengthening school-industry STEM skills partnerships*. https://www.chiefscientist.gov.au/2017/06/report-strengthening-school-industry-stem-skills-partnerships"https://www.chiefscientist.gov.au/2017/06/report-strengthening-school-industry-stem-skills-partnerships.

Bronfenbrenner, Urie. (1976). The experimental ecology of education. *Teachers College Record 78*(2), 1-37.

Bronfenbrenner, Urie. (1979). *The ecology of human development: Experiments by nature and design*. Harvard University Press.

Capra, Fritjof. (1994). *Ecology and community*. Elmwood Quarterly, California, 1-11.

Cosby, A., Manning, J., Fogarty, E., McDonald, N., & Harreveld, B. (2022). High school technology teacher's perceptions of agriculture and careers: an Australian perspective. *The Journal of Agricultural Education and Extension*, *30*(1), 91-112. https://doi.org/10.1080/1389224X.2022.2153887.

Cosby, A. M., Manning, J. K., & Trotter, M. G. (2019). TeacherFX - building the capacity of STEM, agriculture and digital technologies teachers in Western Australia. *International Journal of Innovation in Science and Mathematics Education, 27*(4). https://doi.org/10.30722/IJISME.27.04.006.

Creswell, J. & Poth, C. (2016). *Qualitative Inquiry and Research Design*. Thousand Oaks: SAGE Publications.

Education Services Australia. (2018). *Optimising stem industry-school partnerships: Inspiring Australia's next generation Final Report*. Education Services Australia. https://www.chiefscientist.gov.au/sites/default/files/2019-11/optimising_stem_industry-school_partnerships_-_final_report.pdf.

Flynn, M. (2015). *Industry-school partnerships: An ecological case study to understand operational dynamics*. [PhD thesis, Queensland University of Technology].

Hands, C. (2005). It's Who You Know and What You Know: The Process of Creating Partnerships between Schools and Communities. *School Community Journal* 15(2), 63-84.

Hattie, J. (2012). *Visible learning for teachers : Maximizing impact on learning*. Routledge.

Leonard, Jack. (2011). Using Bronfenbrenner's ecological theory to understand community partnerships: A historical case study of one urban high school. *Urban education 46*(5), 987-1010.

Merriam, S. B. (2009). *Qualitative research: a guide to design and implementation* (3rd ed.). Jossey-Bass.

Morris, J., Slater, E., Boston, J., Fitzgerald, M. T., & Lummis, G. (2021). Teachers in conversation with industry scientists: Implications for STEM education. *International Journal of Innovation in Science and Mathematics Education*, *29*(1). https://doi.org/10.30722/IJISME.29.01.004.

O'Dea, M., Cosby, A., Manning, J., McDonald, N., & Harreveld, B. (2022). Industry perspectives of industry school partnerships: What can agriculture learn? *Australian and International Journal of Rural Education*, *32*(3), 1–21. https://doi.org/10.47381/aijre.v32i3.334.

O'Dea, M., Cosby, A., Manning, J., McDonald, N., & Harreveld, B. (2023a). Who, how and why? The nature of industry participants in agricultural industry school partnerships in Gippsland, Australia. *Journal of Agricultural Education and Extension*, 1–20. https://doi.org/10.1080/1389224X.2023.2249445.

O'Dea, M., Cosby, A., Manning, J., McDonald, N., & Harreveld, B. (2023b). The ecological structure of agricultural industry school partnership systems in Gippsland, Australia. [Manuscript submitted for publication]. School of Health, Medical and Applied Sciences, CQUniversity Australia.

O'Leary, Z. (2017). *The essential guide to doing your research project*. Sage.

QSR International Pty Ltd. (2020). *NVivo (released in March 2020).* Retrieved August 27, 2023, https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home.

Torii, K. (2018). *Connecting the worlds of learning and work: Prioritising school-industry partnerships in Australia's education system.* https://cica.org.au/wp-content/uploads/Connecting-the-Worlds-of-Learning-and-Work.pdf.

Yilmaz, M., Jianhong Ren, Custer, S., & Coleman, J. (2010). Hands-On Summer Camp to Attract K-12 Students to Engineering Fields. *IEEE Transactions on Education*, *53*(1), 144–151. https://doi.org/10.1109/TE.2009.2026366.

Yin, R. (2014). *Case study research: Design and methods*. Sage.

Appendix A

The case

The single case studied is an ISP delivered as part of the RACE Gippsland project in Gippsland, Australia. The following names are pseudonyms. The ISP was between two separate year five/six science classes (25 students in each class, total of 50 students), their science teacher (Nelly), three local agricultural industry partners (Valerie, Gordon, and Tim) and a facilitator (Millie), who was also one of the researchers. This partnership was delivered in 2023, spanning three weeks, and formed a component of a unit of work for the students which focused on electrical energy. The ISP focused on energy in the dairy industry. An overview of the partnership activities is provided in Appendix A.

1. First, one 60-minute incursion was held separately for each class, where Valerie, who worked for a dairy industry organisation, and Millie, the facilitator, discussed energy use in the dairy industry. First, Millie handed out a hard-copy survey, designed by the research team, for students to complete. Next, Valerie and Millie introduced themselves and their careers. To allow Valerie and Millie to gauge the students' current knowledge and provide an anticipatory set to engage and introduce students to the topic, students were asked by Millie what happens on a dairy farm, and then watched a 1.5-minute-long video Millie found online about running a dairy farm. Millie then asked students to brainstorm what energy is needed for on a dairy farm, and then where this energy comes from and what types of energy generation sources could be used. Millie and Valerie wrote student answers on the whiteboard and facilitated discussions based on student answers, and questions raised. Students then worked in small groups, selected by Nelly, to brainstorm the pros and cons of one type of energy source, before sharing their answers with the class.
2. Second, three weeks later, a 60-minute excursion was held where both classes of students visited Gordon and Tim, colleagues at a dairy farm who also undertook research including trials related to energy generation. Students were split into two groups by Nelly, with one group first going with Gordon, and the other with Tim and Millie, and then swapping. During the excursion, Gordon and Tim showed and discussed different types of energy generation including solar, wind, and hydro. They also showed students other aspects of the workplace, including the dairy farm, and explained research being undertaken. Millie handed out hard-copy surveys to students to complete on the bus while returning to school, which were collected afterwards by Millie.