Do Students Value On-Campus Field-Based Education? A Case Study of Science Educational Initiatives in the Jock Marshall Reserve

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Abstract

Fieldwork, known for fostering more engaging and authentic learning experiences, is an established tradition in higher education which is changing; increasingly run on-campus for financial and logistical reasons and enhanced through education technologies to reflect industry practices. Here we examine student perceptions of on-campus fieldwork with the aim of understanding if on-campus fieldwork was valued and why, to be able to compare against literature on off-campus fieldwork. We explore student views on activities at the Jock Marshall Reserve, an on-campus nature reserve of Monash University, Australia using mixed-methods approach. An online survey targeted students undertaking four subjects across first to third year and received 116 responses. In alignment with off-campus fieldwork studies, we found that overwhelmingly respondents highly valued fieldwork with dominant reasons being; 1) developed skills relevant to 'real-world' science, 2) reinforced theoretical learning, and 3) was more engaging than traditional study, with some benefits to their wellbeing. The novel perceptions related to increased convenience and authenticity. Since a majority of respondents wished to undertake on-campus fieldwork more frequently, this study suggests that the inclusion of on-campus fieldwork should be considered within science curriculum in higher education.

Introduction

Fieldwork, or field-based learning, can provide highly authentic and active learning experiences in undergraduate science (Da Silva, 2014; Dillon et al., 2006). In Da Silva's (2014) review of the use of fieldwork in tertiary science across Australia, one of the main strengths from the student perspective was its ability to enable deeper learning of theoretical learning outcomes. Fieldwork experiences are also widely perceived as enjoyable, and this can increase cognition and retention of concepts. Indeed, some students reported remembering their experiences for years after the fieldwork activity (Dillon et al., 2006). Fieldwork allows students to develop practical fieldwork skills relevant to 'real-world' employment in biological, environmental and/or ecological disciplines (Ellis, Kuchel, & Wilson, 2015; Peasland, Henri, Morrell, & Scott, 2019), which is highly valued by students in relation to the jobs market (Tomlinson, 2007). Students value developing technical skills, and transferable skills for their future careers (Ellis et al. 2015). Students often report developing teamwork, communication, leadership and organisational skills (Kent, Gilbertson, & Hunt, 1997). For example, Stokes and Boyle (2009) surveyed 62 geoscience students and found evidence they had developed skills in teamwork, decision-making and autonomy. Indeed, fieldwork curriculum is sometimes explicitly used to develop employability skills across disciplines, including medicine to geology. Students often view fieldwork as more authentic and therefore more relevant to their future than traditional learning (Peacock, Mewis, & Rooney, 2018). Da Silva (2014) and Fleischner et al. (2017) have suggested fieldwork can also enable socially-enhanced learning methods such as peer-to-peer learning. The less formal environment can lead to more dynamic, informal and natural social interactions (Da Silva, 2014; Fleischner et al., 2017; Smith, 2004) and foster a sense of community and belonging (Matthews, Andrews, & Adams, 2011). This may provide benefits to students' mental and emotional wellbeing (Edwards et al., 2001).

Experiential Learning and Constructivist Teaching

Fieldwork aligns with the constructivist approach to teaching (Barker, 2002). The theory behind this pedagogical approach states that students will learn and develop more effectively when they are actively involved in the learning process and can contextualise the information in a broader social and/or natural context (Barker, 2002), which fieldwork can provide. This broader context could, for example, relate to the natural environment, professional or disciplinary identity (Halliwell et al., 2020; Peacock & Bacon, 2018), complex problem-solving (Millenbah & Millspaugh, 2003), or students' perceptions of environmental careers (Healey, 2000). Working in a natural complex environment creates context for visualising and understanding complex ecological interactions and interconnections and associated theoretical concepts, as well as the opportunity to build personal confidence and efficacy, and experience playing affective roles in a team (Boyle et al., 2007). It can also enable one to envision themselves as belonging to a particular professional identity and community (Halliwell et al., 2020; Peacock & Bacon, 2018). Extending upon the above using Eccles' Expectancy-Value Theory (Wigfield & Eccles, 2000), students' perceptions of the value and relevance of their task, their identity, or their socially derived views on their own abilities to perform the task, influence learning. Thus, fieldwork can increase engagement, cognitive outcomes and the student experience and identity (Scott, Humphries & Henri, 2019).

Field-based learning is also considered a format of experiential learning (Healey, 2000). This encompasses 'hands-on' physical experiences that foster practical skills (Healey, 2000; Malone, Rickard & Tudor, 2016). It provides students with the opportunity to apply theory in a complex and authentic environment, and to test their assumptions and thinking processes (Da Silva, 2014). It can be a more advanced pedagogical approach, requiring greater autonomy as well as judgement, conceptual integration, reflection and applied problem-solving (Millenbah & Millspaugh, 2003; Peasland et al., 2019). By integrating the learning into a personal experience, experiential learning reinforces theoretical knowledge by associating it with the lived experience, and contextualising or anchoring it in the 'real-world' (Hefferan, Heywood & Ritter, 2002) and even in the context of careers (Healey, 2000). As such, students generally perceive greater authenticity in field-based learning (Barker, 2002; Da Silva, 2014; Healey, 2000).

Fieldwork in the current higher education environment

Despite the known value of fieldwork education, universities have encountered multiple logistical and financial difficulties when attempting to incorporate this into coursework, even before COVID-19 conditions. The key challenges to staff and institutions are cost, time allocation within the content curriculum, time organising travel, staff contributions, equipment and other resourcing, and upholding Occupational Health and Safety regulations (Da Silva, 2014; Fleischner et al., 2017). From the student perspective, fieldwork can also be financially costly and it may be time consuming or inconvenient to travel to off-site locations (Boyle et al., 2007; Smith, 2004). Additionally, the effect of 'novelty space' on off-campus fieldwork can affect student learning (Cotton & Cotton, 2009), although other more recent studies show that novelty and new experiences were viewed as positive by students (Goodenough et al., 2015). Students also struggle to link off-campus overseas fieldwork with employability, despite identifying that they had developed technical and transferable skills as a result of the experience (Tran, Phan, & Bellgrove, 2021).

From an equity perspective (O'Shea, Koshy, & Drane, 2021), off-campus fieldwork can create barriers for students, particularly those from low socio-economic contexts (Kent et al., 1997) who may be working (Custis & Shani, 2002) and students with a disability (Hall, Healey, & Harrison, 2004). As class sizes for tertiary biological courses steadily increases (Smith, 2004), these issues, both from the educator and student perspective, become more prominent. These deter universities from incorporating fieldwork and field-based activities into their curricula (Allen & Tanner, 2017). The subsequent result of this is that in 2014, only twenty-five percent of tertiary biology courses in Australia included a component of field-based activities (Da Silva, 2014). These issues have been accentuated during the COVID-19 pandemic (Day et al., 2021). During 2020-2021, COVID-19 restrictions prevented students from attending university campuses, and the urgent shift to online teaching further pressed educators to breaking point (Watts & Roberson, 2011).

To counteract this, the use of an on-campus nature reserve, such as the Jock Marshall Reserve (JMR; Monash University, Australia), is increasingly used to offer fieldwork. A number of universities now house on campus nature reserves that are used for this purpose, for example La Trobe Wildlife Sanctuary (La Trobe University, Australia) and Oak Creek (Oregon State University, USA). On-campus fieldwork allows a university to limit some of the costs and other resources incurred from conducting field-based activities with a large number of students (e.g. travel costs, accommodation and entry fees for monetised parks/reserves), and assists with timetabling and student availability. This often means more students can attend and participate. For students, on-campus opportunities can increase accessibility of fieldwork, meaning more students from all backgrounds and locations, rather than select groups, may access the benefits to their learning, skill development, and well-being. Fieldwork becomes more common and scalable rather than being offered as 'signature' study tour style experiences for small groups of typically 20-50 students (Phan, Tran, & Bellgrove, 2021). There is currently a deficit in educational literature covering the opportunities and educational benefits provided by the incorporation of on-campus field-based learning into traditional science degrees (Boyle & Stokes, 2009; Da Silva, 2014).

Study Aim

Given this context, this study seeks to, via a case-study approach of the JMR, first understand undergraduate science students' views of the value of on-campus fieldwork. The JMR is a 3-hectare bushland reserve, and a premier learning space, at Monash University's Clayton campus (Melbourne, Australia; see Supplementary Materials). Through time, the reserve has undergone multiple educational enhancements to boost the authenticity and effectiveness of learning experiences. The innovations feature technologies that reflect industry practice and facilitate flexibility, active learning, social learning, and professional practice (e.g., Chapple, Weir, & San Martin, 2017; see Supplementary Materials).

Our main sub-questions were as follows:
1) Why do biology undergraduates value on campus fieldwork experiences?
2) Which field-based teaching approaches do students find most engaging? (e.g., technology, observation, problem-based)

3) Are on-campus fieldwork approaches perceived to develop transferable skills and thus employability? (e.g., communication, problem-solving)

Methodology

This study used a mixed-methods online survey (voluntary), which was developed and disseminated via *SurveyMonkey* (SurveyMonkey Inc., Palo Alto, California, USA). The survey focused upon student perspectives of learning, engagement and skills development during on-campus fieldwork at the JMR. The study complied with the Monash University Human Research Ethics Committee Guidelines (MUHREC Approval Number: CF16/2290 - 2016001142).

Survey distribution

Students were invited to take part in the online survey on a voluntary basis between the 3rd of October to the 31st of December 2016, after the completion of their fieldwork experiences. The online survey was advertised across three main platforms including social media (Monash Biological Society Facebook page), email, and announcements on an online learning management system (Moodle).

Questionnaire design

This study used a 'mixed methodology' approach to data analysis (Sadan, 2014). The quantitative component of the survey consisted of both regular (positive) and reverse-scored (negative) questions, which is a validated approach for preventing response biases (e.g. Agreement response tendency; Eisenbach, Hill, & Schrieseim, 1991). Examples of this include positive statements such as, *"The learning in this unit was more authentic because of activities at the JMR"* followed by negative statements such as *"I see no educational value in using the JMR in this unit"*. The survey consisted of question formats widely used in educational literature, including multiple choice questions, Likert-attitude scale questions (1 – Strongly disagree to 5 – Strongly agree) and open-response questions, to allow students to give varied and comprehensive responses regarding their perspectives and experiences (Jarrett, Ferry, & Takacs, 2012). Open responses allow students to elaborate on their viewpoints, and were included to provide context for interpreting the quantitative results. The wording of the open-ended response questions was developed carefully in order to not be leading in any way and allow themes to naturally emerge without bias. An example of an open-ended question was, for each of the units targeted by the survey, how did the *'activities at the JMR change your thinking about [the unit in question]'*.

The survey was structured to begin with basic classifying questions concerning age, gender, year level and degree type. These allowed for post-hoc testing of variance between various groups within the survey population and to gain an understanding of non-tested variables. The next part of the survey focused upon the student's perceptions of the JMR's educational value and the educational technologies. The survey was then divided into four sections to target students' perceptions of activities in each of the four biology units. Participants were invited to answer questions specific to any of the aforementioned units they were completing, as well as those they had undertaken previously during their undergraduate studies. Finally, students were asked within an open-ended response question *'How could we better utilise the JMR in order to enhance your educational experiences during your undergraduate degree?'*.

Demographic data
This survey was offered to undergraduate students at Monash University undertaking one or more of four biology units featuring educational activities at the JMR during the survey period in 2016. The relevant units were Environmental Biology (BIO1042), Conservation Biology (BIO2040), Biology of Australian Vertebrates (BIO3132) and Environmental Sampling and Monitoring (ENV2022). Overall, 116 students participated in the survey. Most students were undertaking the first (33%, 38 students) or second year (32%, 37) of their undergraduate degree. The majority of respondents were enrolled in either a Bachelor of Science (58%, 67) or a Bachelor of Science – Double Degree (20%, 35), with a small proportion undertaking Engineering (3%, 3). There were more female (66%, 77) participants than male (30%; 35) or unspecified 3% (3) participants.

Data Analysis
For the quantitative data, descriptive and summary statistics were produced (e.g. means, standard errors and percentage of response). In addition, various non-parametric tests of variance (Kruskal-Wallis test; Chan & Walmsley, 1997) were conducted using R-Studio (Version 3.1.2, 2014) to examine the possible effect of gender, year level, degree and amount of fieldwork experience on quantitative student responses. No consistent significant differences were identified (see Table S1 in Supplementary Materials), potentially due to the sample size and power, and data were subsequently pooled for further analysis.

Qualitative data from the open-ended responses were analysed using the NVivo software (QSR International Ltd. Version 11, 2016). Open-coding was used to identify prominent and recurring themes that emerged from the responses. Two researchers independently conducted open-coding (LW and SH) to reduce bias in the nomination of nodes and recurring themes. Selected excerpts from the student responses have been de-identified and presented with an anonymous code to distinguish between respondents.

Results and Discussion
Overall, students responded positively regarding the educational value of the Jock Marshall Reserve (JMR; Table 1, Table S7). This finding aligns with previous studies of undergraduate students undertaking off-campus fieldwork (Cotton & Cotton, 2009; Goulder et al., 2013). Education researchers have reported multiple benefits in terms of conceptual learning, engagement, social connections, skills development and wellbeing (Goulder et al. 2013). These various benefits emerged from the results of the current study, speaking to students gaining similar perceived benefits from on-campus fieldwork. Interestingly, many of the reported benefits perceived by students appear interlinked. For example, engagement and application, and skills development and authenticity, appear to be interlinked benefits from the students' perspectives, as discussed below.

Table 1: Student perceptions of the educational value of the Jock Marshall Reserve.
This table represents the percentage of students who mentioned one of the open-coded themes listed below within their open-ended response to the question *"What has been the value, if any, of undertaking educational activities at the JMR during your undergraduate degree? Please give specific examples."* (n = 99)

Open-coded Theme	**Percentage of Students* (No. of Students)**
Develop Skills and Experience Relevant to 'Real-world' Biological Fieldwork	43% (43)
Allows 'Hands-on' Practical Fieldwork Experience	42% (42)
Values Practical Application of Theoretical Knowledge	25% (25)
Creates a Better Understanding of Biological/Ecological Theory	20% (20)
More Engaging than Classroom Learning	18% (18)
Learnt Specific Survey and Sampling Techniques	16% (16)
Positive Emotionally and a 'Breath of Fresh Air'	12% (12)
Convenient for Units Requiring Fieldwork	8% (8)
Value Creating and Analysing Own Dataset	8% (8)
Values Interactive Learning	8% (8)
Increases Familiarity with Flora and Fauna	7% (7)
Further Understand the Complexity and Limitations of Fieldwork	7% (7)
Contextualises Significance of Biological/Ecological Research	3% (3)
Values Teamwork and Collaboration	2% (2)
No Value	2% (2)

**Percentages have been rounded*

Reinforcement of theory through interactive and engaging hands-on practice

Overall, students highly valued on-campus fieldwork overall, with greater than 90% in each unit that agreed it had a valuable impact in some way. The main reported values included '*Helps develop skills and experience relevant to 'real world*'', '*practical applications of knowledge*' and '*allows 'hands-on' fieldwork experience*' (Figures 1 and 2). A dominant theme was, reported increased theoretical or conceptual knowledge through practical application (Tables 1, 2, S2-S4), in alignment with previous studies of off-campus fieldwork (Easton & Gilburn, 2012). Enhanced information retention is an established outcome of fieldwork, which may be driven by reinforcement, application, social interactions or visualisation (Fleischner et al., 2017; Goulder et al., 2013). In the current study, students primarily discussed this in relation to seeing concepts in real life. For example, within the open-ended responses (Table 1), eight students (20%) explicitly stated that the fieldwork reinforced course material by enriching the visual or practical application of biological and/or ecological theory. Typical comments are shown below:

> *"Many of the concepts introduced in the units (particularly BIO1042) were further enhanced through activities such as water sampling for "critters" in the JMR. Being able to see the diversity of invertebrates within the lake was a valuable experience, as sampling and identifying individuals is a richer task than simply discussing it on paper." – (JMR2)*
>
> *"The best thing about the JMR is that it is memorable - the more you're in it, the more you remember aspects of it that all come together." – (JMR3)*

Additionally, some students viewed on-campus fieldwork as being complementary to traditional formats in their units and cited that this complementary approach deepened learning, understanding and retention. This concept has previously been supported (Longergan &

Andresen, 1988) and also linked to the use of visualisation to integrate ideas (Gilbert 2005). Some typical quotes included:

> *"[JMR] provides space to have mini field trips to allow the practical application of the theoretical knowledge learnt during lectures.." – (JMR4)*
>
> *"Understanding how science works in the real world - it's much more motivating and drives ideas and concepts home a lot better." (JMR5)*

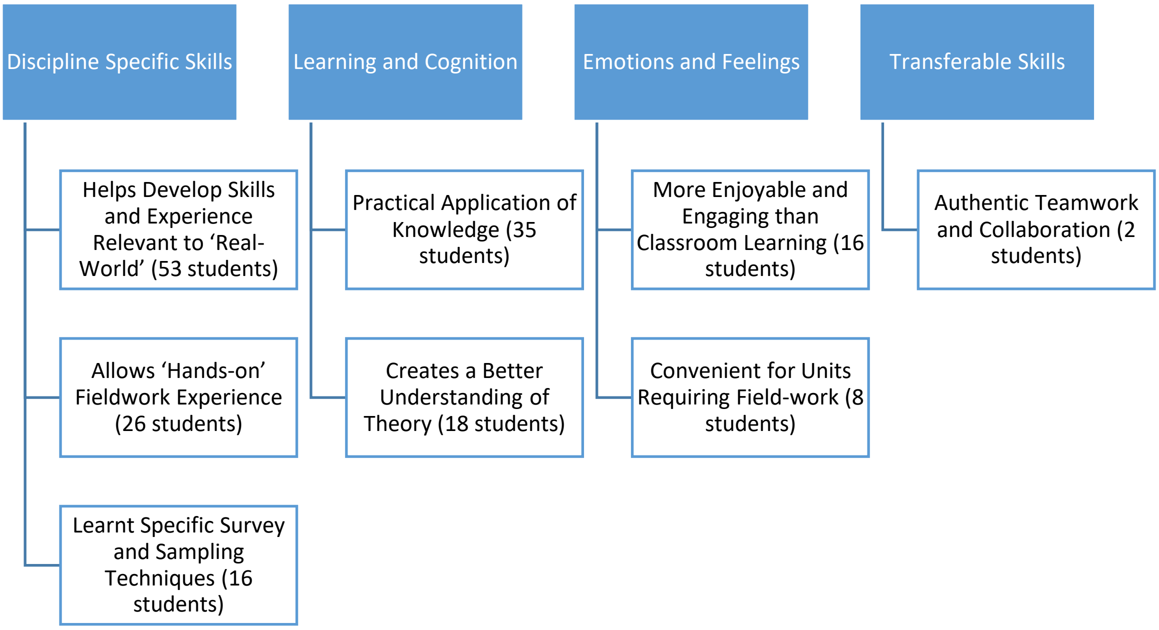

Figure 1. ***NVivo*** **coding results of the open-response question 'What has been the value, if any, of undertaking educational activities at the JMR during your undergraduate degree? Please give specific examples.' (n = 99). Blue boxes denote overarching themes and white boxes denote sub-themes.**

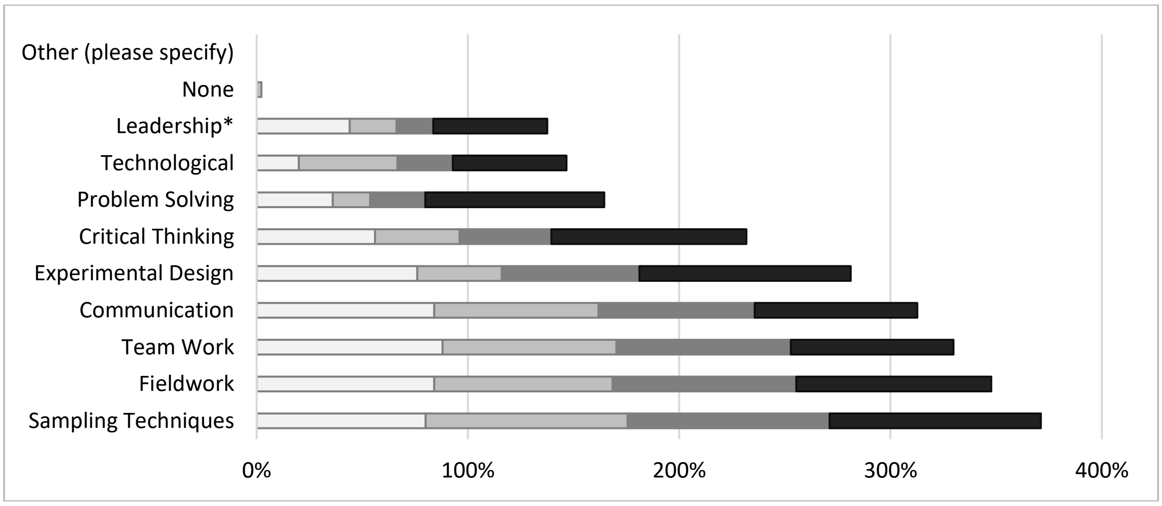

Figure 2. A stacked bar-graph representing the combined percentages of students from each unit surveyed (BIO1042, BIO2040, BIO3132 and ENV2022), stating that working in the JMR allowed them to develop the skills listed above on the y-axis. The percentage of agreeance for students from BIO1042 is represented by the white bar, the light grey represents BIO2040, the dark grey represents BIO3132 and the black represents ENV2022. (*Significant difference [chi-sq.= 9.71, df= 2, p<<0.05] between males [0%, 0 students] and females [61.11%, 11 students] in BIO1042)

Table 2: Student perceptions of the Jock Marshall Reserve activities within the BIO1042 Environmental Biology unit.
This table shows the mean and standard error (SE) values for student responses to the statements given below. The Likert-attitude scale used for responses has been quantified as follows: Strongly agree (5), agree (4), neutral (3), disagree (2) and strongly disagree (1). The percentage (%) of participants who selected either agree or strongly agree is also shown. (n=25)

Likert-attitude Scale Question/Statement	Mean ± SE	Percentage of Agreeance (%)
I valued the opportunity to apply professional practices and equipment	4.28 ±0.12	92%
The learning in this unit was more authentic because of the activities at the JMR	4.40 ±0.14	88%
The activities at the JMR helped me address the unit learning outcomes	4.32 ± 0.14	88%
I learnt practical skills in environmental biology during fieldwork at the JMR	4.32 ± 0.16	88%
The teaching was more engaging because of the activities at the JMR*****	4.24 ± 0.16	88%
The assessments were more engaging because of the activities	4.38 ± 0.18	84%
The practical activities at the JMR were the most valuable element of this unit	3.96 ±0.17	80%
The data that I collected from the JMR helped me to understand environmental biology******	4.04 ±0.16	76%
I believe the activities I undertook at the JMR will increase my employability	3.44 ± 0.20	44%
This unit would have been of a similar quality without any activities in the JMR	2.20 ± 0.21	16%
I see no educational value in using the JMR in this unit	1.84 ± 0.22	12%

**Significant difference (chi-sq.= 3.95, df= 1, p<0.05) between males (μ=3.88) and females (μ=4.41)*
***Significant difference (chi-sq.= 5.34, df= 1, p<0.05) between males (μ=3.43) and females (μ=4.29)*

Table 3: How use of the Jock Marshall Reserve altered students' thinking in regard to the unit BIO1042.
This table represents the percentage of students from the unit BIO1042, who mentioned one of the open-coded themes listed below within their open-ended response to the question *"In the unit BIO1042, did your activities at the JMR change your thinking about Environmental Biology?"* (n=25)

Open-coded Theme	Percentage of Students (No. Of Students)
Overall Views of Environmental Biology Didn't Change	40% (10)
Improved Understanding of the Unit's Practical Application	24% (6)
Reinforced Understanding of 'Environmental Biology'	24% (6)
Contextualised Learning in 'Real-world' Environmental Biology	24% (6)
Reinforced Passion and Interest in 'Environmental Biology'	16% (4)

Table 4: Student suggestions for potential improvements to the Jock Marshall Reserve in order to enhance the educational experience.
This table represents the percentage of students who mentioned one of the open-coded themes listed below within their open-ended response to the question *"How could we better utilise the JMR in order to enhance your educational experiences during your undergraduate degree?"* (n=92)

Open-coded Themes	Percentage of Students (No. of Students)
Have More Fieldtrips to the JMR within Units Currently Using it	22% (20)
No Need for Improvements	13% (12)
More Interactive and Student-driven activities	11% (10)
More Facilities and Improve Existing Facilities (e.g. Toilets, Classrooms, Signs)	10% (9)
Less Construction and Human Interference	9% (8)
Study a more Diverse Range of Species within JMR	8% (7)
Use More Areas of the JMR for Activities (e.g. Not just Lake)	8% (7)
Use the JMR in more Units	7% (6)
Unsure	7% (6)
Allow Students to Utilise More Survey and Sampling Techniques in JMR	5% (5)
More Instruction with Technological Aspects of JMR (e.g. QR Codes)	4% (4)
More Information Prior to JMR Fieldtrips on the Activity and the JMR itself	3% (3)
Make JMR Activities more Relevant to 'Real' Research	3% (3)
More Volunteering Opportunities in JMR	3% (3)
Expand the land of the JMR	3% (3)
Remove Pest Species	2% (2)
Build a Longitudinal Database	1% (1)

**Percentages have been rounded*

Authentic skills development

Another dominant theme regarding the value of the on-campus fieldwork was students' belief that it allowed them to develop practical skills and experience relevant to 'real-world' biological and/or ecological fieldwork (43%, 43 students; Table 1; Figure 2). The practical skills students reported having developed from completing activities within the JMR included primarily skills regarding biological and/or ecological sampling techniques. These were then followed by general fieldwork skills, and transferable skills including teamwork and communication (Figures 1 and 2). Students appeared to recognise and value the opportunity to develop more generic and transferable skills such as teamwork and communication. Both skills were cited as the third and fourth most commonly developed skills within JMR activities aside from the more obvious technical and discipline-specific skills (e.g. Sampling Techniques, Fieldwork skills; Figure 1). As one student explained, working within the reserve had benefited them in the development of both transferable and technical skills:

> *"I was able to relate my lecture content into real-life applications (JMR) that facilitated my knowledge and understanding. Also I developed skills in communication, team work, surveying and statistical analysis etc." – (JMR15)*

Students strongly believed that they were able to learn authentic skills during JMR activities across all four units targeted in this survey (Tables 2, S2-S4). Some students reported that these skills could not be developed within traditional classroom learning. Within the open-responses some students further explained:

> *"The value of a thoroughly researched area near the Monash campus allows for students to practice and learn skill sets that are transferable to other areas outside of labs and classrooms." – (JMR12)*
>
> *"Giving students a guided first-hand experience at field work before moving through internships, volunteer work or paid jobs in environmental biology is really valuable. Students can obtain an understanding of what is required, how to work outside of a classroom while still learning and exactly how educational theory can be applied in practice. At least for me, the feeling that I'm learning but getting even closer to experiencing real world jobs in the environment field through working at the JMR is really exciting." – (JMR13)*
>
> *"It was a great experience to actually do hands on field work under a professional atmosphere." – (JMR14)*

Students appeared to highly value the opportunity to develop transferable skills relevant to authentic biological fieldwork. This may align with current findings around students' focus on employability and impact beyond academia (Deloitte 2017) as well as an emerging focus upon the skills curriculum in graduate attributes (Stewart 2020). As posited in other field-based activities, practical learning, engagement and authenticity may emerge from a skills curriculum in some programs.

Overall, these findings support a trend (McGuiness & Simm, 2005) towards authentic learning in higher education, otherwise referred to as solutions-based learning or impact, and associated perceived benefits in terms of engagement and work relevant skills development. In the current study we see a preference by environmental students, which appears to be linked to all the aforementioned areas. An effective fieldwork-based skills curriculum in environmental fields may be a hook that draws students to undertake fieldwork and integrate these elements and benefits, ultimately empowering students (Scott, Humphries, & Henri, 2019). Considering the gap in generic transferable skills that has been reported among Australian science graduates (Sheldon & Thornthwaite, 2005), and previous studies reporting improved skills development from practical fieldwork (Tran, Phan, & Bellgrove, 2021), it is particularly important to identify whether on-campus fieldwork can be used to enhance the skills curriculum and a sense of empowerment (Norton & Cakitaki, 2016; Scott, Humphries, & Henri, 2019).

Pedagogies and education technologies

Students were asked what pedagogical tools, approaches and activities they preferred, mostly showing a preference for the more interactive and problem-based activities offered in the reserve (Figure 2). This links to the themes of autonomy and a sense of personal efficacy seen in other studies (e.g. Boyle et al., 2007). For example, students had the ability to collect and analyse their own data from natural environment. Students commented that the learning was more valuable when they had collected the data themselves. Two students stated:

> *"I also think that there is a great value in collecting our own data, such as in the Waterbirds practical." – (JMR10)*
>
> *"It allowed me to experience what data collection in the field would be like." – (JMR11)*

The findings support previous studies that suggest students gain greater insight into the requirements of research and professional work in environmental science, through understanding how data is collected and gaining confidence in their personal ability to do so (Boyle et al., 2007).

In keeping with past studies, practical and hands on learning was overall viewed positively because it was more interactive. Students explained that the ‘interactive’ nature of the practical or hands on work was more engaging and more useful for their cognition:

> *“I believe that the most valuable thing about working and learning in the JMR is its 'interactive' quality. This area gives students a place to learn theories and then apply those theories to practical examples that are near. For example, in BIO1042 students learnt about how microorganisms are dispersed in a lake, and then they were able to directly observe this at the JMR lake.” – (JMR1)*

A number of students (8%, 8 students) cited that their learning was improved by increasing the interactivity of the learning (Table 1). Indeed, the third most common suggestion for potential improvements on teaching approaches, was to make activities more interactive (11%, 10 students; Table 4). Students reported a strong preference for those activities whereby they designed the activity themselves, in line with increased autonomy, and problem based and experiential learning practices, as previously found (Millenbah & Millspaugh 2003). For example:

> *“I think it would be beneficial to allow more opportunities to have us students develop our own study designs to utilise in the reserve (maybe on vegetation more so than animals, obviously because of ethical issues).” – (JMR3)*

This was viewed as increasing the ‘hands-on’ nature of the experience with the wildlife and/or sampling tools in the JMR. The results suggest that active learning and experiential learning approaches are perceived as central to fieldwork activities and a main benefit to students. The reinforcement and visualisation of theory, as well as the grounding of the material in an authentic and practical context, is important to students:

> *“I would have liked to spend more time in the JMR. My favorite[sic] unit, Environmental Biology, a first year unit, was totally based to the JMR, and thus made the pracs[sic] a lot more realistic and applicable to the real world.” – (JMR16)*

This has been shown in previous studies (Da Silva, 2014; Dillon et al., 2006), and speaks to learning space and the context of learning activities being important. The results also suggest that some students see greater benefits when the level of autonomy and experience is increased. Other studies have found that staff-lead fieldwork causes students to identify technical skills, while student-lead fieldwork helps students to identify transferrable skills and link to enhance their employability (Peasland et al., 2019). Yet some studies have shown that students still struggle to link off-campus fieldwork with employability (Pha, Tran, & Bellgrove, 2021). This appears linked to perceptions of the authenticity of the task and potentially affective responses to developing a sense of professional identity (Halliwell et al., 2020; Peacock & Bacon, 2018).

With regard to educational technologies and associated online resources during on-campus fieldwork, largely respondents indicated this was beneficial (also see Figure 2). From the total of the survey population, the majority of students (61%, 60 students) reported that they used online resources at the JMR to supplement their learning. The students accessing online resources in the JMR mainly used smartphones (81%, 48 students), followed by laptops and notebooks (57%, 34 Students) and then tablet devices (13%, 8 students). Of the online resources available to them, students primarily reported using online domains such as ‘Google search’. This supports studies on the use of education technologies to increase flexibility for students in the way that they learn, particularly in a post-COVID-19 landscape where fieldwork may be limited (Whalley et al., 2021). There may also be an expectancy of this, although this did not emerge from this study.

Within this study, students appeared to align educational technologies with authentic learning, which may be linked to increased engagement. Predominantly students used Google search (85%, 50 Students) with the next largest proportion of students using resources designed by the educator/s (61%, 36 Students). Lastly, just over half of students used online resources, reported using JMR website as an online resource in the reserve (58%, 34 Students). Of these students, the clustered results showed that the majority of students used the website, or were neutral about its use (Figure 3). A flaw of our experimental design was that it is possible that the ‘neutral’ stance indicated that these students may not have realised that the relevant website was available and thus did not present a clear response.

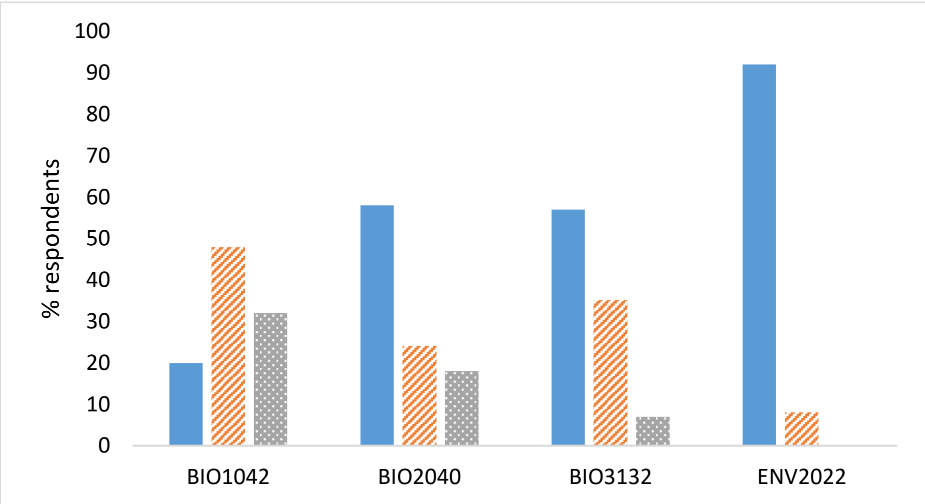

Figure 3: Student use of the JMR website. The majority of students in BIO2040 (n=26), BIO3132 (n=13) and ENV2022 (n= 12) used the JMR website (blue solid). For BIO1042 most respondents (n=12) indicated that they did not use the JMR website (orange stripes). Several students remained neutral across BIO1042 (n=8), BIO2040 (n=8) and BIO3132 (n=2) (grey dots).

Whilst educational technologies were generally viewed as increasing the authenticity and flexibility of tasks (Figure 3), the uptake was varied and may speak to a need for further integration in assessment, as in ENV2022. Other work in the JMR incorporating QR code scanning into a lizard survey, also indicates a hesitance to use mobile technology, despite finding that it increased student engagement (Chapple et al., 2017). Clearly there is room to expand upon use of education technologies, but this must be carefully balanced by educators to prevent overwhelming students and detracting from the real-world experience (Thomas & Munge, 2017).

As higher education increasingly focuses upon active learning approaches, field-based learning may present a pathway into more advanced and effective active learning approaches, particularly problem-based and experiential learning approaches requiring high autonomy and building a sense of personal efficacy (Scott, Humphries, & Henri, 2019). Findings appear to support a general shift in undergraduate receptiveness to such approaches from trepidation

(Felder & Brent, 2010) to appreciation (Boyle et al., 2003; 2007). The results remain intertwined with perceptions of value regarding enjoyment and emotional wellbeing, as discussed below.

Increased engagement and emotional wellbeing

Students recurringly stated throughout the survey that they believed working in the JMR was a more engaging learning experience (Tables 1, 2, and 3, S2-S7, Figure 2), often discussing this in relation to immersion, visualisation and authenticity. One student went on to elaborate on why learning within the JMR was more engaging, from the student perspective, by stating that:

> *"Being in a nature reserve is so much more immersive than being in lab, especially when studying a field like environmental biology. Being able to go down to the lake and use it as a study site is so great to use it as a model in the real world instead of seeing models online or in textbooks, to see ecosystems in action is so important." – (JMR5)*

On occasion, enjoyment was linked to emotional wellbeing. Within students' responses regarding the value of the JMR (Table 1) twelve students (12%) specifically stated that working within the reserve had a positive effect on their emotional state. Students reporting that working within the JMR was 'relaxing' and a 'breath of fresh air'. Two students stated:

> *"If anything, it was quite enjoyable to be in a science environment, rather than sitting in a computer lab." – (JMR6)*

> *"It was an interesting setting, very different to the rest of the concrete jungle that is Melbourne." – (JMR7)*

The results of this study are encouraging when considering the mental health issues facing universities (Gallagher & Odozi, 2015). For example, several students in this study perceived immersion in nature as helping them feel a sense of belonging, or in alleviating stress or anxiety. With these results in mind, educators could consider the potential for fieldwork to benefit students' mental well-being when designing educational activities. Elias et al. (1997) and Liff (2003) also report that accounting for the social elements of the learning environment in educational design could help to boost student well-being. Informal interactions with both students and staff were viewed favourably and seen as beneficial, and may link with perceptions of increased mood. Other studies have reported that social interactions during fieldwork create long-term positive effects (Carew, Ho, & Brookes,2020).

Previous studies suggest designing field tasks that emphasise collaboration may encourage the formation of social connections, and using on-campus field sites to provide frequent recurring field activities could facilitate this (Kent et al., 1997; Peacock & Bacon, 2018). A variety of benefits to well-being were reported, supporting the findings of past science and non-science studies from off-campus fieldwork. Several previous studies cite increased enjoyment and engagement as a benefit of fieldwork (Boyle et al., 2007; Goulder et al., 2013; Kent et al., 1997), and other studies discuss how fieldwork can augment student social connections and feelings of community and identity (Smith, 2004). In line with Eccles' expectancy theory and affective theory, students' wellbeing and perceptions of their own abilities may increase their ability to learn.

Recommendations by students

When asked how the reserve could be utilised more effectively for teaching activities, most students reported that they would like more fieldtrips to the JMR within the unit design (22%, 20 students; Table 4). Typical comments included:

> *"In Environmental Biology uni[sic], Year 1, we used the JMR a lot more than in BIO2040, conservation biology, this unit we were able to learn the cameras and do more sampling and observation skills, I would like to do more of that rather than just on one assignment, this way of study is much more engaging (for me especially) but for all student too, we all learnt better with hands on field work, rather than in the lab/lecture room." – (JMR4)*

Similar to staff, students consider convenience and logistics in their fieldwork experiences, recognising the value of on campus locations for their learning opportunities. Another strength of the JMR from the students' perspective, is its convenience when undertaking field-based activities within a unit (8%, 8 students; Table 1). Students went on to state that having the reserve on the campus allowed them to experience fieldwork without extensive travel. Two students commented:

> *"It is very convenient as it is on campus so we don't have to constantly get on buses and travel to the location." – (JMR8)*

> *"An accessible, nearby study site with camera traps that allow for a practical understanding of ecology and zoology." – (JMR9)*

Conclusion

This study suggests that on-campus fieldwork provides a rich suite of benefits to students, similar to off-campus fieldwork. Students reported a perception of increased conceptual understanding of theory, greater retention and engagement, and authentic skills development relevant to their careers. Some also reported benefits to wellbeing and increased convenience due to the on-campus location. After previous disease outbreaks that had an impact on fieldwork, students deeply valued fieldwork despite, or perhaps because of, its absence (Fuller, Gaskin, & Scott, 2010). Our results may give educators a pathway forward for identifying mechanisms to enhance learning and the student experience through the incorporation of further on-campus fieldwork, particularly given the preferences reported by students following the COVID-19 pandemic (Whalley et al., 2021). Our study is unable to determine whether a dedicated reserve was an essential component of the students' experience of on-campus fieldwork. For universities without a nature reserve on campus, it is possible that on-campus fieldwork activities could have similar benefits for student engagement and achieving educational objectives.

The findings of this study show that students value fieldwork for many reasons besides traditional theoretical understanding. The diversity of responses illustrates the range of potential benefits of fieldwork to the student experience. These results support the idea that 'feelings and values matter to students' as well as professional authenticity and context (Fleischner et al., 2017). Overall, this study supports and aligns with numerous previous studies on students views on the benefits of off-campus fieldwork, but add a more nuanced understanding of students' rationales particularly within an on-campus context. This more convenient form of fieldwork may be as valuable to students as other traditional forms of fieldwork for engagement and learning, as well as more scalable and implementable.

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