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RESEARCH NOTE

Trialling the Use of Google Apps Together with Online Marking to Enhance Collaborative Learning and Provide Effective Feedback [version 1; peer review: 2 approved with reservations]

Nicky J. D. Slee¹, Marty H. Jacobs²

¹School of Biological Sciences, University of Essex, Essex, CO4 3SQ, UK

²Learning and Development, University of Essex, Essex, CO4 3SQ, UK

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Abstract

This paper describes a new approach to an ecology practical where the cohort was divided into four groups to collect data. Each group studied a different habitat; the cohort was further subdivided into seven groups to collect field data. Each of the four groups collaborated through Google Drive on descriptions and images of the habitat site, and also collaborated at the subgroup level on their own habitat data. The four groups then shared habitat descriptions with the aim to provide enough information to enable everyone to understand entire data set.

Group work was assessed online and feedback was given at both the group and subgroup levels. At the end of the first stage, peer assignment of all the work was carried out on an individual basis to engage students in other habitats. A complete set of data was finally provided to all students, so that individuals could carry out their own analysis of all four habitats; work was again assessed online and feedback given to each individual.

The three-stage assignment from group work to peer assessment to individual analysis was a success. The collaborative work through Google Drive enabled students to produce high quality documents that were valuable for the next step. The peer assignment enabled students to gain information on expected Minimum Standards and exposed them to a variety of habitats. The final stage was open ended and challenged students. This approach is recommended but the data collection process needs modification, and students need more guidance when completing the final stage of the assignment.

Open Peer Review

Approval Status ? ?

	1	2
version 2 (revision) 10 Jan 2017		
version 1 01 Jul 2015	? view	? view
1. Kay Yeoman , University of East Anglia, Norwich, UK 2. Melanie Link-Perez , Armstrong State University, Savannah, USA		
Any reports and responses or comments on the article can be found at the end of the article.		

Keywords

Collaboration, Digital Literacy, Ecology, Fieldwork, Google Docs, Google Drive, Peer assessment, Self-Directed

This article is included in the **Teaching and communicating science in a digital age** collection.

Corresponding authors: Nicky J. D. Slee (nicola@essex.ac.uk), Marty H. Jacobs (marty@essex.ac.uk)

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Introduction

This article is aimed at university lecturers and outlines a method that enables students to enhance their knowledge and understanding of ecology by working in the field, in the lab, and online as members of a small group. The method makes use of free online tools—provided by Google—to facilitate collaborative activities that can be easily monitored by a lecturer; these activities also aim to increase the digital literacy of both the staff and students involved.

This report demonstrates that an academic with limited technological ability, but with an open mind and a small amount of support from a learning technologist, can create and manage an online assignment method that enables students to collaborate within a framework that is both defined and monitored. The approach also meets the “[Challenger Philosophy](#)” that is a key driving force at the University of Essex.

The rationale for trying new methods came from a Society for Experimental Biology (SEB) “Researchers – Teachers – Learners” conference (2012). Other influences included the concept of learner autonomy to encourage student engagement ([Scott, 2012](#)), [Voelkel’s work \(2012\)](#) on staged assignment to engage students, and the use of technology to promote student engagement and self-directed learning ([Mello, 2012](#)). The approach was also developed as part of a process to enrich large-scale teaching ([Biggs, 2003](#)) and to encourage student-student interaction, as well as student-led group work to enhance cognitive understanding.

The approach taken involved a new cohort of first-year students taking part in a three-stage assignment designed to give individuals an opportunity to gain practical experience in ecology, both in the field and in the lab, and to increase their knowledge of their local surroundings. This combined field and lab work represented 50% of the practical work associated with their first year ecology module (BS111). The students gained first-hand knowledge of one field site and this, together with the group work, gave them the confidence to analyse data from other unfamiliar habitats; [Scott et al. \(2012\)](#) concluded that first-hand exposure to field work enhanced pupils’ knowledge in ecology, and thus made them capable of engaging in self-directed learning. It was hoped that the practical work would give students a feeling of ownership over the data collected, and hence make it possible for them to take part in self-directed tasks connected with their data, as well as associated unrelated data (which the students would be able to contextualise through their hands-on experience of collecting data at one of the other four habitats).

It was also hoped that this new approach would help the students—new to university life—make the transition from the small group session format popular at most colleges, to the large group teaching scenarios that are commonplace within a university setting. The divided practical work aimed to create a small, friendly atmosphere which would enable students to ask each other questions, and encourage them to engage in discussion with the Graduate Lab Assistant or academic leading the group.

The students were given open-ended templates to enable creativity within the parameters of the standards required. This fulfils the educator’s task to create an environment with a high level of

control where student learning is possible ([Brown, 2004](#)). Brown states that a series of tasks are needed to enable successful learning, and that students should start with simple tasks, but later be challenged to complete more complex work. With this in mind, students were first asked to produce group documents; these documents were then used by the whole cohort for peer assignment, and then by the lecturer as a means to accurately assess each student’s contribution to the task as a whole.

Students regularly work in pairs for practical tasks (School of Biological Sciences, University of Essex), but generally write up reports independently. However, scientific research papers are frequently written by multiple authors. Therefore, another aim of the assignment was to teach students to work collaboratively, using digital tools and self-directed methods, to produce work that met with Minimum Undergraduate Standards. See [School of Biological Sciences UG Handbook](#) for full details of these standards.

The Google Apps service was selected to support the assignment process because Google is a familiar brand and is responsible for running the world’s most popular search engine; it was understood that this familiarity would make engagement more likely. Ease of access and versatility were also important deciding factors when selecting technology to support the assignment. Office 365 and wiki tools were also considered when deciding what technology to use, as they can both be used for online collaborative tasks ([Doolan, 2007](#)). However, the Google Apps service has a stronger emphasis on real-time collaboration. Also, the various apps use concepts that students are already familiar with (borrowing several features from traditional office software packages). Google Docs has also been used for effective collaborative English Language Learning ([Hosseini, 2014](#)) and has been used by business schools in a similar manner (see [unpublished paper by Schneckenberg](#)) and the apps enable multiple users to work on a single document via a web browser. The document owner can also retrieve an earlier version if necessary. Knowledge can be created, edited and exchanged ([Doolan, 2007](#)) which empowers learners to develop team skills. By using a platform not controlled by the University, students were given greater ownership of the learning environment, which helped with engagement and motivation.

The rationale for a three-stage process of assignment was to encourage students to engage in tasks outside of their comfort zone, and to enhance deep learning rather than surface learning ([Biggs, 2003](#); [Rust, 2008](#)). The multi-staged assignment was also designed to promote student engagement at each stage of the assignment ([Brown, 2004](#); [Voelkel, 2012](#)).

A summative assignment was used to improve student engagement in the task. A peer assignment element was also included to promote a deep learning strategy ([Biggs, 2003](#)). (The quality of the peer assignment activity was also a key component of the summative assignment.) The learning outcome of engagement in peer assignment is twofold: the students were exposed to the other habitats they did not visit, which helped them with their independent task, and, secondly, the peer assignment process forced students to understand task requirements and, as a result, involved them in a deeper learning experience ([Biggs, 2003](#)).

Methods

A new cohort of students (n=76), from the School of Biological Sciences, taking a first-year module in Ecology (BS111) were involved in the assignment. Five students did not submit work for the collaborative coursework and four did not complete any part of the three-stage assignment. There may be a variety of reasons why students failed to submit work, e.g. transferring to another module.

Two practical sessions were used to carry out fieldwork, followed up by subsequent analysis of samples in the laboratory. The cohort was divided into four groups of 20, which, in turn, were split into 7 subgroups.

The assignment was split into three stages:

1. **Collaborative work (group & subgroup collaboration)** - By working within one of the four groups on shared Google Slides and Docs files. Each group worked on their own set of documents. The seven subgroups within each group used a separate shared Google Sheets file to record their dataset.
2. **Peer assignment** - This involved individual assessment of the group work, to make all students engage in the group work data from all sites, and also demonstrate their gained knowledge of the Minimum Undergraduate Standards.
3. **Independent work** - To produce a document for individual assessment.

Stage 1 of assignment: collaborative work (Group & subgroup collaboration)

Due to the early scheduling of the practical session in the autumn term, it was not possible to have a lecture to prepare the students prior to the session. Therefore, information was disseminated via Moodle, the University's Learning Management System, and through a PowerPoint presentation given during one of the first practical sessions of the term.

Each group (W, X, Y and Z) went to a different habitat on campus. The habitats used were as follows:

- Group W - Benton's Top Heath & Hay Meadows (Site Number 16).
- Group X - Bluebell Wood (Site Number 15).
- Group Y - Kingfisher Lake (Site Number 14).
- Group Z - Campus farm and pond (Site Number 13).

(For more information about these habitats and site numbers, visit the University's [biodiversity web page](#).)

Each subgroup collected data from two quadrats within their selected habitat and samples of soil, plants and invertebrates were taken for further analysis in the laboratory. The site was also over-viewed to assess different plant species, whether monocot or dicot, and allocated a code to be used by the group. Samples and photos

were also taken. This information was used during data collection from the quadrats which were thrown randomly, twice per subgroup. Field measurements taken included a number of different types of plant species, percentage cover for each species, and bare ground.

Additionally, point quadrat was used to assess the height of the vegetation at 10 cm intervals across the quadrat and also to determine the number of hits (e.g. number of leaves contacted before the pin hits the ground when following a vertical path). Temperature of air, plant (IR temperature gun) and soil (temperature probe) were also recorded. Soil was assessed in the field for dampness, odour, and colour. A sample was taken from the centre of the quadrat using a trowel to a depth of 10 cm. The vegetation was put in one labelled sample bag and the soil in a second. In the lab, fresh and dry weight measurements were determined for the vegetation and a subsample of the mixed soil core. Soil samples were also analysed for pH using the method described in the soil test kits (Palintest, 1997); texture was determined from feeling wet and dry samples, and from sedimentation profiles and porosity. Plant samples collected at group level were identified and the range and type of invertebrates found in soil samples were recorded.

Instructions were given via Moodle and verbally during a practical session, so that each student could create a personal Google Account; in addition, a handwritten record of their account details was collected during this practical sessions. Students were instructed to navigate to <https://drive.google.com/> to access the Google Apps service.

The lecturer created a folder for the module (BS111) containing four group folders (labelled W, X, Y and Z). Within the group folders there was one folder that was shared at the group level and seven subfolders, each shared only with the relevant subgroup. The Google Drive desktop application was used to duplicate a template folder/file structure, as this proved to be much more time efficient than creating all of the folders and files through the web interface (see [this support article](#) for more details about the desktop application and how it works).

Each group folder (X to Z) contained two template documents: a Google Docs file called "BS111 Practical 1 Description of Habitat" (see [Supplementary materials 1](#) and a Google Slides file named "BS111 Photo Submission for Group Work ([Supplementary materials 2](#)); the group folder was shared with all students in the group, who were granted full editing rights over the content of the folder. Within each group folder there were a further seven separate sub-folders; these folders contained the Google Sheets document for the data collection task, and were only shared with members of the subgroup. The Google Sheets included pre-formatted tables, with some of the column headers already containing units. The documents at the group and subgroup level also contained inline instructions for the collaborative work ([Supplementary materials 3](#) for example).

Students worked collaboratively at the subgroup and group level; each student downloaded a copy of the Slides and Docs file that was then uploaded to the University's online coursework submission service (FASER). The group Slides and Docs files were exported as PDF files and the data collection Sheets were exported in Excel format (to make further manipulation possible).

Once this point was reached, the lecturer removed the editing rights of the students in Google Drive, so that further editing was not possible, effectively making all of the collaborative documents “read only”. The documents were then uploaded to Moodle and students used these copies for stages 2 and 3 of the assignment.

The lecturer also established a discussion forum site on the BS111 Moodle page to facilitate student discussion of the fieldwork.

Stage 2 of assignment: Peer assignment

A *pro forma* for peer assignment was issued to the students (see [Supplementary materials 4](#)). Each student peer assessed the other group work (including the subgroup data collection sheet). This was worth 10% of the overall assignment mark.

The lecturer assessed two aspects of the student peer assignment process:

1. Evidence of engagement in peer assignment, which required students to review information produced by the other groups and subgroups for the other three habitats;
2. Evidence of engagement/research into definition of question terms used and correct application of Minimum Undergraduate Standards.

Stage 3 of assignment: Independent work

Printed instructions, also available in Moodle, were issued. The final part of the assignment was individual analysis of the four habitats for patterns, correlations, variability and species richness. This was an open-ended task (see [Supplementary materials 5](#)), facilitated by a guidance file (Excel document), which was provided on Moodle for download. Students requested further help and support, which was subsequently given.

The individual assignment files were uploaded to FASER by each student. Electronic marking and feedback was returned at an individual level via FASER.

Results

As in the previous section, the results have been sorted into the three distinct stages of the assignment to ease understanding.

Stage 1 of assignment: Collaborative work (Group & subgroup collaboration)

The students mainly succeeded in setting up Google Accounts, and the lecturer shared the documents at the appropriate level to enable group work in Google Drive. Handwritten records of the student Google Accounts were nearly complete for two of the four groups; the other two groups emailed the missing account details to the lecturer. There was a good level of online collaboration, evidenced by the group-level documents. The group work demonstrated that students were more aware of the campus grounds, and had an increased understanding of ecology through collecting and analysing the biotic and abiotic characteristics of the campus habitats.

Three groups successfully collected all of the expected field data; the fourth group collected half the expected amount, i.e. from single quadrats rather than two. A considerable amount of data was collected within the two three-hour practical sessions. This involved a lot of collaboration in the field, as well as in the lab, to ensure data sampling and recording was accurate.

Students successfully accessed the documents on Google Drive to create a written description of the habitat. All groups also managed to curate photographs of the habitat site and plant species found using Google Slides. Self-directed learning clearly took place during the creation of the group documents, which surpassed the expectations of the lecturer in terms of overall quality and attention to detail. The descriptions and figures for the submissions were of a very high standard, especially considering the students had no formal training on expected undergraduate academic standards.

An example of the type of data created from one group (X) can be seen in [Figure 1](#); it shows the habitat site ‘The Bluebell Wood’ and one of the plants identified, *Plantago major* ([Figure 2](#)). This data demonstrates that students did research the Minimum Undergraduate

Figure 13: The Edge of the Bluebell Wood

Notes:

The Bluebell Wood is located at the shelter belt alongside the main road from the lake to the middle lodge. It is the woodland along Clinghoe Hill Road.

Figure 1. Example of student generated Google Slide of habitat from Stage 1 of assignment.

Figure 2 : Greater Plantain (*Plantago major*)

Notes :

The Greater Plantain (*Plantago major*) commonly known as rat tails, is identified as a monocotyledon from its distinct fibrous root and parallel veins. It is a perennial plant that is pollinated by wind distribution of seeds and can produce as many as 1,500 seeds per individual. The dark green leaves lie close to the ground and form a rosette at the base. There are few veins present on the leaves, and the flowers are borne on a long narrow spike that gives the plant its nickname (rat tail). The leaves and spikes themselves are very resistant to trampling by feet, and can sometimes even harm the thing that trampled on it, giving a small bruise or cut. Consequently, this plant can also be used to treat ulcers and sores, as it has been used in Britain. It is very widespread in the area and has even been used to create bread (way-bread).

Figure 2. Example of student generated Google Slide of plant from Stage 1 of assignment.

Standards required, as evidenced by the correct use of binomial names and the use and position of figure legends. **Figure 3a** provides evidence that the students engaged in the task, researching and identifying plants to species-level. They produced a high quality document with expected standards, all within six weeks of arriving at university. In general, correct standards were applied to the group level documents. The task instructions were purposely brief to enable students to make their own contribution. **Figure 1** and **Figure 2** show that some students used this opportunity to deepen their learning and understanding; the inclusion of additional notes shows that several groups were engaging in high quality research into their allocated habitat and the species discovered there (**Figure 3a**).

The Google Sheets data, collected during the subgroup task, highlighted a greater range of student ability and was less successful overall. Raw and calculated data were expected; the submitted data ranged from no data, incomplete data sets, to data sets complying with Minimum Undergraduate Standards.

The approach required students to be responsible for keeping data safe until it was inputted online, and to understand the Minimum Undergraduate Standards for tables. Evidence suggests that many students were unaware of these expectations, as more than one of the data sheets had no data submitted and many others contained data with the units in the body of the table.

The small size of the subgroups meant that there was greater variation in the standard of work. (This is to be expected for normal distribution of data.) This demonstrates that the subgroups were working within the team that they were assigned to. The large number of

data sheets generated (21) meant it was difficult to quickly achieve a single, combined dataset in a format that was suitable for the students to access for the second and third parts of the assignment. The deadline for the assignment was adjusted to take account of the time needed to collate and disseminate the data to the cohort.

Interesting group dynamics were evident from monitoring the Google Drive activity. Members of one group engaged in the process very actively, and some members became natural leaders. These leaders then became a little too controlling and removed the other group members' editing permissions. The lecturer intervened by sending an email out via Moodle to let them know this was not acceptable behaviour, and reinstated the permissions for all group members. Students used the Moodle forum after this intervention. The students also engaged in group discussions using the Google Apps comments feature. This was particularly useful when students were refining their documents; the comments stream acted as a private, student-led forum for discussion.

Stage 2 of assignment: Peer assignment

The second part of the assignment, the peer assignment of the group work, was aimed at making students aware of the marking process and the criteria that the final individual work would be marked against (questions set and standards expected). The process also exposed individuals to the entire dataset collected. By engaging students in peer review of the document and data collected, it was hoped that individuals would become familiar with the habitats they had not visited, and not just rely on the site that they were actively involved in.

a

Group Number/Code: 15 / X	Habitat Site: Bluebell Wood
---------------------------	-----------------------------

Description:

The habitat that we sampled in was located at the edge of Bluebell Wood. It was a small area, about 10m x 10m, with a mix of grass and bare earth. The vegetation was scattered around in small patches within the area and they were cut short along with the grass. We sampled the vegetation growing above the cut line. There were also leaves scattered around the roots of the trees from the tree itself, but not a large amount giving the impression that leaves are raked to keep the area clear. This allowed us to make the assumption that the area is managed in a specific way, and most likely managed quite often to prevent the grass growing too high. This could possibly limit various plant species growth in the area, possibly weeds if the maintenance of the area includes weeding, especially around roots of the trees.

Due to the grass in the sampling area was moist and the subsequent patches of bare earth (the exposed soil with little or no vegetation) was muddy. Near to the sampling area, between the parallel row of trees that are planted on the walk to the treelines that grow parallel to each other, with the trees providing a moderate amount of shade for species of plants growing beneath them. One of the most important factors that had impact on our results were habitat conditions.

Many species of plants were identified scattered around the trees and in the field, such as Creeping Thistle (*Cirsium arvense*), Plantain (*Plantago*), Creeping Buttercup (*Ranunculus repens*), Chickweed (*Stellaria media*), Broad Leaf Dock (*Rumex obtusifolius*), Agrimonia (*Agrimonia eupatoria*), Ragwort (*Senecio jacobaea*), Yarrow (*Achillea millefolium*) and two different species of Grass that could not otherwise be specifically identified. There were some other species present but they could not be accurately identified as we did not have enough information for proper identification.

These habitat conditions differed in the two general areas that we took our samples from. One area was mainly sunny, but had some shade in smaller patches. Medium sized grass was observed growing on small mounds. Air temperature was generally around 13 degrees Celsius, but in the areas exposed to the sun, the temperature did reach the high teens. The soil had a damp texture due to heavy rainfall the day before. The grass was shorter in this area than further into the forest due to groundskeepers periodically cutting it, limiting its height and potentially damaging it. The sampled area had a uniform covering of plant life with no bare earth visible. The other sampled area was in the shade of a few trees so the ground was exposed to less sunlight and rainfall, the effect of which could be seen in the fact that plants were scattered in small patches and there was a presence of more bare patches. The earth was more dry and crumbly in this location and there were small stones.

b

Comments List (7)

Find

nicola +
Page 1 13/11/2014 11:15:46
Good to start with habitat, add more details about location, Colchester campus

nicola +
Page 1 13/11/2014 11:16:17
Avoid we as this is a personal style.

nicola +
Page 1 13/11/2014 11:18:14
This is a reason, do not include for descriptions. Many examples in this paragraph were your opinions are expressed. You include these if you were asked to explain.

T nicola +
Page 1 13/11/2014 11:16:38
Good details of plants, including common and binomial names, using correct conventions

nicola +
Page 2 13/11/2014 11:18:50
Good details of plants, including common and binomial names, using correct conventions

nicola +
Page 2 13/11/2014 11:19:37
Repetition of comments already made about weather.

nicola +
Page 2 13/11/2014 11:20:06
Good

Figure 3. (a) Example of feedback comments on descriptive task of stage 1 of assignment. **(b)** Lecturer comments added to student descriptive task in Figure 3a.

The peer assignment required students to look at the eight group documents, descriptions and figures of the four habitats, as well as the 28 data sheets. A high proportion of students fully engaged in the task (68.4%), i.e. they reviewed the minimum standards and used their observations to peer assess the work of the other three groups (see Figure 4 for an example). This enabled them to achieve greater than a 2.1 mark for the task. It was also found that 52% of students obtaining a first class mark for the peer assignment also obtained a first class mark for their independent work.

A number of students struggled with the peer assignment process. The assignments in these cases had arbitrary marking patterns and over-inflated scores, e.g. 5/5, and comments were very brief or absent. 5.3% of students obtained lower second class marks for this second stage of the assignment and demonstrated that they had limited knowledge of expected requirements and types of answers.

The last set of students (26%) did not engage in stage 2 of the assignment at all. There was no evidence that these students knew

about Minimum Undergraduate Standards and this was reflected in the work they submitted for stage 3, as the maximum mark obtained for this set of students was 55%.

Stage 3 of assignment: Independent work

The independent work was an open-ended task that challenged the students to work within, and then beyond, their current knowledge base, e.g. use the tutorial guidance to find out about how to carry out averages and correlation. Students also needed to write some accompanying text. The initial tasks (e.g. finding averages) should have been accessible to all students. Stage 3 assumed that stages 1 & 2 had been achieved to a high standard. However, the data sheets between subgroups were not consistent—one group had a complete data set missing and other groups had sheets with incomplete data.

The endpoint of the entire assignment was to carry out correlations to establish if there were any discernible patterns in the data from the different habitats. Students found that the data sheets were not in a suitable format to enable correlation, and had to make difficult

BS111 Practical 2& 3 Correlation of species richness to soil properties

Student Name: XXXXXXXXXX

Group: Z

Date 04/11/14

Peer Assessment form for other groups: W, X and Y

Element	Requirements	Score Group W	Score Group X	Score Group Y
1. Written description of the habitat	Minimum Standards : Sentences, with descriptive words , no explanation, good grammar, no/few spelling mistakes	3/5 Grammar good, but mistake regarding tense. Describe is factual recall, but included interpretation of factors.	4/5 Sentence structure and wording concise. However different font sizes were used within the text	3/5 Slight grammar mistakes including missing full stop. Simple descriptive words
2. Provide Photos of site & some of the species	Range of photos of habitat and close up of species (12 – 20 photos) Fig number and title below photo (labeling if appropriate)	4/5 Included species and habitat photographs. Some photos out of focus (e.g. fig. 11). The photos of species were zoomed out, perhaps not the appropriate level of detail.	4/5 Effective use of notes to give further species description of species. Clear photos of species, including plain background. A few photos of poor quality (e.g. fig. 14 & 16)	3/5 Lots of general habitat photos and not enough of species. Didn't include any specifically named species identification. Fig. 15 was a repeat of fig. 14.
3. Provide data obtained from quadrat analysis and subsequent lab work	Tabulated data applying Minimum standards.	2/5 Lots of data missing. Units were included in the table rather than the heading. Some data from the same grouping was not to the same number of decimal places	4/5 One of the sub groups had data missing. Units included in the table. Come cases where the number of decimal places were not uniform.	4/5 Missing data for a few entries. Cases where the same number of decimal places not uniform. Few sub groups included units in their tables.
Overall comment:				
Best aspect with reasons why	Group X's species photographs because the photos were clear, showed close ups and the use of annotation included further detail on species.			
Area that needs most improvement and why	Consistent data collection, because there was data missing throughout tables and this data was not always uniform e.g. to the same number of decimal places.			

2

Comment [njds1]: Good analysis, and understanding of requirements needed for assessment and areas that needs to be improved most.

Figure 4. Example of a good individual student peer assignment task, stage 2 of assignment.

decisions on what data to include/exclude and how to standardise the results. As a consequence, the students asked for guidance on sorting and analysing the data. Some individuals became stressed, evidenced by emails sent to the lecturer. An emergency tutorial was run in a computer lab to support these students; however some had overcome these issues by that stage, e.g. they had produced correlation tables and figures which they submitted in their individual assignment (see Figure 5 and Figure 6). During the tutorial, the

majority of the attendees felt anxious because they had not achieved the ultimate endpoint of the assignment. As a result, the task was modified to include a simpler outcome that they could achieve. Students had put a huge amount of time into the activity; the lecturer feedback indicated that they had done well and listed achievements for figures and descriptions, and highlighted the fact that most had created tables and figures that mainly complied with expected academic standards.

Table 2: The recorded invertebrate data found from each habitat; W, X, Y and Z

Invertebrate type	Habitat W	Habitat X	Habitat Y	Habitat Z
Spider	yes	yes	no	no
Beetle Larva	yes	no	no	no
Centipede	yes	yes	yes	yes
Millipede	yes	yes	no	yes
Worm	yes	yes	yes	yes
Nematode	yes	no	no	no
Wood louse	no	yes	no	yes
Beetle	no	yes	no	no
Fly	no	yes	no	no
Caterpillar	no	yes	no	no
Ants	no	yes	yes	yes
Weevil	no	no	yes	no
Mite	no	no	no	yes
Geophilomorpha	no	yes	no	no
Insect larvae	no	no	yes	yes

Figure 1: The number of different invertebrate species found in each of the habitats; W, X, Y and Z

Table 3: The recorded plant identification data from each habitat; W, X, Y and Z

Plant Type	Habitat W	Habitat X	Habitat Y	Habitat Z
Creeping Thistle	yes	yes	no	no
Plantain	yes	yes	yes	yes
Speedwell	yes	no	no	yes
Buttercup	yes	no	no	no
Grass	yes	yes	yes	yes
Ragwort	yes	yes	no	yes
Chickweed	yes	yes	no	no
Creeping Buttercup	no	yes	no	no
Yarrow	no	yes	no	yes
Agrimonia	no	yes	no	no
Broad leaf Dock	no	yes	no	no
Clover	no	no	yes	yes
Dandelion	no	no	yes	yes
Small Thistle	no	no	yes	no
Moss	no	no	yes	yes
Daisy	no	no	no	yes

Figure 2: The number of different plant species found at each of the different habitats; W, X, Y and Z

Comment [N1]: Add habitat locations as well as codes; add binomial names for plants.

Figure 5. Demonstrating how a capable student sorted the class data for stage 3.

Table 9: the correlation between the number of Dicot species and the soil pH

	No. of Dicot species.	soil pH
No. of Dicot species.	1	
soil pH	0.568810261	1

Figure 3: The positive correlation between the number of dicot species and the soil pH at each of the habitats; W, X, Y and Z**Figure 6.** Demonstrating how a capable student sorted the class data to produce correlation figure (stage 3).

Dataset 1. Raw data for 'Trialling the use of Google Apps together with online marking to enhance collaborative learning and provide effective feedback'

<http://dx.doi.org/10.5256/f1000research.6520.d50329>

Mark review stages 2 & 3 for BS111 2014: Raw Data with information on manipulation (Slee & Jacobs, 2015).

Discussion/Conclusions

The three-stage assignment was a successful learning experience for most of the students involved, who had no prior knowledge of Google Drive or the collaborative Google Apps learning tools. The lecturer embraced the University ethos which involves being tenacious, bold and challenging. The collaborative activity stretched the lecturer as well as the students; both learnt how to use these new technologies together.

Stage 1 of assignment: Collaborative work (Group & subgroup collaboration)

The division of the cohort into four smaller learning groups and seven subgroups provided an effective and friendly environment for practical work, which provided a good situation to meet the challenge of online collaborative work. However, improved management,

e.g. rotating the groups around the laboratory-based activities, would increase the efficiency and reduce the pressure on the limited equipment available in the laboratory.

It was evident from the practicals and data collection stage that there was too much data to collect and analyse; this could be simplified in the future, e.g. reduce sample collection to one quadrat per sub group. This would decrease the time pressure for staff and students during the practical sessions and would also simplify the class data set.

A better system is needed for subgroup data collection, as the method used was cumbersome and not as effective as alternative methods. Other options include the use of a single document at the group level; use of electronic voting devices (clickers) to collect data, or the use of an online form to collect class data in a standard format (Google also have a tool to facilitate this). This would help team leaders provide class data in a usable form. These alternative approaches would make it easier (and quicker) for students to collect and clean the data.

Students collaborated within Google Drive and, in some cases, managed to produce high quality documents (Figure 1 to Figure 3). There was a noticeable variation of style between the four groups.

This indicates that students worked within their own group and were not using other mechanisms to exchange information with other students outside of their allocated group. Therefore this part of the assignment met its intended learning outcomes.

The group work, together with the use of comments within Google Docs, demonstrates that students engaged in self-directed learning. The open-ended nature of the assignments allowed the students to deepen their learning, which is evident from research notes added to [Figure 1](#) and [Figure 2](#). Students demonstrated emergent behaviour, which included self-discovery of features in Google Apps, e.g. the discussion stream and document permission settings, which suggests student-student learning took place. Therefore, this met the intended outcome of this approach.

During the group work, it emerged that students were using three methods of electronic communication, e.g. discussing and using comments and emails in Google Drive; using the Moodle forum, and also emailing each other via Outlook. The communication tools within Google Drive were most advantageous, as they acted as a private forum for student discussion. The disadvantage of the Moodle forum was that it was accessible to the whole cohort rather than just the group. Also, more importantly, all lecturers teaching first year modules in the School of Biological Science were able to see comments made; this might colour a lecturer's view of a particular student when setting and marking their future work. Therefore, it would be wise if the lecturer directed the students to a single method (most likely within the Google ecosystem) as this would avoid such problems.

The success of the three-stage assignment required the rapid creation and collection of Google Account details from students. Overall this worked well, but students who didn't create accounts did not create any evidence of collaboration, hence did not pass stage 1 of the assignment. Reasons for lack of student engagement were varied: some individuals were reluctant to try something new, others distrusted the online services, and a few didn't want to put their data in the "Google cloud". Another possible reason for this poor engagement is the timing of the task; it took place early in the term, so students had to contend with many new things, such as some subgroup members changing degree schemes.

In the future, it would be advantageous to use Google Apps for Education or the Microsoft Office 365 suite of tools, as all members of the University have access to both of these services now. (However, Office 365 would only be used if the collaboration features are as good as those found in Google Drive.)

Using Google Apps for Education would give the lecturer greater control, e.g. the ability to establish student accounts for Google Drive before the start of the practical session. Google takes the education arm of its business very seriously, which should reassure students that their data is safe. Showing the students a short video revealing the security measures that Google enforces at its data centres would perhaps ease any concern, e.g. [Inside a Google data center](#). Getting students to look at the [Google Drive privacy policies and terms of service](#) would also be helpful.

Using Google Drive/Apps did make it a little difficult to see which students had done what, as the activity updates are presented as one continuous stream of information. Using Google Apps for Education would also help improve this situation.

It would be possible to provide formative feedback for the stage 1 work rather than wait for formal feedback. This environment is good for self-directed learning, experimentation, and for encouraging informal communication (which will help students engage at a deeper level and help with a more comprehensive understanding of the subject).

Stage 2 of assignment: Peer assignment

The peer assignment provided the link between the group and individual work. It also ensured that the students engaged in data that they were not involved in creating. Those students who engaged in the peer assignment activity went on to do a more thorough individual report (third stage of the assignment). This was in stark contrast to the students who had dealt with the peer assignment superficially, who achieved a much lower score.

Stage 2 enabled students to regain entry into the assignment process if they had failed to complete stage 1. By engaging students at this stage of the assignment, it was hoped that they would become familiar with the habitats they had not visited and not just rely on the site they sampled. Students did analyse all of the data sets, so the peer assignment activity met its intended aim.

Stage 3 of assignment: Independent work

For the third stage of the assignment, some students used the tutorial and managed to achieve all of the expected outcomes, i.e. correlation figures and identified plants to species level through their own endeavours ([Figure 5](#) and [Figure 6](#)). It is important to let students know that there is no correct answer expected, and that the assignment is designed to force them to work outside of their comfort zone.

The fact that there were three stages to the assignment allowed any student not succeeding at a particular stage to still be successful at a later stage. Another benefit of this staggered approach was that it required a variety of skills for completion, thus enabled a diverse range of learners to succeed at one or more parts of the assignment.

The overall assignment demanded a high level of engagement, so students who succeeded were clearly involved in a deep learning experience. Many students met this challenge, but some became stressed as they had other assignments to carry out in the same time frame; there was a definite cost versus benefit relationship between the stress created and the learning achieved. To increase the balance towards increased learning, rather than increased stress, a simpler data set together with a more directed final assignment, with some scope for an open-ended approach, will be used in the future.

Finally, the collaborative behaviour that students took part in represents the development of important transferable life skills. The students have been encouraged to use Google Apps for their third year project (but this time they took ownership rather than the lecturer).

Data availability

F1000Research: Dataset 1. Raw data for ‘Trialling the use of Google Apps together with online marking to enhance collaborative learning and provide effective feedback’, [10.5256/f1000research.6520.d50329](https://doi.org/10.5256/f1000research.6520.d50329)

Consent

Consent has been obtained from BS111 students using an electronic voting system and only students giving consent had data used.

Author contributions

Nicola Slee (NS) and Marty Jacobs (MJ) conceived the study. NS designed the experiments. MJ carried out the research and training of Google Drive collaborative tools and integration with FASER. MJ provided support to NS and BS111 students. NS contributed to

the design of experiments and assignments. NS and MJ prepared the first draft of the manuscript and preparation of the manuscript. All authors were involved in the revision of the draft manuscript and have agreed to the final content.

Competing interests

The authors declared no competing interests.

Grant information

The author(s) declared that no grants were involved in supporting this work.

Acknowledgements

We would like to thank Students of BS111 (2014–15) for their participation and granting permission to use their data in this research note. Also, we would like to show our appreciation to Google for their provision of free tools and resources.

Supplementary materials

Supplementary materials 1: Google Docs document instructions

Aim to apply minimum Undergraduate Standards of Presentation. See Undergraduate Handbook for Guidance: http://www.essex.ac.uk/bs/current_students/default.aspx (see page 27–32).

Provide a written description of the habitat you visited and sampled including details of its location. Apply Minimum Undergraduate Standards of Presentation and appropriate details for term “Describe” (see Undergraduate Handbook for guidance). Ideal word count 500–750 words.

[10% of overall mark Practical 2 and 3.]

Supplementary materials 2: Google Slides document instructions

Provide photos of site and some of the species found. Apply standards required for figures (See guidance in Undergraduate Handbook, section on Minimum Standards of Presentation Diagram/Figures). Ideal number of Figures: 12–20.

[10% of overall mark Practical 2 and 3.]

Supplementary materials 3: Google Sheets document instructions

BS111 Ecology Practical 2 and 3
Part A Subgroup Data Sheet

It is important that you all access your own version of this via your Google Drive. Divide the tasks up, e.g. for your subgroup one member can put in raw data information from data sheets, one member can work on calculation needed, other members to check.

One member to check requirements of Minimum Undergraduate Standards for tables, and apply them.

One member can cross-check with descriptions and photos for details on species identification.

Final version to be downloaded as an Excel document from Google Drive. The final version will be uploaded to the BS111 Moodle page after the Part A deadline to be used for Part B (evaluation and analysis).

This will be worth 10% of your assignment.

Add units, etc, to comply with Minimum Undergraduate Standards.

Supplementary materials 4: Peer assignment

Worksheet for BS111 Practicals 2 & 3 Part B: Individual submission:

Aim to apply minimum Undergraduate Standards of Presentation. See Undergraduate Handbook for Guidance) http://www.essex.ac.uk/bs/current_students/default.aspx (see page 27–32).

Using all the group data that is accessible on Moodle BS111 i.e.

The written description of the 4 different habitats; photos of habitats and plant species of the four sites and group data from quadrats, cores that included vegetation, soil, invertebrate analysis carry out the following for this worksheet.

Part B submission: (Stage 2 & 3)

Work to be assessed (see Practical 2 & 3 Part B):

1. Peer assessment & submitted with Part B. Use the Peer assessment form from the BS111 Practical 2 & 3 handbook to assess the other groups information on

[10% of overall mark Pract 2 & 3].

Instructions:

1. Access the group data which will be uploaded to Moodle in section for BS111 Practical 2 & 3. Using Peer assessment form peer assess the following:
 - a. Group descriptions for each habitat (excluding own group).
 - b. Figures of the site and species (excluding own group).
 - c. Group data sheets (excluding own group).

Use the FEEDBACK Checklist of Expectations and Common Errors to guide you in your peer assessment & Minimum Undergraduate Standards (p27–32 of Undergraduate Handbook).

Use Guidance given in instructions and example excel workbook.

Worksheet for BS111 Practical 2 & 3 Part B:

Individual work submission:

1. BS111 Practical 2 & 3 Peer Assessment form.

[10% of overall mark Pract 2 & 3, part of Part B mark.]

Student Name: Group: Date:					
Peer Assessment form for other groups: W, X, Y, Z (delete as appropriate)					
Element	Requirements	Score Group W (/5)	Score Group X (/5)	Score Group Y (/5)	Score Group Z (/5)
1. Written description of the habitat	Minimum Standards : Sentences, with descriptive words, no explanation, good grammar, no/few spelling mistakes				
2. Provide Photos of site & some of the species	Range of photos of habitat and close up of species (12 – 20 photos) Figure number and title below photo (labeling if appropriate)				
3. Provide data obtained from quadrat analysis and subsequent lab work	Tabulated data applying Minimum standards.				
Overall comment: (exclude your group which is -----)					

Supplementary materials 5: Individual assignment: Feedback sheet and instructions for individual work
Feedback sheet used by students to complete Peer assignment task and used by lecturer for Stage 3 assessment.

Student Name: _____

FEEDBACK SHEET FOR YEAR 1 FOR BS111.2 & 3 Part B:

COMMENTS: (Good points/areas for improvement)

Text (written answers)

GOOD POINTS	BAD POINTS	COMMENT
Neat presentation	Careless, untidy presentation	
Clear answers	Points not made clearly	
Concise writing style	Waffle and irrelevant material	
Legible	Difficult to read writing	
No/few spelling mistakes	Many spelling mistakes	
Good grammar	Poor grammar	
Correct units always included	Units missing/wrong/poor choice (e.g. 1.2 ml, not 1200 µl)	
Correct number of d.p.	Excessive d.p. used	

Figures

GOOD POINTS	BAD POINTS	COMMENT
Numbered consecutively	Not always given a number	
Number and title together BELOW	Titles sometimes above or beside figure	
Title concise and contains all key information	Title too brief/long or missing important details	
Figure fully and neatly labelled	Untidy/inappropriate labels	
Sharp hard pencil used for drawing, scale included where appropriate	No scale Blunt soft pencil	
Axes always labelled on graphs, units included	Poor/un-labelled/units missing	
Good choice of graph type: line or bar chart (continuous or discontinuous data)	Inappropriate format selected	
Grouped data presented	Raw/individual data presented	

Tables

GOOD POINTS	BAD POINTS	COMMENT
Numbered consecutively	Not always a number	
Number and title together ABOVE the table	Titles sometimes below table	
Title concise and contains all key information	Title too brief/long or missing important details	
Neat layout	Gridlines not drawn with a ruler or untidy	
Appropriate headings	Headings missing/unclear	

Part 3: Mark out of 60

Part 3: Assignment of Marks for Stage 2 Assignment: Individual Submission

Stage 3: Instructions for Individual Work to be assessed (see Practical 2 & 3 Part B):

Questions

1. Individual evaluation of class data on the 4 habitats. Details

You will have access to 3 excel documents that will provide you with

1. Information and examples of the types of analysis to carry out.
2. Class data for the four habitat sites in one workbook where each habitat will have a separate page in the excel workbook. There is also the original downloaded subgroup data in another excel workbook.
3. In the class data workbook, save with your surname BS111 2 & 3 Part B then **Analyse to determine habitats species richness and variability in habitats following quadrat sampling & further laboratory analysis: Some guidelines of potential analysis.**
 - a. For each habitat calculate the average, standard deviation and standard error for each parameters (numerical data), just a few are shown in the example document.

- b. Tabulate the average data into a new table (must comply with Minimum Undergraduate Standards).
- c. Decide how many dp are appropriate for numbers.
- d. Past Table(s) & if appropriate Figures into word document, reformat as necessary to comply with expected standards.
- e. **Analysis of data to find out if there are patterns and correlations in the habitats investigated.** See information at the end of worksheet on how to carry out analysis.
- f. Your aim is to create a correlation table of the different parameter,
- g. Work out if there is a significant correlation between the different factors.
- h. For two significant correlations produce figures of the scatter plots of the data but add a different symbol or colour for the different habitat sites. (See examples on example sheet).
- i. Past relevant tables and Figures in this document of correlation data.

Steps e to i became a bonus section

- j. Write your interpretation of the determine habitats species richness and variability in habitats results in text box (ideal word count <750 words).

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Open Peer Review

Current Peer Review Status: ? ?

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Reviewer Report 20 July 2015

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Melanie Link-Perez

Department of Biology, Armstrong State University, Savannah, GA, USA

This article describes a multiple-week ecological exercise that has both field and laboratory components and combines opportunities for collaborative learning, peer assessment, and individual work, with instructor feedback included at several stages. An important component of the three-stage assignment is the pivotal role of technology, in the form of free Google online tools, in order to facilitate the collaboration between students and the delivery of feedback from the instructor. The introduction does a nice job of providing context and articulating the rationale behind the design of the method described. The assignment is well-conceived, and there is a natural progression from group work and collaboration toward individual demonstration of learning outcomes. Especially valuable is the opportunity for the students to engage in assessment of their peers, a high-impact activity that the authors noted led to higher achievement in the final stage of the assignment for those students who fully participated in the peer-review. This method should be easy to implement for instructors willing to do so.

General comments to consider during revision:

- Change “peer assignment” to “peer assessment”; better reflects the nature of the activity, less confusing.
- Make the abstract a bit more explicit; for example, in the third paragraph it states that the assignment “was a success.” Based on? How so? The answers are there, but the reader has to wait for them and is not certain if she has correctly identified them. Go all the way when making a statement; don’t lead the reader part of the way there, and expect him to complete the thought the way you intended. Be explicit. This comment goes for the article in general.
- In the introduction, the authors refer to the “Challenger Philosophy”; the hyperlink requires additional log-in information and is not generally accessible. Please summarize the key points and remove the hyperlink.
- The authors repeatedly reference the “Minimum Undergraduate Standards,” which appear

on pages 27-32 of a 79-page PDF that is hosted elsewhere online. These standards should at a minimum be summarized (so that the reader doesn't have to find them in the aforementioned document in order to know what type of criteria are included). Since the PDF that contains them is likely to be updated regularly the by School of Biological Sciences at University of Essex, therefore causing the page reference to change, the authors may wish to create a static, free-standing document containing this information.

- Under Methods, Stage 1: What kind of information was disseminated via Moodle to prepare students for the habitat visits? What background information did the students have? I was often distracted by the lack of information provided about the field and laboratory portion of this assignment (although I could clearly follow the collaborative and individual written work). What size quadrats did the students use? How did they go about species identification? When the soil samples were collected, the authors state that "the vegetation was put in one labeled sample bag and the soil in a second." Was that the upper, vegetative layer of the soil sample, and for what purpose? How were the insects collected? By Berlese funnel from the soil samples? Were they just the invertebrates that were observed while the students were in the field?
- Add more information about Instructor Feedback in the Methods section; what kind of feedback was provided at each stage? Were students assessed primarily based upon the presentation criteria (following guidelines regarding Tables and Figures, etc.) or were they also assessed to some degree on accuracy/correctness of information presented (for example, in Figure 2, the student notes state that *Plantago major* is a monocotyledon, which is erroneous; it is a Eudicot)? Based on the article title, a reader will expect more information about this aspect of the research.
- I like the examples of student generated work. It might be nice to include a few more examples under "Supplemental Materials" for those who would like to view them.
- I was a bit surprised by the amount of students who didn't participate in stage 2 (26%). Any suggestions for how to resolve this issue? Why the low "buy in" by these students?
- I think it would be nice to include a little more information about the lecturer's experience. Could some of this be added to the Results and/or Discussion?
- The final paragraph of the paper ends oddly. It seems to reference a future event (having students use Google Apps for their third year project) but talks about it in the past tense ("but this time they took ownership"); consider revising. It is not a good idea to end an article with a parenthetical comment (weakens it).

Quick fixes:

- Data are plural (see 5th paragraph under Results)
- Second to last paragraph under Results, Stage 1: "The large number of data sheets generated (21) meant..." I think the number in parentheses should be 28.

Overall, a nice teaching module that I would encourage instructors to try; I can envision several standard laboratory or field exercises that could be modified and expanded to include the collaborative group work, peer assessment, and individual analyses presented here. It is a really nice model. The article itself can be strengthened by providing more details, where relevant, and

by being more explicit.

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 17 Aug 2015

Nicky Slee, University of Essex, Essex, UK

We thank the reviewer for her helpful comments. We will address these, along with others, in a revision of our paper once the other reviews have come in.
Nicky Slee

Competing Interests: N/A

Author Response 25 Nov 2016

Nicky Slee, University of Essex, Essex, UK

The authors would like to thank Melanie Link-Perez for her review and helpful comments to improve the paper. We have addressed the comments raised and incorporated them into the updated version of the paper e.g. terminology has been changed from peer assignment to peer assessment. The hyperlinks have been updated (Challenger Philosophy) or changed e.g. Minimum Undergraduate Standards is now in Supplementary Materials. Information has been added about the Lecturer's background and experience. The methods section has been expanded to give more details about the ecological sampling. Information on feedback has been included. The new version Numerical data been added to make information more explicit together with definitions about success criteria (performance related to average for stage 1 and success related to degree class marks). Abstract and paper has been updated to include specific details on success at each stage, looking at different success criteria that have been defined; statistical analysis has been carried out and reported; results are the final results assigned to the students for this work. An example of one student's group work, Google slide document, is added in the supplementary materials.

Competing Interests: None.

Reviewer Report 10 July 2015

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Kay Yeoman

School of Biological Sciences, University of East Anglia, Norwich, UK

This is an interesting paper which gives a lecturer who is new to learning technology an opportunity to try a relatively straight forward intervention. The paper describes the use of Google Web 2.0 technology tools, namely Google Docs and Google Slides to help with the ecology field work of first year students. I think it would be good to alter the use of the terminology, and refer to first year students as 'Level 4'. I would also like to know the range of degree programmes which these students are enrolled on, and what the gender ratio is. The first link in the introduction 'Challenger Philosophy' requires the use of a password to enter the content. I think it would be good in the introduction to say something about what the challenger philosophy is, as readers will not be able to access this information via the link. In the development of this idea, it would be good to know what had been done in previous years, and what promoted the change to this new approach, or was this a new module? The introduction gives a good rationale for this choice of technology intervention, e.g. enhanced group work, opportunity for peer assessment, and a greater opportunity for cohorts to get to know each other and to discuss data generated. Other educational literature is cited to support the rationale. In the results, the authors stated that the students 'mainly succeeded' in setting up Google Accounts. This suggests that some did not? If they did not, what were the barriers? (This was actually subsequently looked at in the discussion). The authors indicate that after the group work the students showed a greater awareness of ecology techniques and the campus, how was this information gathered? Was it through informal discussion, or was it through comparison to previous experiences of work produced in this module? This needs some clarification. There were interesting reflective comments from the authors, but I would like to see some information on the student evaluation, it would be particularly interesting to see if any themes were emerging from student free text comments on the skills which they considered they had developed. If this module has run before, without this technology intervention, is there a difference in the marks obtained for the module? The authors mentioned 'ownership' of the information several times during the paper. I think some referral to the wealth of literature surrounding research-led teaching where ownership is a key outcome of this type of learning, would enhance the paper.

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 17 Aug 2015

Nicky Slee, University of Essex, Essex, UK

We thank the reviewer for her helpful comments. We will address these, along with others, in a revision of our paper once the other reviews have come in.
Nicky Slee

Competing Interests: N/A.

Author Response 25 Nov 2016

Nicky Slee, University of Essex, Essex, UK

The authors would like to thank Kay Yeoman for reviewing the paper and giving comments to improve it. We have addressed the comments raised and incorporated them into the updated version of the paper.

The terminology has been updated, first year students are referred to as Level 4 students. Details have been added about the degree programmes studies and gender ratio. An updated link has been provided for the Challenger Philosophy which provides information needed. The rationale for the new approach and reasons for changing the previous practical have been given and information about the lecturer's experience has been added. Greater awareness of ecology and campus was based on work submitted rather than from informal discussions with students or comparison to other years. Literature has been added about student centered learning and proposed benefits of the approach. Student evaluation was not included in this work but would be an important addition in the future.

Competing Interests: None.

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