The Role of Overseas Field Courses in Student Learning in the Biosciences

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Abstract

Field courses provide excellent opportunities to engage students with their subject. Previous research has confirmed the considerable academic and pastoral benefits gained from taking students out of the classroom, especially in Biosciences and related disciplines. Here, we compare student attendance/attainment on a Level 5 Biosciences field course to South Africa to: (1) attainment on other Level 5 modules; (2) attainment at Level 6; (3) dissertation performance; and (4) grade trajectory between Level 5 and Level 6 for two successive cohorts. Students who attended the overseas field course tended to attain higher dissertation marks than non-attending peers and had a better grade trajectory, being more likely to improve their degree classification between Levels 5 and 6. We discuss possible (non-mutually-exclusive) reasons for this, including academic experience, undertaking challenging assessment at the end of Level 5 based on independent research (essentially a mini-dissertation), piquing students' enthusiasm, or simply that field trips attract students motivated to improve academic performance. Given the limited specific consideration of running field courses in unfamiliar environments (e.g. overseas) in Higher Education, we also discuss the potential additional benefits afforded by geographical novelty, considering: (1) student experience and enjoyment; and (2) student perceptions of learning. We found that, with appropriate preparation, running field courses in unfamiliar locations can add to the general benefits of fieldwork for student learning. Our findings do not support previous work suggesting that students can be disadvantaged by novelty, concluding instead that the novelty of the environment, and the new experiences thereby afforded, were positive.

Introduction

Field courses are an important element of many undergraduate degree courses in Biology, Ecology, and Zoology, as well as allied disciplines such as Geography and Environmental Science. They can provide excellent opportunities for students to develop their understanding of the links between theory and practice via active, immersive and enquiry-based learning (Wilson et al., 2008). Well-designed field courses also provide a mechanism for teaching practical skills within the appropriate environment (Kent et al., 1997; Dillon et al. 2006). The academic importance of field courses has been widely recognised (e.g. Davenport, 1998; Smith, 2004; Dillon et al., 2006; Rahman and Spafford, 2009; Gamarra et al., 2010). In one of the few comparative studies so far undertaken, Eaton (2000) showed that field courses were more effective for developing deep-level understanding and cognitive skills than classroom based learning, probably through their influence on students' "affective domain" and associated development of transferable skills (Boyle et al., 2007; Wurthmann and Conchie, 2007). Indeed, students involved in immersive undergraduate research, such as that conducted on field courses, report increased confidence and improved communication skills (Kremer and Bringle 1990; Spilich 1997), which are key aspects of graduate employability (Saunders and Zuzel, 2010).

Field courses also have important benefits in terms of pastoral care. While in the field, and outside of the confines of formal lectures and personal tutoring sessions, lecturers are often able to gain an understanding of issues that may be preventing students from reaching their full potential and work with students to help them overcome difficulties (Cohen et al., 1982; Hart et al., 2011).

As a result of their academic effectiveness and supportive atmosphere, field courses are an important component of student experience (Orion and Hofstein, 1991; Boyle et al., 2007) and enhancing or refining career ambitions (Prokop et al., 2007). However, despite their many advantages, there is evidence of long-term decline in field course provision throughout Higher Education (Smith, 2004), possibly as a consequence of time, budget, and logistical constraints. Given that such constraints are unlikely to disappear, it is crucial to ensure that remaining field course provision is maximally effective, both academically and in terms of student experience.

The single biggest influence on a field course is, arguably, location (Cotton and Cotton, 2009; Maw et al., 2011). Location influences the overall focus of the course, what specific topics and experiences can be included, mode of delivery, learning opportunities, prospects for skills acquisition, and what type of assessment is appropriate. It also likely affects student perception pre-trip, on-trip, and post-trip. However, few studies of field courses explicitly discuss the role of location, or the relative benefits of taking students to familiar or unfamiliar locations, other than to stress the importance of adequate student preparedness in unfamiliar environments (Falk et al., 1978; Orion and Hofstein, 1994). In particular, there has been little consideration of overseas field courses (*de facto* involving an unfamiliar environment), and their role in student learning within the Biosciences at Higher Education level. This is surprising given that 'exotic' locations are popular field course destinations (Smith, 2004), largely because they provide field experience unavailable in the UK (Maw et al., 2011) and are seen as positive in terms of student experience and applicant recruitment (Smith, 2004). The few studies that have been done on running field courses in unfamiliar locations have either focussed on the *experiences* of students in terms of cognitive, psychological and geographical aspects of 'novelty space' (Falk et al., 1978; Orion and Hofstein, 1994; Cotton and Cotton, 2009) without relating this to student learning and attainment, or have focussed on learning and attainment without specifically linking this to novelty of location (Hill and Woodland, 2002). This is symptomatic of a general lack of discipline-specific educational research conducted in the field (Singer et al., 2013) and is despite the aforementioned importance of fieldwork to the study of Biosciences at HE level.

Here, we discuss the role of overseas field courses (i.e. field courses based wholly, or substantially, in a country other than that which hosts the parent course) in student learning. We base our discussion on experiences of running a South African field course for Biosciences undergraduate students for two different cohorts over two successive years. We examine: (1) student experience and enjoyment; (2) student perceptions of learning (reinforcing knowledge, extending knowledge, expanding knowledge); and (3) objective measures of knowledge and understanding as evidenced by module grades. We consider these metrics holistically from the standpoint of geographical, cognitive and psychological novelty. In the case of student attainment, we also link field course attendance and attainment to performance in the third year dissertation module, third year performance, and overall degree classification test the hypotheses that involvement in, and engagement with, novel situations on a field course has lasting academic benefits. This is one of the first studies to assess the role of field courses as progressive learning experiences in this way (Hill and Woodland, 2002; Singer e*t al*., 2013).

Methods

Focal field course

The focal field course took undergraduate students out of their biological comfort zone to the savannah grasslands of South Africa. Two 12-day trips were run in successive years (2012 and 2013), each based at Mankwe Wildlife Reserve, Northwest Province. In both years, the trip was attended by Level 5 (second year) students, studying either BSc (Hons) Biology or BSc (Hons) Animal Biology (n = 15 in 2012; n = 20 in 2013). The trip was partly subsidised by the Institution, but the majority of the £1250-£1400 (UK pounds) cost was met by the attendees. Teaching was undertaken by 2-3 academics with differing backgrounds and subject expertise (AEG and AGH in both years, plus RNR in 2013) in conjunction with field centre staff (LM). Student participants had attended a UK-based field trip the preceding year (2012 cohort: 7-day field course in Dorset; 2013 cohort: 5-day field course in the Forest of Dean, Gloucestershire).

In both years, the focus of the South Africa field course was animal biology, behaviour, species conservation and habitat management. Participants stayed in safari-style tents or wooden chalets within the wildlife reserve. Twelve half-day field exercises were undertaken. These made full use of the novel ecosystem, for example, students walked transects to quantify abundance of large mammals such as zebra, wildebeest and giraffe; completed Veldt grassland condition indices (VCI: Tainton, 1999); and monitored nocturnal species such as aardvark and porcupine using motion-detecting cameras. These activities were designed to extend students' knowledge of complex ecological concepts such as predator-prey interactions, population dynamics and niche partitioning already covered in previous classroom-based modules and allow them to understand how such knowledge is applied in conservation and management. Skills acquisition was imbedded within all activities. For example, some sessions involved using equipment to perform simple tasks (e.g. using a compass to take a bearing, using a GPS unit to fix and locate a survey point, and using an optical range finder to measure distance), while others covered more advanced skills (e.g. field mapping and use of keys to identify unknown species).

The trip culminated in students undertaking an independent research project in a small group. Each project was survey-based rather than experimental, and was student-derived (with supervisor support), such that students could work on topics that particularly interested them. Critically, projects were designed to answer previously unaddressed questions or build on existing projects and existing datasets. In this way, projects were set in a problem-based learning framework (reviewed by Barrett and Moore, 2010), where the “problem” was a real one rather than a hypothetical scenario contrived for the purposes of student assessment. There were two elements of assessment: (1) a field notebook, in which students had to demonstrate sustained engagement with field course activities by taking notes on each session, recording data, and (where appropriate) analysing those data; and (2) an individual write-up of the group project (in the usual scientific paper format: Abstract, Introduction, Methods, Results, and Discussion).

To ensure adequate preparedness, and to make sure that time in the field was spent enhancing students' knowledge rather than covering the basics (Kent et al., 1997; Hill and Woodland, 2002; Smith, 2004), students' learning was supported via several pre-trip briefing sessions. In addition, each student received a printed 64-page handbook two weeks before the field course. This was written specifically for the field trip and contained, for each field exercise, background theory, field method protocols and analytical techniques. Students in the 2013 cohort also benefited from conceptual and instructional videos made by the 2012 cohort (Goodenough and Hart, 2012; Goodenough et al., 2013).

Evaluating student enjoyment, experiences and perceptions of learning

To examine student enjoyment, and perceptions of learning, all participating students were asked to complete a questionnaire (Appendix 1) either on the last night of the trip (2013) or shortly after returning to the UK (2012). The questionnaire did not differ between years and utilised both quantitative and qualitative approaches, combining free-text responses with Likert-scale or yes/no questions. Asking students their view on the extent to which different topics had been covered allowed perceptions of learning to be compared with actual taught content. The questionnaire was divided into two sections. The first (qualitative) section asked students to consider, without being led, what topics they had learnt in free-text responses; the second (quantitative) section asked students to rank trip experience of specific topic areas. The sections were given in this order to ensure that the free-text responses were unbiased by topics listed in closed questions. The survey was designed to be quick to complete, having eight compulsory questions plus space for additional comments; the response rate was 100% in 2013 and 60% in 2012. Student responses were evaluated both in general, and, where appropriate, in relation to student grade distribution from the field course module, to establish whether responses differed between stronger and weaker members of the same cohort.

In addition, students in the 2013 cohort were asked to make short (~5 minute) videos on their project using University camcorders. These were designed to complement videos resources complied previously by the 2012 cohort (the 2012 videos having been used by the 2013 cohort prior to the trip) (Goodenough and Hart, 2012; Goodenough et al., 2013). In the project videos made by the 2013 cohort, students were asked to explain their project and its findings. Videos were analysed by the authors (AEG and RNR) to document what topics and skills were discussed.

<u>Assessing student attainment</u>

Direct evidence for the extent to which the field course liked to attainment was provided from results of summative assessment (as per Hill and Woodland, 2002) for both cohorts. Several analyses were undertaken to answer specific questions and/or to test specific hypothesises.

We hypothesised that high achieving students on the field trip would have strong academic profiles overall. To test this, we quantified the relationship between field course attainment (module mark) and overall academic performance for the rest of Level 5 (i.e. across all second year modules excluding the field trip itself) using regression analysis. Percentage marks were arcsine square root transformed to normalise them prior to regression being undertaken. To extend this analysis beyond a simple baseline quantification of correlation, we also compared field course mark and mean Level 5 performance on a student-by-student basis using a paired-samples t-test. This was done to test the possibility that although these marks might be correlated, performance on the trip might still be significantly higher, or lower, than mean attainment at that level for individual students.

To examine the potential role of the field course as a progressive learning experience, we tested whether attendance on the field trip, and performance on that trip, was significantly associated with future attainment. We undertook three different types of analysis, all based on the 2012 cohort (the only cohort with data on Level 6 performance at the time of writing):

1. **Field course attendance and grade trajectory**: To test whether attendance on this overseas field course was associated with student grade trajectory, we compared attendance (yes or no) to whether degree grade (3rd, 2:2, 2:1, 1st) increased, decreased or remained the same between Level 5 and Level 6 using a 2*3 chi square test for association. Trip non-attendees completed the same degree as the attendees, at the same time, but took a different optional module *in lieu* of the field course.

2. **Field course attendance and Level 6 attainment**: To test whether *attendance* on the trip linked to future attainment, we correlated attendance (binary variable: 0 = non-attendance; 1 = attendance) with attainment at Level 6 (mean mark) using Kendell's Tau partial correlation analysis, with student attainment at Level 5 (mean mark) entered as a covariate. This approach allowed the direct relationship between field course attendance and Level 6 attainment to be quantified with any underlying correlation between Level 5 performance and trip attendance allowed for statistically to avoid it confounding the analysis (Field, 2000). The same approach was used to test for a partial correlation between field trip attendance and dissertation (honours project) mark.
3. **Field course attainment and Level 6 attainment:** To test whether on-trip *attainment* for field trip attendees correlated with subsequent attainment, field course marks were correlated with mean Level 6 mark, again with mean Level 5 mark added as a covariate (such that a significant result would indicate a link between field course performance and subsequent attainment over-and-above the (expected) link between general Level 5 and Level 6 performance). Again, a similar analysis was undertaken for dissertation performance.

It should be noted at this juncture that testing whether associations/relationships between field course attendance/performance and Level 6 attainment were directly causal was outside of the remit of the current paper. We were interested in establishing, in this study, whether field course attendance and future performance were linked, not establishing the mechanism for any such link (this is discussed further in subsequent sections).

Results and Discussion

Overall student experience

Student experience was overwhelmingly positive. When asked to rate enjoyment of the trip from 1 (not at all) to 5 (very much) (Q4, Appendix 1), 82% of students gave a response of "5" while the remaining 18% gave a response of "4". All but one of the students who gave a score of "4" mentioned that personal circumstances made it hard to be away from family at that time. When asked to consider whether the trip was worthwhile for extending knowledge given its cost (Q7, Appendix 1), all students gave very positive free-text comments, although interestingly only one comment specifically included consideration of the financial cost of the trip:

> *"Worth every last penny"*
>
> *"The trip was both extremely useful for our academic future and highly enjoyable."*
>
> *"Really enjoyed the trip. Amazing experience, learnt so much, done so much, and all of it hugely enjoyable - totally awesome."*

Students felt that field trips were an important part of their Biosciences degree programme (Q8, Appendix 1), rating their importance as a mean of 4.75 on a Likert scale ranging from 1 (lowest) to 5 (highest). This is interesting given the long-term decline in field provision throughout HE (Smith, 2004) and the current lack of an explicit benchmarking statement to make field experience compulsory within Biosciences degrees (Quality Assurance Agency for Higher Education, 2007). Interestingly, students rated international trips above UK-based trips in this regard (4.64 and 4.05, respectively). There was no association between student mean Level 5 grade and student perception of the usefulness of field trips in general or international trips in particular (Chi square test for association with grade as one nominal variable (3rd, 2:2, 2:1, 1st) and ranking of perceived usefulness of field trips as the other : $\chi^2 = 9.38$, d.f. = 6; P = 0.153 and $\chi^2 = 5.383$, d.f. = 6; P = 0.700), which suggests that all students enjoy such trips and find that they enhance the student experience regardless of academic attainment. Despite no specific question being asked on careers, two students reported that the trip had caused them to (re)consider their future careers, reconfirming the importance of field courses for student aspirations (Prokop et al., 2007):

> *"Before this trip, I didn't know what I wanted to do after graduating. Now I want to be involved in conservation - this place and these people* [reserve staff] *have inspired me."*
>
> *"The trip has inspired me to carry on with my dream of being a park ranger."*

Student perceptions of learning

Students felt that the field course substantially reinforced or extended learning of all named theoretical biological concepts covered in previous classroom-based modules (Q5, Appendix 1; Fig. 1a) and allowed them to acquire knowledge of applied concepts (Q6, Appendix 1; Fig. 1b). Students' perceptions of the level of knowledge reinforcement or extension of each named concept generally matched the extent to which that topic had been covered within the course. Concepts that were covered in several sessions (e.g. animal health; foraging strategies), or throughout the entire course (e.g. land management; motivations for conservation) were rated more highly than concepts considered in just one session (e.g. animal behaviour) or indirectly rather than explicitly (e.g. predator-prey interactions; competition; niche partitioning) (Fig. 1a&b). It was pleasing to see students recognising that techniques (e.g. survey strategies and statistical analysis) had been covered in addition to biological concepts (Fig. 1a). There was no association between mean student Level 5 grade (3rd, 2:2, 2:1, 1st) and student perception of the usefulness of the field course for extending knowledge of sampling or statistics (Chi square test for association: $\chi^2 = 6.000$, d.f. = 6; P = 0.423 and $\chi^2 = 4.390$, d.f. = 6; P = 0.624). This is in contrast with previous studies where student perception of the usefulness of field activities has been associated with attainment, with stronger students rating usefulness more highly (Hill and Woodland, 2002). The lack of association found here might reflect the fact that, on this course, each activity started with a "refresher" session to ensure all students (especially weaker ones) were comfortable with the basics before moving onto new material, which was often high-level (complicated sampling designs, advanced statistical techniques) and designed to push all students including the stronger ones. It could also link to the fact that participating students had already been on a residential field course and therefore all students (regardless of attainment) recognised the importance of field based activities, or be attributable to the extensive pre-course guidance that was provided (further highlighting the need for appropriate participant preparedness: Falk et al., 1978; Orion and Hofstein, 1991; Hill and Woodland, 2002). Somewhat disappointingly, however, most students reported that the field course had reinforced knowledge of experimental design when, in reality, this was not covered at all. This likely reflects a lack of understanding of the difference between surveys and experiments; indeed several students erroneously referred to their "experiment" in their video presentation (see below). Confusion between surveys and experiments is common in University students (Stafford et al., 2010) and findings here likely reflect a widespread issue.

The role of the novel environment

Field courses, in any environment including ones familiar to students, can have a range of benefits, as discussed in the Introduction. However, holding field courses in novel environments has the potential to change field experiences in ways that can provide opportunities for learning enhancement relative to holding courses in familiar locations or, alternatively, act as barriers to student learning (Falk et al., 1978; Orion and Hofstein, 1994; Cotton and Cotton, 2009). Here, students were asked to identify what biological concepts they had learnt on the trip that they could not have learnt in a different (e.g. UK) environment (Q2, Appendix 1). Interestingly, every student exclusively listed Africa-specific topics, such as species identification or species-specific survey techniques (73%); species-habitat interactions (22%); management of game reserves (60%) and behaviour/conservation of African species (45%). It is possible that the students were simply unable to extend the question to their wider studies, and thus responded very specifically in the context of their recent African experience, which is something that we cannot rule out. However, we consider it more likely that this demonstrates students being aware of the specific advantages (and limitations) of studying in a novel environment, and not being swayed by enjoyment of the trip to exaggerate the learning opportunities that it afforded. Further evidence for this comes from some insightful student questionnaire comments:

> *“We could have learnt some things that we have learnt here at home BUT it wouldn’t have stuck as it wouldn’t have been as interesting.”* [Student emphasis]

> *“We could have done large amounts of stuff at home – like diversity index work and looking at how species use habitat – however the application of new techniques to new environments and new species encouraged me to apply myself more enthusiastically than I would have done on a home trip.”*

> *“Some techniques could have been learnt in the UK but practicing* [sic] *here meant I understood more as I had to pay more attention.”*

Several students commented on cognitive or geographical novelty, noting either that experiential learning (*sensu* Kolb, 1984) made it easier to understand key concepts than passive classroom-based learning (cognitive novelty) or that being in a new environment made learning more exciting or made theory-practice links more apparent (geographical novelty). Some students also noted an interaction between cognitive or geographical novelty, for example, commenting that specific new concepts were easier to understand because they were taught in a new environment:

Cognitive novelty*:*

> *“The opportunity to witness so much first hand means much valuable knowledge gained.”*

"Analysing data in the field is far more understandable and makes the stats experience more fun and useful."

"Hearing from someone who's experienced issues first hand gave me a much better insight rather than reading up on it in the UK."

Geographical novelty*:*

"[Working in] a different environment made everything more interesting."

"Being in Africa really helped understand monitoring and conservation theory and methods, and made it more fun ... It was AWESOME."

Cognitive and geographical* novelty:*

"Looking for things I had not already seen before using new methods was great – if I had seen them before I wouldn't have been as enthusiastic."

There were no comments relating to psychological novelty on any of the questionnaires distributed at the end of the field course. The only issues reported were problems caused by being away from home due to particular personal circumstances (not linked to novelty *per se*, but rather absence from home environment). These issues were eased by staff (the authors) being aware of potential problems and ensuring that such students had access to a telephone to call home as necessary. The only other issues relating to psychological novelty noted by staff at the start of the trip were ca 20% of students being worried about the presence of insects, spiders or snakes, especially around their accommodation. In most cases, these fears eased quickly as students became more familiar with their environment, as reported previously (Emmons, 1997; Cotton and Cotton, 2009). It did not appear as though students were masking on-going fear, since the students concerned appeared relaxed about the situation after the first couple of days. None of the students opted to change accommodation to move to an area with fewer spiders, despite being given this option and none of these issues were reported on end-of-trip questionnaires as might be expected if fears were on-going throughout the trip. It should, however, be noted that these issues could have delayed initial student engagement with the trip, such that devoting information to this topic pre-departure might allow students to pre-adjust to a greater extent.

Video analysis – experience, learning and novelty

Five groups from the 2013 cohort created short field-based videos on their project. These can be seen, alongside videos made on concepts and field techniques by the 2012 cohort, at www.africanbiosciencevideos.esafari.co.uk. The projects themselves addressed different questions, drew on different theoretical concepts, and focussed on different taxonomic groups. Briefly, projects considered: (1) bird feeding behaviour; (2) methods of monitoring large mammals using direct and indirect evidence; (3) movements of animals across fence lines; (4) relationships between mammal diversity, grassland condition, and habitat management; and (5) effect of the presence or absence of active termite mounds on vegetation.

In their videos, all five groups discussed, without prompting, accurately-named biological concepts that were relevant to their project (including niche partitioning, predator/prey interactions, population dynamics, foraging behaviour and species-habitat interactions). Moreover, all groups mentioned project or survey design (note that although all groups undertook non-manipulative projects, two groups referred to this incorrectly as "experimental design") and discussed appropriate field techniques. All groups mentioned statistical analysis of data or the results thus obtained. In many cases, the statistical techniques used were new high-level techniques, such as repeated measures and nested ANOVAs (cognitive novelty with considerable staff support). Four of the five groups showed that they were aware of the limitations and biases of their project and made suggestions for future work. This demonstrated high-level understanding and the critical analysis skills that would not normally be expected until Level 6 (*sensu* Bloom, 1956). This underlines previous findings by Wilson et al. (2008) on the importance of project work in developing student learning.

Interestingly, four of the five groups independently discussed the advantages of performing their study in Africa relative to other environments. All these groups mentioned enjoyment (using words such as "*fun*", "*enjoyable*", "*interesting*", "*enthusiasm*", "*exciting*", "*cool*" and even "*once-in-a-lifetime*"). Three groups identified non-mutually-exclusive aspects of their study that would not have worked in their home (UK) environment because of the focal species (two groups), environment (two groups) or hypotheses being tested (two groups). Furthermore, two groups mentioned that working on novel species or in areas of high species diversity not only strengthened their work academically, but also increased their enthusiasm and commitment to the project.

> *"It was a real strength doing this project in an area with high species diversity. Doing something similar at home would just be foxes, badgers and rabbits, here we have warthogs, kudu and impala* [antelope species]*, jackal, mongoose, francolin* [bird species]*, snakes and so on – more data and more interest!!."*

> *"The hands-on project approach working on new species in a new environment means more enthusiasm amongst the students."*

Finally, three of the groups mentioned that they thought doing a project that had genuine value was important. They appeared to engage more with their project because they knew it would have real-world applicability, underlining previous findings that undertaking work of genuine value can increase student ownership (Exley and Dennick, 2004). Indeed, student-collected data, especially GIS data, have been useful to the Reserve management team. This demonstrates the mutual benefits that can be derived through taking a problem-based learning approach (reviewed by Barrett and Moore, 2010), especially when the "problem" is a real one that needs solving.

> *"The projects can be used to help the reserve, directly on the reserve, so you feel as though you are giving something back."*

> *"We wanted to see for them [reserve staff] as well as just our curiosity ... we found things that the Reserve didn't know before."*

Student attainment

Field courses, in any environment, have strong academic potential. Here, as hypothesised (see Methods), there was a strong and significant relationship between students' field trip marks and their Level 5 (second year) mean mark after excluding the field trip module when analysed using linear regression (2012 cohort: $F_{1,12} = 18.692$, $r^2 = 0.629$, $p < 0.001$; 2013 cohort: $F_{1,16} = 20.995$, $r^2 = 0.567$, $p < 0.001$). Relationships were very similar between the years as regards both slope gradient and intercept (Fig. 2). However, despite these strong and significant relationships, field course marks were actually significantly lower compared to mean Level 5 performance when analysed on a per-student basis using paired t-tests (2012 cohort: t = -2.344, d.f. = 12, p = 0.037; 2013 cohort: t = -3.247, d.f. = 17, p = 0.005). This differs from previous research by Hill and Woodland (2002), which found that student attainment did not differ significantly from mean Level 5 marks. However, that analysis was undertaken at cohort-level rather than the individual-level analysis undertaken here. It is worth noting that applying a cohort-level analysis to the data presented here (independent rather than paired t-test) also results in non-significance because the differences between marks were small enough to be masked by cohort-level variability when mean attainment was analysed.

The slightly lower-than-average marks for the field course likely link to the challenging nature of the assessment, especially the research project write-up. The module is taken by students at the end of Level 5, just prior to their end-of-year examinations and is designed to be a bridge into Level 6 and the research project that forms the double credit dissertation module.

It is worth noting that, although on a per-student basis field course marks were slightly lower, they were still in line with the Institutional mean for a Level 5 module (field course mean 58% in 2012 and 60% in 2013; Institutional mean 59% in both years). A common theme in both years was that write-ups appeared somewhat rushed. This could be due to concurrent exam pressures (students were asked to submit work approximately two weeks after returning home so it was still fresh in their minds but this write-up period did clash with revision for end-of-year examinations) or simply poor student time management, an influential factor in student attainment more generally (e.g. Britton and Tesser, 1991).

There was no direct relationship between field course attainment and either mean Level 6 mark (Kendell's Tau: $r = 0.177$, d.f. = 10, $p = 0.301$); or dissertation mark ($r = 0.096$, d.f. = 10, $p = 0.394$) after controlling for mean Level 5 mark by adding this in as covariate (see Methods) to ensure that an underlying correlation between attainment at Levels 5 and 6 did not bias analysis. However, there was a significant correlation between *attendance* (as opposed to attainment) on the South Africa field course (binary variable: 0 = non-attendance, 1 = attendance) and students' dissertation mark at Level 6 (Kendell's Tau $r = 0.373$, d.f. = 20, $p = 0.044$). This analysis controlled for each student's mean Level 5 mark (again by adding this as a covariate in the analysis) to account for the fact that generally slightly stronger students attended the field course relative to the overall cohort (attendee mean Level 5 mark = 62.3%; non-attendee mean Level 5 mark 58.6%). Similarly, there was a significant association between field course attendance and student grade trajectory (Chi square test for association: $\chi^2 = 5.15$, d.f. = 2; $p = 0.038$). Consequently, students who attended the field course either improved their degree grade between Levels 5 and 6 (57% of students) or remained static (43% of students) (Fig. 3). No field course attendees showed a downward trend. In contrast, most students who did not attend the field course either received a lower grade in Level 6 compared to Level 5 (25%) or achieved the same grade (50%); just 25% improved (Fig. 3). Mean performance at Level 5 and Level 6 also correlated more strongly for field course attendees than non-attendees (attendees: $r = 0.956$ d.f. = 12, $p < 0.001$; non-attendees: $r = 0.769$, d.f. = 10, $p = 0.006$).

Taken together, these results suggest that attendance on the field course was beneficial to students' long-term academic attainment, especially in independent project work. This might link to improved biological knowledge and field skills through field course attendance (Kent et al., 1997; Dillon et al. 2006). Fieldwork has also been shown to have a positive effect on the interest, attitudes, motivation and self-confidence of learners (Boyle et al., 2007), which could support learning in later modules. Moreover, although students might have struggled with the field course assessment, undertaking and writing up a research project appears to be useful preparation for Level 6. In this way, the field course project and write-up provided a reasonably "safe" dry-run for the skills required for preparing a final year dissertation project, including independent learning, the research process and time management. It also provided a way for students to adjust to the learning challenges inherent in replacing "tried and tested" experiments in the classroom with real-world practical ecology (Openshaw and Whittle, 1993). It is, however, also important to note that this pattern could have arisen because the students motivated enough to pay to go on a field course might also be the students motivated enough to put extra effort into their studies and improve their grade trajectory. In other words, although this study has found a correlation between field trip attendance and future attainment, this relationship might not be causal. Disentangling these possibilities would be an interesting further study.

Conclusion

This study suggests field courses can enhance student learning in the Biosciences. Student experience of the focal field courses, held in an unfamiliar location, was very positive, as noted in some previous studies (e.g. Boyle et al., 2007) and student perception of on-trip learning tallied with topics covered and the extent to which they were covered. The findings do not support previous work suggesting that students can be disadvantaged by novelty (Falk et al., 1978; Orion and Hofstein, 1994; Cotton and Cotton, 2009). On the contrary, the novelty of the environment and the new experiences that environment afforded, was seen to be positive. This positive reaction possibly reflects time invested in student preparedness before the field course (Orion and Hofstein, 1994), which included showing videos of the camp so student knew what to expect, and ensuring logistics such as accommodation arrangements, which tend to worry students (Cotton and Cotton, 2009), were sorted out well before departure.

Student marks correlated with overall performance but were slightly lower than mean Level 5 mark, possibly because of the challenging nature of the assessment. Students who attended the focal overseas field course, tended to attain higher dissertation marks than non-attending peers and had a better grade trajectory than non-attendees, being more likely to improve their degree classification between Levels 5 and 6. Although we cannot ascribe causality to these associations, the academic experiences of the trip, the necessity of undertaking challenging assessment at the end of Level 5 based on independent research (essentially a mini-dissertation), and piquing student's enthusiasm for their studies are possibilities.

Overall, this study reconfirms the importance of field courses, including ones held in novel locations, on student experience and attainment.

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Figure legends

Figure 1:

Students’ perceptions of the level of reinforcement or extension of: (a) named theoretical biological concepts and (b) new understanding of applied concepts. Scores are on a Likert scale ranging from 1 (lowest) to 5 (highest); bars show mean; error bars show standard error.

Figure 2:

The relationship between students’ field trip marks and their Level 5 (second year) mean mark (2013 cohort = closed circles; 2012 cohort = open circles).

Figure 3:

The grade trajectory from Level 5 (second year) to Level 6 (final year) for students that attended the 2012 South Africa field course (n = 14) compared to students from the same cohort and taking the same degree, who did not attend (n = 12).

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Appendix 1 – Questionnaire

1. What biological concepts have you learned about on this trip? Please list…

2. What biological concepts have you learned about on this trip that you feel that you could not have learnt in a different environment (e.g. on a UK-based trip)? Please list…

3. What biological concepts have you learned about on the trip that you feel that you could have learnt better here than in a different environment (e.g. on a U.K.-based trip)? Please list…

4. How much have you enjoyed the trip? Please rate on a 1-5 scale (1 = not at all; 5 = very much)

5. To what extent has this trip reinforced classroom-based learning on the following theoretical concepts? Please rate on a 1-5 scale (1 = not at all; 5 = trip invaluable for reinforcing learning)

Animal behaviour	
Foraging strategies (grazing, browsing etc.)	
Animal health and welfare	
Predator-prey interactions	
Competition	
Niche partitioning	
Sampling and survey strategies	
Statistics	
Experimental design	
Environmental change	
Mapping and GIS	

6. How much have you learned on the following applied topics by being in this field course compared to being in the classroom? Please rate on a 1-5 scale (1 = not at all; 5 = trip invaluable)

Management of land for wildlife	
Motivation for conservation	
Poaching	
Hunting	
Ecological economics	
Resource management – e.g. water	

7. Has the field course been worthwhile in terms of extending your biological knowledge given the cost of the trip?

Yes
No

8. Overall, how important do you consider the following types of field courses to be in biological degree programmes? Please rate EACH OPTION on a 1-5 scale (1 = not at all; 5 = invaluable)

Trips in general
UK based trips
International trips

9. Any other comments you would like to make…