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Developing Transferable Research Skills in First Year Agricultural Economics Students

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A problem-based learning approach was adopted for a unit of study in first year agricultural economics at the University of Sydney with the aim of starting development of students' research skills earlier than usual. The novel teaching approach employed a structured and guided problem activity in the first semester and progressed to a more authentic problem activity in the second semester where the students worked in online peer groups to identify their own problem within a specified challenging area (market failure), carry out research and discuss findings prior to submitting an individual essay on their chosen topic. A structured learning journal with 10 questions was used in the second semester where the students recorded their reflections on a range of aspects of the learning process. None of the questions specifically asked about research yet 72% of the students mentioned it at least once. These learning journals were analysed for unsolicited comments about learning and research to gauge what the students themselves believed they had learned about research and how it can be transferred to other disciplines and future employment. The final essays were independently analysed by using eight research performance criteria to estimate the degree of research skills displayed by the students. Most of the students performed well in six of the research criteria indicating that development of research skills can be initiated in the first year of a degree program.

Research skills, problem based learning, student perspective

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Introduction

This paper describes a new online inquiry based learning module that was introduced into the two core units in the first year Bachelor of Agricultural Economics degree in 2008 at The University of Sydney. This new approach builds on practices recommended in the literature in that it aims to develop research skills early in the degree, and emphasises the multidisciplinary aspects of agricultural economics, problem based learning, and working in groups online, facilitated by the use of up to date computing facilities and software.

Student learning journals were analysed to illustrate how the students believe they have developed research skills from their perspective. The student claims were examined by an analysis of a final assignment that provided evidence of the application of research skills learned.

The structure of the report firstly considers relevant literature concerned with agricultural economics teaching; inquiry, research and learning; and the use of learning journals. The problem-based learning methods utilised are then described (with reference to the literature) followed by the investigation methods employed. The results of the application of the approach are subsequently analysed and discussed.

Agricultural economics teaching

Studies relating to the teaching of agricultural economics to undergraduates have appeared intermittently in the agricultural economics literature. Many of these studies relate to the structure of the curriculum, and some deal with the need to introduce “agribusiness” degrees in departments of agricultural economics, and to meet the requirements of agribusiness employees (for example, Dooley and Fulton 1999; Biere 1999). Harris (2000) advocates pulling undergraduate learners out of a passive mode by using computers and small group work. Turner (1995) suggests that an undergraduate student should value the research attitude, process and product. Hoffman (1969) quotes a group of members of the Chicago Agricultural Economists Club, who, as far back as 1969, were saying they valued the ability to problem solve, well developed reasoning ability, and the capacity for logical and incisive thinking. Williams (1971) emphasises the need for an approach to teaching which is concerned with solutions to problems. Johnson (1971) advocates learning experiences with or in multidisciplinary problem solving studies and efforts.



Hansen (2001) ranks the analysis of a current economic problem, and conducting research as a group activity at the highest levels of proficiency development in an undergraduate economics major, and attainment of these proficiencies is broadly seen as a worthy goal (Adkins and Newsome, 2006). Problem-solving activities have long been seen as important practices for undergraduate economic students (Williams, 1971), particularly as active learning strategies in relation to real-world problems (Carlson and Schodt, 1995; Guest, 2001; Nguyen and Woodward, 2009). In addition to problem solving abilities, Barkley (2001, p18) also recommends a broader set of ancillary skills: “Focus course and curricular content on the durable skills of problem solving, written and oral communication, and higher-order thinking, rather than on facts and information that will depreciate rapidly in an era of rapid technological change.” Development of these skills in relation to solving real-world problems in an authentic context requires research activities, analysis, teamwork, communication and writing abilities. These are precisely the attributes that this innovation hoped to develop.

Inquiry, research and learning

An outcome of research activities is *learning*. Engaging in diligent searching, studious inquiry, discovery of facts, or collecting information all lead to learning. Academic researchers extend learning in their discipline by engaging in one or more of these aspects of research to solve a particular problem or simply to find out more about the discipline. By the time tertiary students graduate, they are expected to have some experience of research and to have engaged in a research project individually or collaboratively. If research experience is provided, it usually occurs in the more senior years. Research activities in higher education may be reserved for more advanced students who are deemed to have sufficient background knowledge for participating in research practices (Jenkins *et al.* 2003).

The recognition that research is at the heart of learning supports the use of inquiry-based learning (IBL) as a method of teaching (Justice *et al.*, 2007). The Boyer Commission on Educating Undergraduates in the Research University (1999) advocated that IBL should begin in the first year of undergraduate study. The practice of IBL is not widespread and its implementation differs between disciplines (Healey, 2005), yet Spronken-Smith *et al.* (2007: p4) report that IBL can improve student learning “in terms of student engagement, academic achievement and higher order learning outcomes”.

The latter authors also note that problem-based learning (PBL) is a subset of IBL, and provide a list of distinguishing characteristics of IBL that apply to the teaching method reported here. The PBL strategy employed in this study included: open-ended challenging questions (from a defined range) chosen by the students with more than one possible outcome; students working together to research and construct knowledge; and self-directed learning with increased responsibility.

In teaching research skills for finding and evaluating published materials for a specific purpose, two stages can be employed. Firstly, students should undertake a set of prescribed activities to teach them how to access databases and utilise various search techniques for example (e.g., DaCosta and Jones, 2007; Reed, Kinder and Farnum, 2007). Secondly, students can then be immersed as a team in a complex authentic problem-solving activity where they are required to define the problem and discover how to find solutions (e.g. Biggs, 2003). This latter approach embodies characteristics of IBL (Spronken-Smith *et al.*, 2007) which was used with first year agricultural economics students in our study, with the aim of developing the generic attributes explicitly related to research.

The approach adopted in this study is in line with Peters (2000) who believes that a university must promote autonomous independent learning that is also communicative and collaborative and oriented towards the research process. Furthermore, he advocates the development of student competence in the digital environment that includes working in groups, finding information, communicating and solving problems devised by the students themselves. This peer-directed learning is also advocated by Biggs (2003).

Learning journals

To help students develop their learning in a problem based approach, a learning journal may be used. A learning journal offers numerous benefits for both learner and teacher. Park (2003) and Cooper (2006) have included a list of benefits across several disciplines, such as: integrating new information; learning to learn; stimulating critical thinking; and providing feedback on teaching. Learning journals are usually private between the student and teacher and may be open-ended and unstructured where students record personal observations and reflections about a learning activity or program (e.g., Park, 2003; Chappell, 2006); or structured with specific questions or topics to guide the student reflections (e.g., George, 2001; Grant *et al.*, 2006). The structured journal will be beneficial to students who are not used to recording their reflections on learning and is the format adopted for our study.

Methods

Problem-based learning activities

For both semesters of their first year at university, students of agricultural economics engaged with problems via online group discussion forums (in groups of 10 or less students) and current literature on industry related issues. The group tasks were very different in each semester and the composition of the groups was also different for each semester.

During the first semester the students were supported by structured activities because novices of inquiry based learning are at risk of failure without the appropriate support (Kirschner, Sweller and Clark, 2006). This support, or scaffolding, is necessary in the initial stages of online group learning (Oliver and Herrington, 2001; Salmon, 2003). Our structured support activities required students to participate in a library task (following a lecture and tutorial from a librarian) to help them find electronic resources and to make weekly postings to a monitored discussion forum (participation marks were awarded) with feedback in relation to a weekly topic to help formulate and discuss the problem scenario. Suggested readings were given, and there was guided development of an individual policy brief of 2000 words for assessment. The basic skills that the students practiced in this first semester included searching for electronic resources, posting to an online discussion forum where they were able to discuss the weekly problem with their peers, and writing an assignment that was based on their literature searching, discussion with peers, and further information provided in lectures and tutorials. The students were given the option of using an online journal in first semester but very few made use of this option.

During the second semester, the problem activity was more difficult with much less scaffolding and structure. Following 4 lectures and 1 tutorial on the basic theory of missing and imperfect markets during the first two weeks of the semester, and supported by a basic reading list, the eight student groups were required to find their own example of market failure in the agricultural and resources sector in Australia and to discuss online throughout the semester, the reasons for this market failure, using economic principles. Identification of the problem and finding possible solutions by the students themselves is a part of problem-based learning (Boud and Feletti, 1997; Savery and Duffy, 2001).

Structured weekly discussion topics were not organised for the students, and the groups had to carry out their own research to support the identification of the problem and possible solutions. Individual and group activities were essentially self-directed. Based on these group activities and findings each student had to write an individual essay of 2000 words discussing the chosen issue.

The topic area was challenging and involved the need to understand concepts which would be difficult even at fourth year level. However, it was hoped that the first year students would engage with the problem because it was relevant, current, and one which students were likely to recognise as being important for agriculture. In addition to the economic issues, the problem also included recognition of the physical effects of the market failure, and this added an important multidisciplinary component. There is a considerable Australian agricultural and resource economics literature about the issues and possible policy solutions of the problem area, so the students were able to evaluate and build on suggestions by others.

For the second semester students were obliged (marks were awarded) to keep a structured online learning journal with questions for completion. The journal was in two parts with the first part submitted at the end of six weeks into the semester and the second part submitted eight weeks later immediately prior to the examination period.

Investigation methods

This study into the development of research skills in first year agricultural economics students included analysis from two perspectives: that of the students and that of the course instructor.

The structured online learning journals of 58 students (87% of the cohort) were analysed to examine how the students learned from the online collaborative activities with respect to research activities and how the students themselves perceived they developed as researchers. The analysis specifically focused on the word 'research' as used by the students and not on an abstract interpretation of research by either the students or investigators. For the second semester the students were told at the outset to use the research skills acquired in the first semester to find additional, academically sound sources, and that their assessment would include an appraisal of the quality of their research and the sources used. However, the structured learning journals did not explicitly ask the students about how they thought they developed as researchers; rather the questions were phrased in more general terms. Therefore self disclosures in their learning journals on the development of research skills were unsolicited.

The questions in the learning journal were designed to investigate several aspects of student learning including: the effectiveness of teamwork; motivation; personal learning processes; obstacles encountered; personal strengths employed; satisfaction with the learning afforded; and broader application of what was learned.

Part 1 learning journal questions (due after six weeks of semester 2):

1. How do you feel about working with your team?
2. Are your team discussions useful to your team's progress in this exercise? Why or why not?
3. Were there some comments made by your team members that made you think differently? What were they, and how did they make you modify your thinking?
4. What motivates you to learn through this exercise?

Part 2 learning journal questions (due after 14 weeks of semester 2):

- A. How have you changed as a learner through this exercise? Give examples.
- B. Have you learned anything about "how you learn"?
- C. What obstacles did you face in completing this exercise, and how did you overcome them?
- D. What are some of the strengths you have demonstrated in this exercise?
- E. Are you satisfied with what and how you learned through this exercise?
- F. Do you think your learning through this exercise helps you in your field of study?

The learning journals were analysed manually by TK using a two-stage process based on qualitative grounded theory (e.g., Boyatzis, 1998). First, the responses to a particular question for all students were collated and read through several times to search for themes which were labelled. Second, the responses were read again to find quotes to illustrate the themes. This process was carried out without knowing the students, their history or anything about their performance in the classroom or with written assignments.

Independent to the journal analysis, the course instructor (EN) assessed the 66 written assignments ('market failure') at the end of the second semester in two separate ways. The first was for summative assessment purposes to provide marks to the students as part of their degree program. The second was to analyse the essays for evidence of learning about research. The eight criteria used for this second analysis for research quality were: critical analysis of the literature; synthesis and summary; clearly articulated problem and issues; using the literature to formulate arguments; demonstrating an interdisciplinary approach; recognition of the provisional nature of 'facts'; theoretical understanding; and creative/independent thinking. These criteria for the assessment of research quality may seem advanced for first year students; however successful group activity should have produced some evidence of research performance in these categories. The analysis of essay performance in relation to research was also compared with the student journals where learning about research had been claimed.

Results and discussion

Learning journals and evidence of research learning

During the second semester, the problem solving activities were carried out online by 67 students in eight more-or-less even groups. The online learning journals were completed by 58 students in response to the questions and revealed much useful information about their behaviour, attitudes, personal development, interactions with a group, and peer learning. While the results of the journal analysis reported here are focused on the development of research skills within the context of the problem and online discussion group, other aspects are also coincidentally revealed (particularly in the second part of the learning journal).

In total, 72% of the students mentioned research at least once in response to the journal questions. Students themselves made the link between research and learning within the context of the particular problem that each group identified and investigated. The following results from the analysis of the journals, groups the responses to the questions asked with example quotes selected from the student comments.

Learning Journal Part 1

These four questions in the learning journal were completed in the first half of the second semester. The first three of these questions were concerned with aspects of teamwork and provoked few comments regarding research. The fourth journal question was concerned with motivation and prompted several responses regarding research. Several people commented on the value of the learning experience that required reading, researching and posting in order to receive feedback and to advance the group discussion, and that this was their motivation, e.g.:

“I think group discussion can motivate me to do more research on the topic and read the articles recommended by your team members.”

Learning Journal Part 2

Most groups worked well, particularly later in the semester, with only one markedly dysfunctional group where the individuals engaged in few collaborative activities. Without the weekly posting requirement of semester one, some groups were slow to get going during the second semester and others had a quiet period after an active start before rallying again later in the semester. There were many more comments about research in this second part of the learning journal compared to the first part because the questions were more concerned with learning and by this time the groups would have had to be engaged in considerable research activities to define, refine and find solutions to their problem.

Personal learning processes

Several people commented on being a more independent learner and better researcher even when the group was not functioning well. Students felt that they were able to make effective use of online databases and to evaluate academic journals with or without the support of group discussions.

Many people also noted being a better researcher in addition to learning from peers and using research to support their contributions. Comments were made about not relying solely on lecture notes or the textbook and how contribution to peer discussions encouraged research, e.g.:

“When it comes to writing a comment of my own I have a serious think about what I will write beforehand and research a bit for say a journal to back my comment up. This exercise has definitely refined my learning technique, has made me think for myself not just regurgitate information.”

The general learning process expounded by many people was three-fold: individual research, contributing findings to the group; and then comparing and discussing those contributions which can lead to further research. This group process can aid in refining the mass of information available when researching a topic:

“...That is, in some cases when researching a topic I think you can be engulfed in the enormity of the information available, the group discussions keep you on track in terms of focusing on the question.”

The student responses mirror the process through which academic researchers usually work and learn in that a problem is identified and clarified by discussion with peers and research (often collaborative) is carried out with the aim of finding a solution. The students may be working at a lower level with less knowledge than experienced researchers but there are similarities in the processes described.

Personal strengths employed

Many people commented on the research strengths they developed or applied and contributions they made to the group that has included finding reliable information and data, analysis and interpretation and contributing informed opinions to the group, e.g.:

“Some of the strengths that I believe I have demonstrated through this module are skills of discussion, being able to analyse articles and inform others, and having the ability to read and comment on others posts.”

It was also observed by some students that meaningful contributions to group discussion involved good writing and communication skills as well as research skills.

Satisfaction with learning afforded

In addition to learning about the topic (through personal and group activities), a source of satisfaction was learning transferable skills (including research and academic writing), which can be applied to other units of study and future employment. It was widely appreciated that the skills learned and practised in the particular context were generic and broadly applicable, e.g.:

“I believe it has allowed me to gain valuable skills for future university work and research, group work and team work skills, and analytical thinking skills. This will be very valuable to future years and even after i finish my degree.”

Broader application of what was learned

The majority of students were very positive about this learning experience and noted that they learned a range of skills that are transferable to other courses and to the workplace, including reliable research skills, people skills, communication, dealing with multiple perspectives, and developing arguments. Many of the students appreciated that this was a realistic way of working that required a combination of approaches for a successful outcome: personal initiative; researching data and information to develop and support an argument; negotiating with peers who provided different perspectives; and drawing a personal conclusion from those multiple sources, e.g.:

“I do think this exercise helped my learning in my field of study as it made me work with other people in doing research and finding an argument etc, which I understand will be a skill that will be very useful to have in the future, especially in this course and in the workforce, where I will be dealing with many different people with different views on the one topic.”

Students also appreciated that this was an authentic contemporary problem that was complex and required a multidisciplinary approach. Furthermore, these first year students also recognised that the exercise in which they had engaged was preparing them for future employment, e.g.:

“...Market failure in my mind is without doubt the biggest issue in the global economy as it covers not only issues like salinity but also pollution and action for averting climate change.”

“I often feel that the work I do in other subjects at university aren’t that important to my degree. This exercise has helped me to research a topic, extract important information and then analyse this information....This exercise has made me feel as though I am practicing for the real world, since I am applying economic concepts to practical situations.”

Individual essays and evidence of learning about research

The 2,000-word essay, “An investigation of market failure in the Australian agricultural and resources sector” at the end of the second semester required individual students to draw on the outcomes of the online group discussion activities. Each group had found its own example of market failure and had engaged in research and discussions on the reasons for this market failure and proposals to address the problem. The student groups were also required to make suggestions as to other measures that could be taken.

The course instructor (EN) has marked first year essays in these core first year agricultural economics units for nearly 20 years. The marking guidelines for this exercise had not changed and the essays were marked summatively as part of the degree program. Following this, the essays were analysed separately by EN according to the eight research criteria given in Table 1. The research criteria given in Table 1 are ranked according to the sum of ‘very good’ and ‘good’ to illustrate an order of research performance by the student cohort.

Over 80% of the students showed that they had clearly articulated the problem and issues, and demonstrated an interdisciplinary approach. Three quarters of the students had used the literature to formulate their arguments well; 64% of all the students also showed that they had critically analysed this literature well, and nearly 60% showed good theoretical understanding. 70% of the students had synthesised and summarised the information to at least a

good standard. Only about 30% of students demonstrated creative/independent thinking and the recognition that ‘facts’ should be treated in a provisional way was almost nonexistent.

Table 1. Analysis of student essays for evidence of research (%)

Research Criteria	Very good	Good	Poor	None
Clearly articulated problem and issues	40	43	15	0
Demonstrating an interdisciplinary approach	34	48	15	2
Using the literature to formulate arguments	25	49	23	2
Synthesis and summary	34	36	27	3
Critical analysis of the literature	22	42	32	3
Theoretical understanding	32	25	34	8
Creative/independent thinking	11	20	56	11
Recognition of the provisional nature of ‘facts’	0	0	2	98

This analysis showed that research qualities were not uniformly developed yet six of the research criteria had been demonstrated by most of the students. That only one student gave any indication of the recognition of the provisional nature of facts is hardly surprising since this is quite an advanced research concept. This can be linked to creative and independent thinking (also ranked low) because it is through the challenging of ‘facts’ that creativity and independent thinking can be displayed.

In marking the essays for summative purposes (as a separate earlier exercise) the general perception of the course coordinator was that the standard of the essays was higher and that students coped with the difficult topic better than in previous years when the online peer discussion forum had not been used. Reflections on the summative marking were that some essays dealt very well and very thoroughly with the economic aspects and some dealt very well with the physical aspects. The best essays dealt well with both

aspects, and the best of these integrated the economics into the actual real life problem.

Once the assessment of the journals and the research analysis of the essays had been carried out by the two independent researchers, comparisons between the results could be made. According to performance using the research criteria (Table 1), the students were ranked individually. It was found that students ranked in the top two thirds according to these research criteria, referred to 'research' in their journals about twice as frequently as the remaining students. The quotes given above and selected from the journals prior to the results of the research analysis of the essays being known are mostly from students in the top two thirds of the research analysis ranking.

It therefore seems that the students who appreciated learning by research and noted it in their journals also displayed the best research performance in their subsequent essays. However, this conclusion is not clear cut because a few of the students that were ranked highly according to research performance in their essays did not refer to research at all in their journals, and the eight students with the lowest rank according to research performance in their essays did refer to research at least once. This is encouraging in that the apparently 'weaker' students seemed to appreciate the value of learning by research and implies that a problem-based, peer-supported learning environment could be a strategy for greater student retention as well as challenging the students who perform well.

Conclusion

To develop research skills (amongst other attributes) during the first year of an agricultural economics degree, students were given a difficult problem-solving task in the second semester that required them to be self-reliant and engage in research activities in groups to define an authentic problem concerned with market failure. The students were required to analyse solutions that had been proposed and to suggest their own solutions. During the first semester these students had been supported in group activities and the development of research skills.

The student structured learning journals from the second semester had no specific questions about research, yet 72% of the students mentioned research at least once. The students themselves made the connection between research and learning; when asked about their learning their responses included the development of research skills. Analysis of the learning journals revealed that the majority of students believed they had developed considerable research skills and that these skills were the result of the challenging problem, individual research activities, and group discussions.

Features of the research skills the students believe they have developed, and related learning include:

- Finding, analysing and using academic articles to support arguments
- Research activities and peer discussions are an effective way to learn
- Peer discussions can prompt research and develop understanding
- Research and online peer discussion can improve writing skills
- The research skills learned are transferable to other disciplines and the workplace

These features are all components of transferable research skills and show that from the student perspective at least, they are able to cope with difficult problem-based tasks in the first year of agricultural economics, and several students had commented on welcoming similar activities in subsequent years.

An independent analysis of the final essays using eight research criteria revealed that most of the students displayed research abilities in six of these criteria. The research abilities demonstrated were not evenly developed and suggest that while first year students can develop research skills from challenging problem-based peer activities, certain aspects need more attention.

In the comparison of journal comments by students about learning by research with the analysis of research performance in the final essays, most of the quotes selected from the journals independently before the research analysis results were known belonged to the students who had displayed high research performance in the essays. Students with a relatively lower demonstration of research performance in the essays also expressed the value of peer learning which suggests that a peer-supported problem-based approach could help retain students as well as develop research skills and challenge all students.

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