Authors name and affiliation

Dr Janet Haresnape, Department of Life, Health and Chemical Sciences, The Open University

Title

Student perceptions of an assessed, online, collaborative activity.

Abstract

In this online collaborative activity, adapted from a face-to-face tutorial activity, students each provided data and suggestions about its interpretation, by contributing to a series of wiki pages. They undertook an assessment question based on interpretation and implications of their findings.

The activity involved probing questions inviting students to add comments about the interpretation and long-term implications of their results. It enabled weaker and less confident students, who reported finding the topic challenging, to build on comments from others and add their own valuable contributions.

Nine participating students were asked in telephone interviews about their perceptions of the activity, and their comments were categorised. Categories included the visual, practical/authentic and collaborative nature of the activity, feeling of responsibility to the group, and deeper understanding of the topic. The relative importance of the aspects of the activity represented by these categories for more and less able students was explored using an optional online questionnaire.

The activity is being adapted for use in other contexts in which a complex question, posed on a wiki, enables students to build on each other's responses to gain a deeper understanding, and therefore helps weaker or less confident students to understand particularly challenging concepts.

Keywords

Online, collaborative, authentic, wiki, asynchronous, peer learning

Student perceptions of an assessed, online, collaborative activity.

Dr Janet Haresnape, Department of Life, Health and Chemical Sciences, The Open University

Introduction

This work explores a way to help weaker students to grasp a difficult concept through participating in a collaborative activity based on a wiki. It was undertaken at the Open University, where the students are geographically dispersed distance learners. Those studying a particular module are in groups of about 20, each with a tutor. Tutors support their students through detailed correspondence tuition on assignments spaced at intervals throughout the module. Each tutor group has an online forum, and tutorials, which used to be face-to-face but are now either a blend of face-to-face and online, or all online.

This study centres on students on Evolution, a module in which students use information from the living world, fossil records and simulation to learn how natural selection and other evolutionary processes, such as genetic drift, produce changes in genes and populations over different timescales, how new species originate, and how large-scale evolutionary patterns are generated. The tuition on this module is now exclusively online, so members of the tutor group never have an opportunity to meet face-to-face. This can cause a problem for weaker students, who struggle with the more challenging aspects of the subject, and commonly feel isolated and demoralised. Weaker students of evolution theory tend to have particular difficulty in understanding the evolutionary implications of the process known as genetic drift. It was important to continue to provide an accessible way for them to understand this challenging concept despite there being no opportunity for face-to-face interaction. The purpose of this work was to try to improve the learning experience for students in the online environment, particularly for less able students.

The use of collaborative learning has been widely explored (see for example Crisp, 2007 and Gipps, 2005). Interaction with peers can help students to consolidate their learning (Pachler *et al*, 2009), and use of wikis in group assessment tasks has been explored by Trentin (2009), Kear (2011) and Caple and Bogle (2013). Moreover, assessment is more effective for learning if it is based on authentic tasks (Sambell *et al*, 2013).

Effectiveness of online collaboration activities for distance learning students

A number of authors have particularly explored the effectiveness of collaborative activities in the online environment, and the role of assessment in the success of such activities. Curtis and Lawson (2001) identified differences between face-to-face collaborative learning and that which occurs in an asynchronous online environment.

Asynchronous interaction gives time for reflection and generation of a considered response, but lacks the spontaneity associated with face-to-face collaborations. Price *et al* (2007) compared face-to-face and online tutoring on three Open University modules; students receiving online tuition reported poorer experiences that those receiving face-to-face tuition. At first sight, these results might imply that face-to-face tuition is more effective in helping students to understand the module materials. However, the pattern of marks obtained suggested the students receiving online tuition were academically weaker than those receiving face-to-face tuition, and it was acknowledged that the students who had online tuition may have needed more support than they actually received. Thorpe and Godwin (2006) analysed student perceptions of the contribution of computer-mediated elements integrated into both teaching and assessment on 36 different Open University modules. Some students preferred the anonymity of computer-mediated interaction over face-to-face interaction. There was an important connection between the design of the interaction and the opportunity it generates for students to use their cognitive skills. For example, reading the comments from other students involved the processes of disagreement, self-explanation, reflection and internalisation, and such interaction was thus a critical factor in the quality of e-learning, of particular importance for a distance learning institution. The benefits of learning from peers were particularly clear where students could read the comments of others through asynchronous conferencing. Students who realised that others had similar opinions were reassured, and discrepancies between their ideas and those of others encouraged reflection, and this helped students consolidate their own understanding; such interpersonal interaction could enhance feelings of connection with others and improve the quality of the learning process.

Thorpe and Godwin (2006) also identified some perceived disadvantages of the computer-mediated interactions, for example students cannot get ahead if they have to integrate collaborative work into their marked assignments, and this can reduce the flexibility of distance study for some students. Some found it easier to read other students' contributions than make their own, and there was resentment about students who did not contribute. However, visual, auditory or simulated representations helped students to understand conceptually difficult or abstract material, and the authors concluded that online interaction led to more effective learning and that communication with other students without spatial and temporal barriers expands the learning relationships available. Students felt less isolated and valued feeling part of a shared enterprise, but student learning was influenced by the degree to which collaborative features were integrated into the design of both the module itself and its assessment.

The role of assessment in student learning and its relationship with the use of ICT, and the particular circumstances of this relationship for online and distance learners has been discussed by Macdonald (2004) and by Swan *et al,* (date). Some learners are motivated by the 'fun' element of an online activity whereas others might be

motivated by the interaction with others, but students will undertake activities if they are linked to assessment, so an assessment which requires reflection on an online collaborative activity is likely to lead to high levels of participation; just a few marks can be very effective in ensuring participation (Macdonald, 2004). Different students have different conceptions of learning, different expectations of teaching and learning, and different approaches to learning and some students fail to understand the underlying purpose of the educational activities designed for them (Kirkwood and Price, 2008). The prevailing learner-centred approach at the Open University uses ICT to encourage active exploration, collaboration and reflection, in an attempt to build understanding. Kirkwood and Price (2008) argue that for ICT to be effective, it is necessary to have an assessment strategy which encourages students to adopt an appropriate approach to the learning process.

Different students see different benefits to asynchronous discussion with peers; some see it as a way of gaining help from others or value interaction for its own sake, and others will only take part in a discursive activity if it is part of an assessment (Kear, 2004). Learning through asynchronous peer interaction can be beneficial without direct intervention from a tutor (Kear, 2004). So and Brush (2007) established that structured activities involving collaborative learning increased dialogue and interaction between distance learning students, increased feelings of connection with other students, and helped students to recognise collaboration as a valuable learning experience, but that overuse of such activities could negatively affect student learning.

This paper explores student perceptions of an online collaborative activity which was adapted from a face-to-face tutorial activity in the light of these findings. The activity is a form of computer supported collaborative learning (Crisp, 2007) which facilitates group members who are geographically dispersed to contribute suggestions to address a complex question. It attempts to scaffold learner support so that members of the group, especially weaker members, are able to achieve an understanding that is more complex, and of a deeper quality than that expected from individual students. In a face-to-face tutorial the activity had enabled students to communicate their ideas to each other, to obtain feedback from their tutor and from other group members, and to recognise their own strengths and weaknesses, but creating an equally beneficial learning experience in an online environment is more challenging. Some students are intimidated by having to use a computer to participate in something which can be seen by their peers and potentially accessed at a later date, but on the other hand, for participation to be worthwhile, it has to help in development of the students' cognitive ability. It also needs to be engaging and relevant to the topic being studied, and to be an authentic task with meaningful outcomes (Havnes and McDowell, 2008, Sambell *et al*, 2013). In this paper, 'authentic' is taken to mean something which simulates a real biological situation and mimics a real practical exercise which students might have undertaken in a face-to-face tutorial.

Designing an authentic equivalent online experience

The activity uses the founder effect, which is a particular manifestation of genetic drift, to make the implications of this process easier to visualise and to understand. The 'founder effect' activity, initially developed for use by Open University students in face-to-face tutorials, had been extremely successful in making the implications of genetic drift more comprehensible. It begins with a simple, non-threatening sampling exercise using coloured beads, and progresses to an analysis involving some challenging mathematics, which weaker students tend to find particularly difficult. In moving this activity into the online environment, it was important to retain the aspects of the activity which had worked well in face-to-face tutorials, but at the same time to exploit the advantages of the asynchronous online environment.

The challenge for the online version of the activity was to retain its low risk/low threat nature by starting with something visual and hence accessible, and then progressing to the more challenging aspects of the quantitative analysis once the students had engaged with it. The visual element which was part of the original activity was retained, as were the opportunities for sharing data, but in addition the advantages of the asynchronous online environment were exploited by introducing a way for students to reflect on comments made by others. The aim was to enable weaker students to gain from the contributions of more able students, as had happened in the face-to-face tutorial situation.

The online version mimicked the original practical exercise, requires authentic observation and collaboration with others in the tutor group, but is based on use of a wiki. The task feels like a real experiment such as might be undertaken in a face-to-face tutorial. The online version of the activity was first introduced in 2009 as an optional activity, and only a few students participated. The following year, an assessment question based on the interpretation of the results obtained was introduced, and the participation increased enormously. This assessment question was retained in subsequent years and the increased participation in the activity was maintained. In 2013, 240 of the 246 students registered on the module engaged with at least part of it. This was despite the fact that the assessment question based on the activity formed only one small part of the assignment, and it was possible to pass the assignment without doing it.

Evaluation of student perceptions of this activity in the online environment, undertaken with three cohorts of students between 2011 and 2013, forms the basis of this report. In particular it explores ways in which weaker students were helped in their understanding by learning from the contributions of others in the group.

Students made observations during the practical part of the activity, and added these to a wiki shared with others in their tutor group. They then contributed possible answers to a series of questions about the interpretation of the data obtained, also on the wiki. Time was allocated for the activity in their study calendar, so students

perceived it as important to their studies, and an assessment question was based on what they learnt from it. The wiki became a resource for students in the group to draw on to answer the assessment question, but unlike the group assessment task described by Trentin (2009) and Caple and Bogle (2013), the students were not assessed on their actual contribution to the wiki.

An initial pilot evaluation of student perceptions was made using telephone interviews with students following their participation in it. This enabled aspects of the activity perceived by students to be most helpful to be identified, and these were used to design an online questionnaire which was presented to students in the following year. The results were analysed in conjunction with the results of student performance on the module as a whole.

This paper explores in what way the founder effect activity is perceived by students to be an authentic practical exercise, whether students feel a responsibility to participate for the sake of the group as a whole, to what extent collaboration with others in the group helped students to understand the concept of founder effect, and whether it might potentially enable weaker members of the group to develop a clearer understanding of this challenging concept, and its evolutionary implications. This analysis is followed by an exploration of the use of similar activities in other contexts in which a group of students might collectively explore possible answers to complex questions, and the implications of such activities for student learning.

M**ethods**

Outline of the activity

The activity was designed for students of evolution, and centred on a collection of small founder or ‘island’ populations, each of which has been colonised by a small number of individuals from a hypothetical species of flying insect, represented by coloured beads. Photographs representing the small founder populations on different islands were posted on the tutor group wiki, and each student in the tutor group claimed one ‘island’ as their own by editing the wiki to show their first name and initials underneath their chosen population. Each student counted the number of each different genetic variant, represented by different colours, on their island, and entered the data they had collected in a table on the wiki. Examples of the founder populations are shown in Figure 1 together with a key which was included to help students identify the different variants. Some of these islands have been claimed by students, as shown by the names and initials added underneath the populations.

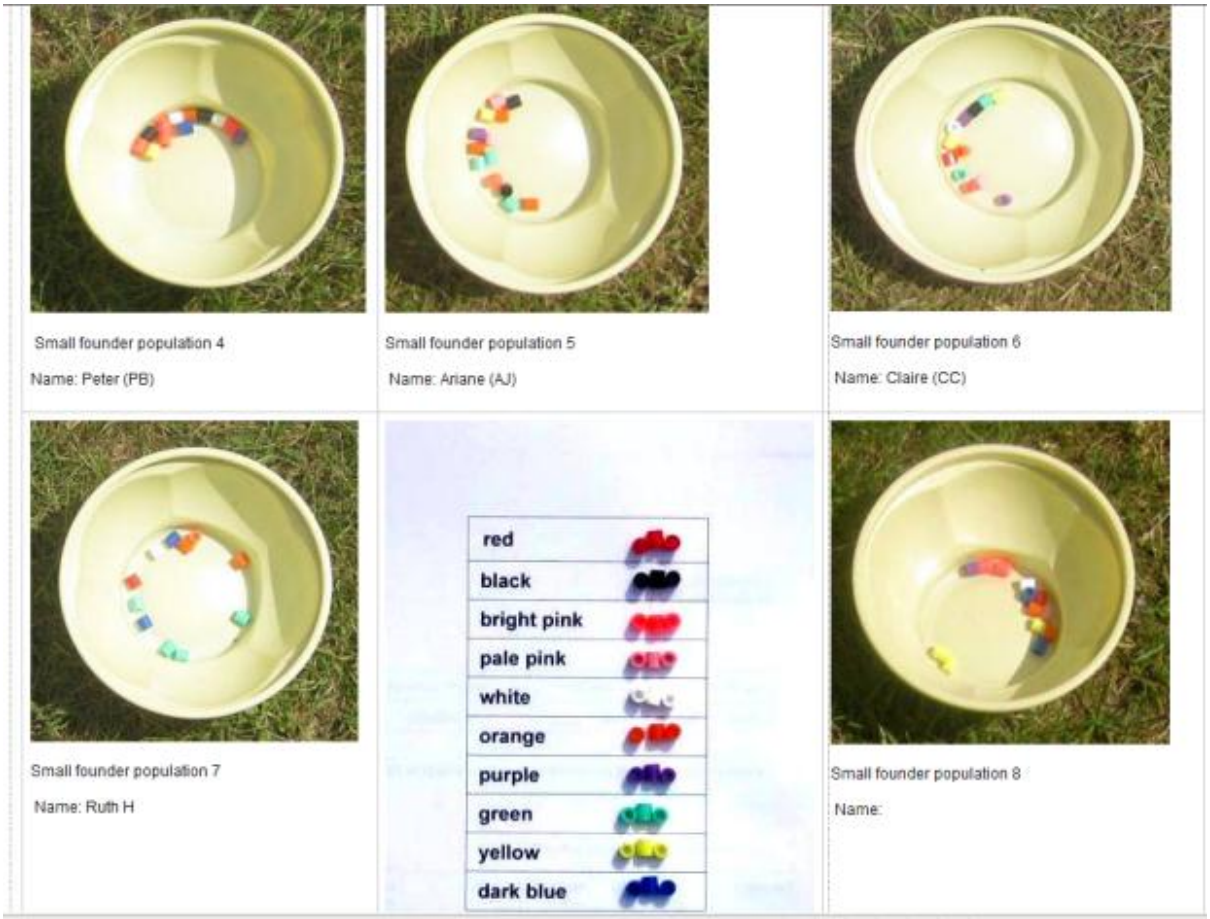

Figure 1. Five examples of founder populations, with four claimed by students and the key provided to help in identifying the different coloured variants.

Variant Colour		**Record number of each variant**						
	Your initials	TA	AA	RB	JC			
red		1	0	1	0			
black		1	2	1	2			
bright pink		0	0	0	1			
pale pink		4	4	1	0			
white		5	1	0	2			
orange		0	2	4	4			
purple		2	3	0	1			
green		0	2	3	0			
yellow		0	0	1	1			
dark blue		2	0	1	1			
Total		15	14	12	12			
Variant diversity (number of different variants)		6	6	7	7			

Table 1. Table from the wiki into which four students (TA, AA, RB and JC) have added their observations.

Table 1 shows a section of the wiki in which four students have recorded their observations. Students also each claim one larger founder population, from a selection presented in which a larger number of individuals have colonised the islands. (Figure 2)

Figure 2. Three examples of larger founder populations, each of which has been claimed by a different student.

Students add their results to the wiki and explore the differences between the populations by comparing their data with that of other students, and performing some calculations (not shown). They then suggest explanations for the differences, by responding to a series of probing questions posed on the wiki, which invited them to comment on their data and observations, relate these to evolutionary consequences, and consider any implications for long term stability of the individual populations and the likelihood of occurrence of speciation and extinction events.

Examples taken from the wiki of the questions posed, and suggested answers given by students are shown anonymously in Table 2. Tutors were asked to make brief comments to give encouragement, and some examples of tutor comments are included.

Student comment	Tutor response (if applicable)
Question : How do populations on each island differ from each other?	
Populations on each island likely to differ slightly in gene composition	
Each island will have a different population due to chance	
Over time more numerous variants in the founder populations will tend to become fixed at the expense of the less numerous ones, so that island populations will tend to differ more from each other	*Yes, this could well happen*
Occurrence of variants on each island is the result of a random process and hence there will be no particular pattern to the	*Absolutely correct*

gene distribution	
Question : How do island populations differ from the parent population?	
Genetic diversity much reduced in founder populations and will tend to become further reduced with possible extinctions	
They'll be severely reduced, my founder population has only 50% of the original number of genes	*Well spotted - 50% of variants present in parent population have been lost*
Only a sample of variants from the parent population had moved to the island so founder populations will be much less genetically diverse than parent population	
Question: What are the implications for the genetic diversity of the populations?	
Less genetic diversity in population originating from very small number of founder individuals	
In small populations the variants will become either fixed or lost by random genetic drift much quicker than a larger population	
Lower genetic diversity means greater chance that low frequency variants may be lost - reduced options = reduced opportunity for rapid adaptation in changing environments which may increase the risk of extinction	*Perceptive comment – well done!*

Table 2: Examples of student and tutor responses to three questions posed on the wiki.

In the assessment task based on this activity, which was part of a written tutor-marked assignment, students compared the genetic diversity of the island populations they had claimed, both qualitatively and quantitatively, with those of one or more other students; they draw on the evidence obtained by the group and suggested explanations on the wiki to give an overview of their interpretation of the long-term evolutionary implications of the data in relation to the relative likelihood of speciation or extinction of the populations on different islands.

Investigating the effectiveness of the activity and its assessment

Comments from students who participated in the activity were obtained from both telephone interviews and an online questionnaire.

Telephone interviews

Nine students were interviewed by telephone during November and December 2011, just after the module results had been published. These students comprised those in the author's tutor group who were willing to be interviewed, out of a possible 12.

The other three indicated that they did not wish to participate in an interview. During the telephone interviews, each student was asked to view the founder effect activity wiki pages on their computer as they answered the questions, to help them remember what the activity had involved. For one student it appeared that her access to the wiki had been denied by the time the interview took place, so screenshots of the relevant sections of the wiki were sent to her by email ahead of the interview. The same basic interview questions were used for each student, exploring what had helped them to engage with the activity and what aspects had been most effective in helping them to understand the crucial evolutionary implications. Students were asked to evaluate each wiki page in turn, to elaborate on their comments if their initial answers appeared potentially enlightening, and were asked a final question which tested their understanding of the core concept. A further 25 students were interviewed in 2012, using the same basic interview script as was used in 2011.

All the telephone interviews were recorded and transcribed, and the comments from students were categorised. Each comment was assigned to one of a number of categories; the five major categories, shown in Table 3, were used to design an online questionnaire.

Category	Explanation	Reference, if applicable
Visual	Comments relating to the visual nature of the activity making it accessible and unintimidating	
Authentic	Comments stating that the activity represented a real situation, or resembling a practical exercise	Thorpe and Godwin, 2006 Bloxham *et al*, 2007 Sambell *et al* 2013
Collaborative	Comments about the opportunity the activity gave to gain from, or build on, the contributions from others	Crisp, 2007 Pachler *et al*, 2009
Responsibility	Comments relating to feeling a responsibility because every member of the tutor group relied on contributions from others	Bloxham and Heathfield, 1994
Deep learning	Comments indicating that the activity helped students to gain a deeper understanding of the topic	Thorpe and Godwin, 2006 Kirkwood and Price, 2008

Table 3: Categories used for analysis of students' comments, with explanations

After publication of the module results in December each year, the number of comments in each category made by students achieving a grade 1 pass was compared with the number made by students obtaining lower grades.

Online questionnaire

An optional questionnaire was posted online in May 2013, at the time that the founder effect activity was made available to students, and was accessed via a link from the wiki, so that students were alerted to it as they completed the activity. The assessment based on the wiki activity was due to be submitted in mid-July; the online questionnaire, based on an idea developed by Nix and Hall (2014), invited students to give Likert Scale responses indicating to what extent each of the following aspects of the activity had been important in motivating them to engage with it

- It was colourful/looked interesting (V)
- It was a practical exercise/felt like doing a real experiment (A)
- It was a collaborative activity, and I wanted to be part of it (C1)
- Other students' answers to the questions were useful (C2)
- My results were needed by others in the group so I had to do it for their sake (R)
- I wanted to understand the founder effect better (D)
- It had to be done to answer the assessment question (Q)

The 'importance scores' for each of these aspects were assigned using a scale of 0 (not important at all), 1 (not very important), 2 (so-so), 3 (quite important) and 4 (very important). The aspects largely matched the categories (V, A, C, R and D) which were identified as important as a result of the initial set of telephone interviews. An additional aspect relating to collaboration asked students whether they had found other students' answers to the questions on the wiki helpful (C2). One further additional aspect listed in the questionnaire, which was not explored in the interviews, was the necessity of participating in the activity in order to answer the assessment question (Q). For each aspect, there was a free text box in which students were invited to elaborate on the importance they had assigned to it.

Following publication of the module results in December 2013, the results obtained by the 30 students who completed the optional questionnaire were compared with those for the entire cohort of 240 students who had participated in the activity. The importance scores given by stronger students (those achieving a grade 1 or grade 2 pass) were compared with those given by weaker students (those achieving a grade 3 or grade 4 pass, or a fail grade).

Results

Telephone interviews

Of the 200 comments from the 9 students who participated in the first set of interviews in 2011, the largest number related to the collaborative nature of the

activity (C), as shown in Figure 3. There were also a large number of comments relating to the visual nature of the activity (V), and to the deeper understanding of the topic (D).

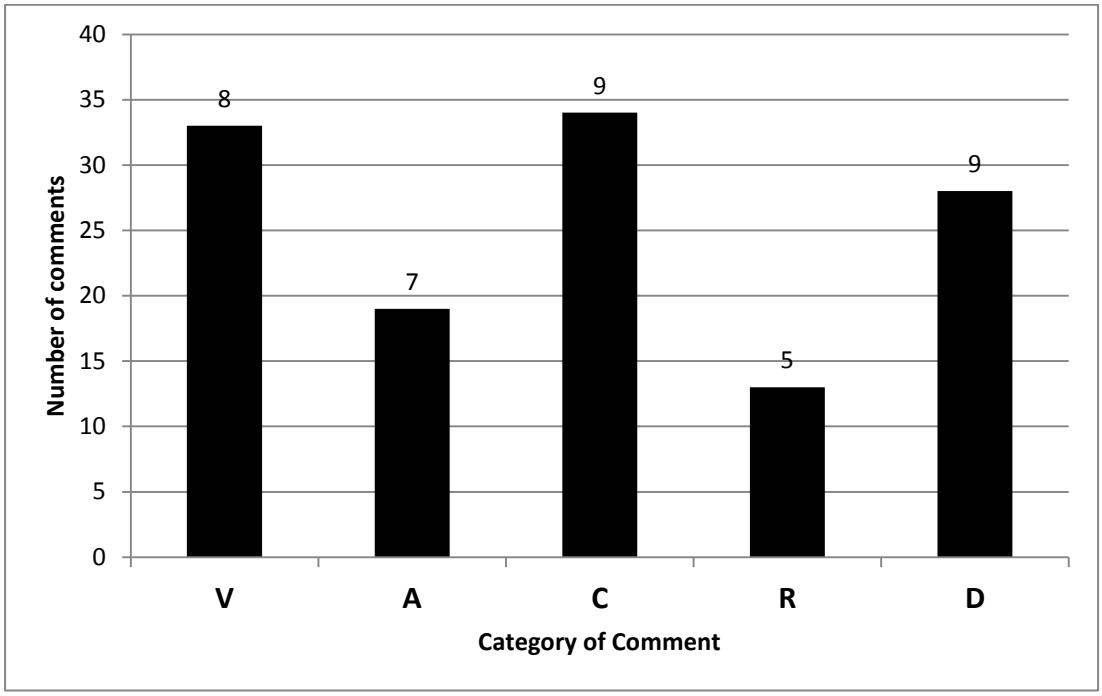

Figure 3: Number of comments in each of five categories made by students in the first 9 interviews conducted in 2011. Categories in this and subsequent figures relate to Visual (V), Authentic (A), Collaborative (C), Responsibility (R) and Deep Learning (D) aspects. Numbers at top of each column show numbers of students making at least one comment in each category.

Examples of the comments in each category are given in Table 4 to illustrate the range of responses.

Category	Examples of comments
Visual/Accessible	• I find photographs and pictures easier to get my head round than pages of text • You could actually see how different all the populations were, so it made it easier to visualise
Authentic/Practical	• it made you feel like there was a whole load of you actually doing the experiment • You feel you're actually counting genes. It's a hands-on style of learning • It was easy to relate (the activity) to what might really happen • It was like a living example so you could actually see the effects on a real life population. • It's doing something that's practical and I like learning in that way
Collaboration	• I came up with some ideas, other people came up with others – it made me stop and think because I hadn't thought of that. • I did find other students' answers helpful. I disagreed with some of them. It focussed my ideas. • You all learn off each other ... you might grasp one bit of it and somebody (else) might grasp another bit. • This was the best interaction on any modules that I've done because

	I was given the chance to have a go at making a comment – whether it was right or wrong. • Sometimes (it felt) intimidating because I thought 'I would never have thought of that - but people write the same things in different ways.
Responsibility to the group	• It gives you a sense of involvement, as other people are relying on you • I needed to make a contribution because we all need to do it to make the activity work. Everyone needed other people's results as well. • You're part of a group and if you're not pulling your weight then you may let others down.
Deeper understanding	• It gave me a reference point to answer the assessment question • This exercise has definitely consolidated my learning experience - with other parts of the assessment I was struggling to understand the concepts • It was hard to find something new to say, so I had to think more – I had to look back at the module materials, so it helped me to draw it all together

Table 4 Examples of comments in each of five categories, selected to illustrate the range of responses given in telephone interviews with students in 2011

The 9 students who participated in the first set of interviews all passed the module. They were a high achieving group of students, of whom 4 obtained a grade 1 pass, 3 obtained a grade 2 pass and 2 obtained a grade 3 pass. None of the students interviewed obtained a grade 4 pass or failed the module. Figure 4 shows the same results as Figure 3 but with the comments from students who obtained a grade 1 pass shown separately from those from students who obtained a grade 2 or grade 3 pass. The proportion of comments which came from the two groups was similar for most categories, including comments relating to the visual nature of the activity (V), and for comments relating to the deeper understanding of the topic (D). However, the proportion of comments relating to the collaborative nature of the activity (C) was considerably lower from the higher achieving grade 1 students than from those who achieved a grade 2 or 3 pass. The proportion relating to the authentic nature of the activity also appeared lower from the higher achieving students. All nine students made at least one comment relating to the collaborative nature of the activity, with a total of 25 comments being from the five students who obtained a grade 2 or 3 pass, compared with 9 from the four who achieved a grade 1 pass. The number of comments relating to the feeling of responsibility towards the group was lower, with a total of 13 such comments identified from a total of 6 students, 3 being grade 1 students and 3 being grade 2 or 3 students.

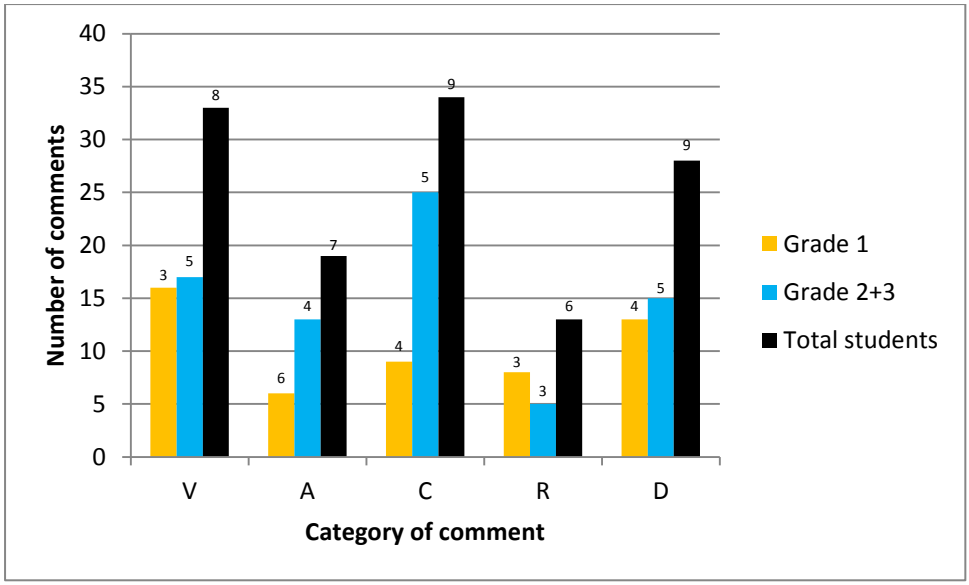

Figure 4: Number of comments in each of five categories made by students in the first 9 interviews conducted in 2011. Figures above each column show number of different students making at least one comment in this category. Numbers of comments from students who achieved a grade 1 and those who obtained a grade 2 or 3 are shown separately (yellow and blue columns respectively) to the left of the total numbers of comments from all students (black column).

Some students found answering the questions on the wiki daunting and difficult and reported that they didn't know how to begin to answer. The data in Figure 4 indicates that weaker, less confident students may have benefited from reading answers given by others, and built on suggestions from those who were more able or confident.

Since the identification of the most important aspects of the activity and the categories of comment had been based on interviews with only 9 students, the comments from a further 25 students were analysed in an attempt to obtain a larger and more representative view. However no further key categories of comment were identified as a result of the additional 25 interviews

Online questionnaire

The online questionnaire was optional and therefore the students who responded were self-selecting, but represented 12.6% of the total number of students studying the module (31 out of 246) and 12.9% of the number of students who participated in the activity (31 out of 240). The analysis of the importance scores given by these students to each aspect of the activity is shown in Table 5 and Figure 5. The importance of the collaborative aspect of the activity was ascertained in two ways, firstly by asking students to what extent they found the collaborative aspect of the activity helpful (C1) and also by an extra question specifically asking students to what extent they found other students' comments helpful (C2). Categories of comment relating to the collaboration are therefore shown in two rows in Table 5,

and two columns in Figure 7. Many students reported that they found other students' comments useful; 14 said this was quite important (importance score 3), and 5 said it was very important (score 4). When asked in more general terms about the collaborative aspect of the activity fewer gave such high importance scores; 10 students opted for the middle importance score of 2, and only 6 said this was quite important (score 3), and 6 said it was very important (score 4) (Table 5).

	Number of students						Percentage of students giving high importance score (3 or 4)
Importance score Aspect of activity	0	1	2	3	4	Total	
V (visual)	2 (1,0,1)	2 (1,0,1)	6 (2,2,2)	16 (7,5,4)	4 (0,2,2)	30	66.6 (63.6,77.8,60.0)
A (authentic)	1 (0,0,1)	1 (0,0,1)	4 (1,2,1)	16 (7,5,4)	8 (3,2,3)	30	80.0 (90.1,77.8,70.0)
C 1 (collaborative)	3 (2,0,1)	5 (1,3,1)	10 (4,4,2)	6 (2,1,3)	6 (2,1,3)	30	40.0 (20.7,22.2,60.0)
C 2 (other students' comments)	2 (2,0,0)	4 (0,1,3)	5 (3,1,1)	14 (3,5,6)	5 (3,2,0)	30	63.3 (54.5,77.8,60.0)
R (responsibility)	3 (2,1,0)	7 (3,3,1)	3 (2,0,1)	10 (3,4,3)	5 (0,0,5)	28	53.6 (30.0,50.0,80.0)
D (deep learn)	1 (1,0,0)	1 (0,1,0)	5 (2,2,1)	8 (2,2,4)	15 (6,4,5)	30	76.7 (72.7,66.7,90.0)
Q (assessment question)	1 (1,0,0)	3 (1,1,1)	0 (0,0,0)	4 (1,2,1)	23 (8,6,8)	30	90.0 (81.8,88.9,90.0)

Table 5. Importance scores for different aspects of the activity as indicated by the responses from 30 students to the online questionnaire. Numbers of students giving a response corresponding to each importance score is shown, numbers in brackets correspond to numbers of students in each of three grade categories (grade 1, grade 2, grade 3+4+fail)

The spread of scores differed for different aspects of the activity; for example there was a more even spread for the first collaborative (C1) and responsibility (R) aspects than for the authentic (A) and assessment question (Q) aspects. The percentage of high scores was lowest for the first collaborative aspect (C1, 40.0%) and the responsibility aspect (R, 53.6%), and highest for the assessment question aspect, (Q, 90.0%), authentic aspect (A, 80.0%) and deep learning aspect (D, 76.7%) as shown in Table 5. This is reiterated in Figure 5 which shows the mean importance scores for each aspect of the activity, so includes the complete range of scores. The highest mean importance scores were those relating to the assessment question (Q, 3.43), to gaining a deeper understanding of the topic (D, 3.17) and to the authentic aspect (A, 2.97). The lowest were those relating to the first collaborative aspect (C1, 2.23), and to the responsibility aspect (R, 2.25). (Figure 5)

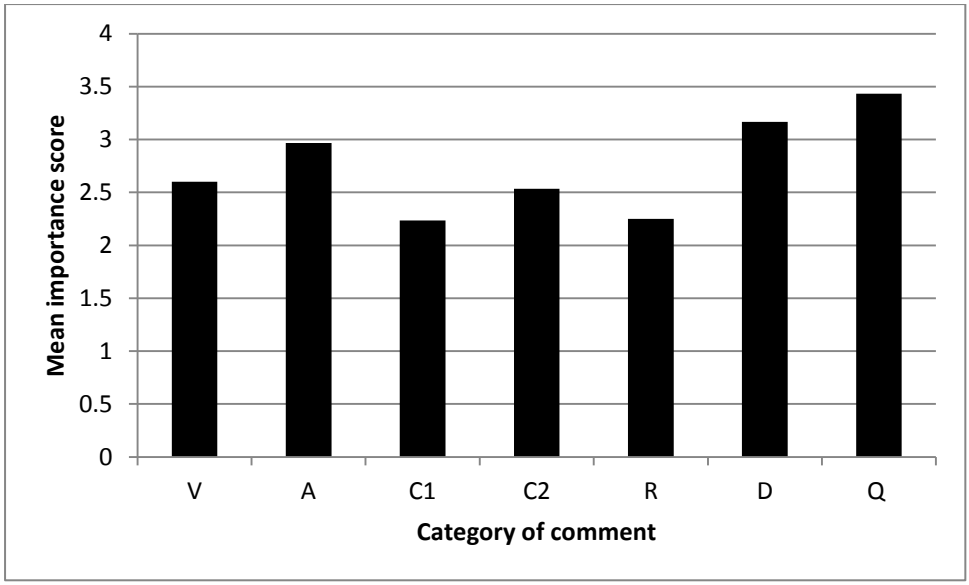

Figure 5. Mean importance scores given to each aspect of the activity by students in response to online questionnaire. Aspects scored were Visual (V), Authentic (A), Collaborative (C1 and C2), Responsibility (R), Deep Learning (D) and the requirement to complete the activity for an assessment question (Q).

The free text comments on the online survey were more numerous than those from the interviews. They were also very informative, but largely confirmed the range of views given in the interviews, with many comments about the activity being authentic in that it felt like a real experiment, gave context to concept, and that the difficulty in differentiating colours helped to make it like a real biological study. There were also numerous comments about the collaborative nature of the activity, for example one student said it enabled her to look at the 'group mind' to see if she was on the right track, and another commented that the work involved in doing the calculations was effectively spread among several people. Most comments were positive, but a few were negative. One student reported that he found the activity more time consuming than it was worth, and another said that it seemed really easy to understand and that a simple explanation would have sufficed. Some were frustrated that other members of the tutor group did not participate in the activity at the scheduled time, left it until just before the assignment was due to be submitted before beginning the activity, or might be using their data and ideas without contributing any of their own. These comments were made by students who completed the activity as soon as it became available, before many others in their group had started it but non participation by a few students would not have disadvantaged those who were engaging at the scheduled time, as the assessment task required some, but not necessarily all, of the students to have contributed data.

Publication of the module results in December 2013 enabled results of those students who answered the online questionnaire to be compared with those of the cohort as a whole (Figure 6). As might be expected, the percentage of students obtaining a grade 1 pass was higher for those who submitted responses to the questionnaire (36.7%), than for the cohort as a whole (18.8%). This is unlikely to

indicate a causal relationship, but probably reflects the tendency for the more diligent students who participate in all the available activities to get high grades. It is interesting to note that many of the negative comments, including all those about lack of timely participation by others, were made by students who achieved a grade 1 pass.

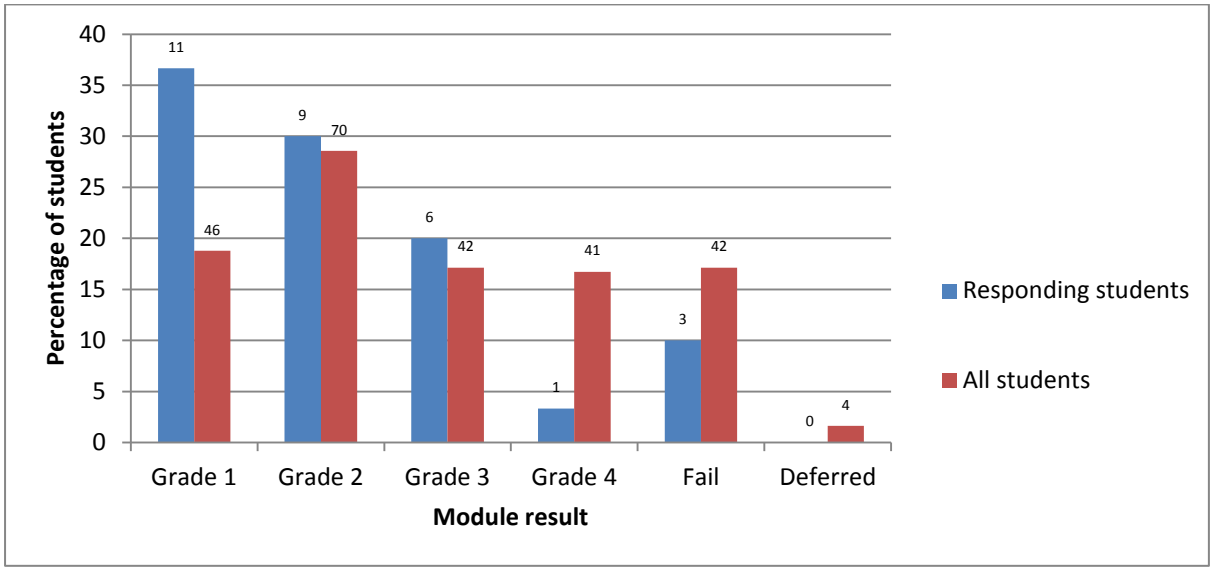

Figure 6. Profile of module result profile for students who responded to the online questionnaire and for the whole student cohort. Figures at the top of each column show actual numbers of students

Publication of module results also enabled responses from more and less able students to be compared, and the results of this analysis are given in Figure 7.

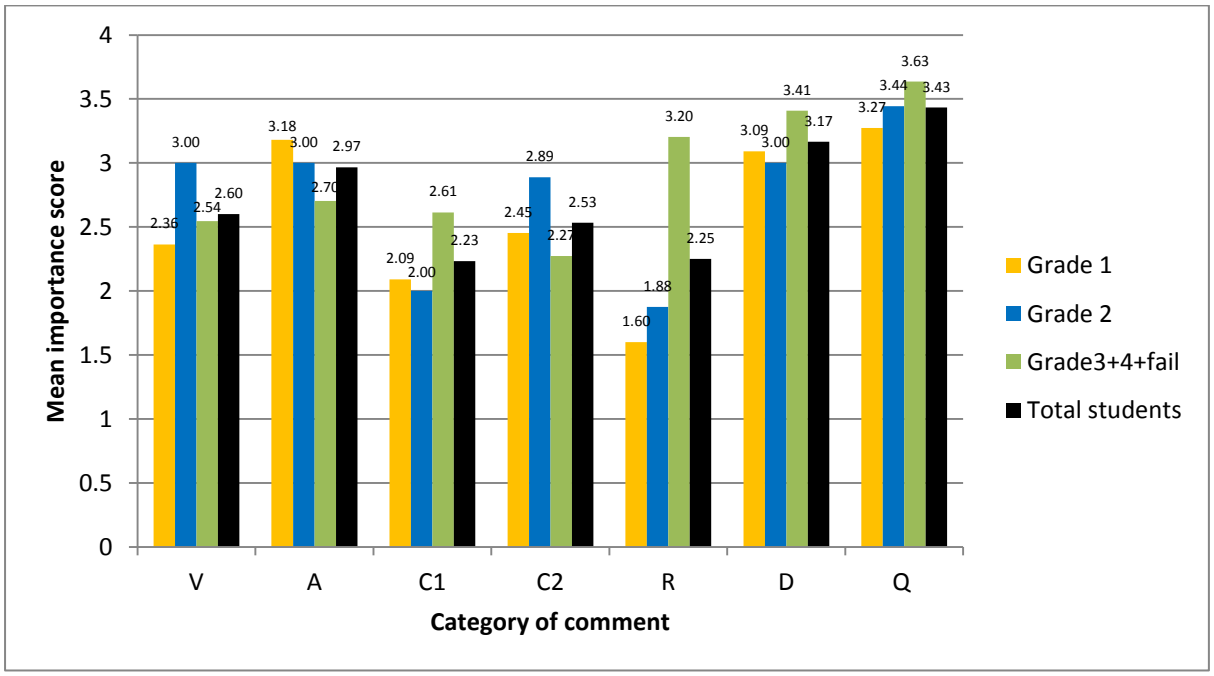

Figure 7. Mean importance scores given to each aspect of the activity by more able (Grade 1 and Grade 2) and weaker (Grade 3+4+fail) students in response to online questionnaire. Figures at the top of each column show mean importance score for each individual student cohort.

It is notable that the grade 3+4+fail students gave a higher importance score to the responsibility aspect of the activity (mean importance score 3.20) than the more able students (mean importance score 1.88 and 1.60 for grade 2 and grade 1 students respectively), indicating that the weaker students felt a stronger responsibility to the group than the more able ones.

Students in all grade bands gave the assessment aspect of the activity and the deep learning aspect a high importance score, with the authentic aspect showing the next highest score (mean importance scores of 3.43, 3.17 and 2.97 for Q and D and A aspects respectively, Figure 7). These were the same aspects which were given a high importance score by the highest overall percentage of students (Table 5).

The collaborative aspect C1 appeared to be more important to the weaker students (mean importance score of 2.61 for grade 3+4+fail students compared with 2.00 and 2.10 for grade 2 and grade 1 students), and therefore showed the same trend as the initial telephone interviews of 2011. There was no evidence from the collaborative aspect C2 that any particular ability group found the contributions of other students more helpful than another, and no evidence that the visual aspect was more important to one ability group than another. The authentic aspect appeared more important to the more able students (mean importance scores of 3.18, 3.00 and 2.70 for grade 1, grade 2 and grade 3+4+fail students respectively), and this is in contrast to the telephone interviews which indicated this aspect to be more important to weaker students. The assessment aspect was more important to the weaker students (mean importance scores of 3.27, 3.44 and 3.64 for grade 1, grade 2 and grade3+4+fail students respectively) according to the results of the questionnaire.

Discussion

Both the interviews and the online questionnaire verified the importance of the perceived authentic aspect of the activity. It is important for students to perceive an assessed task as relevant (Sambell *et al*, 2013) and this is more likely to happen when they see the link to a situation in the real world (Gulikers *et al*, in Havnes and McDowell, 2008). Increasing the authenticity of an assessment task is expected to have a positive influence on student learning and motivation (McDowell, 1995; Herrington and Herrington, 1998). The importance of the authentic nature of the activity was borne out by the students' comments, though it was unclear whether this was more important to weaker or more able students. Students reported that the founder effect activity felt like doing a 'real' experiment, and helped them to visualise what might really happen to populations in the wild. Some suggested that it felt as though there were part of a larger experiment involving others in the group, valued the opportunity to share results, and found it reassuring to compare their data and suggestions with others. Of the students who responded to the online questionnaire, 80.6% gave the authentic aspect of the activity a high importance score.

Definitions of authenticity vary (Gulikers *et al*, 2004, 2008) but here it is taken to refer to the resemblance to a genuine practical sampling exercise, which simulates a real biological situation and might be undertaken in a face-to-face tutorial. Students perceived the founder effect activity as authentic in that it was like doing a real practical activity. Some appreciated that difficulties encountered in identifying the colours were similar to difficulties which would be encountered in categorising individuals in a real biological situation. Collaboration is seen by some as a characteristic of authenticity (Herrington *et al*, 2000), and this activity mimics, albeit in a somewhat simplistic way, a situation in which different students might share results obtained from a practical experiment or groups of researchers share findings about different populations, and ideas about the implications of the differences found.

The participating students are geographically dispersed and never meet face-to-face, and moreover there are no other activities in the module which require students to work collaboratively, so they do not have a strong feeling of belonging to a community. Nevertheless, many of the students felt a strong responsibility to the group, in that their results were required in order for others to complete the activity and the assignment, and it is particularly interesting that the weaker students appeared to feel this sense of responsibility more keenly than the more able, with a mean importance score of 3.20 for the students who obtained a grade 3 or 4 pass or who failed the module, compared with 1.88 and 1.60 for the more able cohorts of students who obtained a grade 2 or grade 1 pass.

Students also appear to have valued the collaborative aspect of the activity. Thirty four of the 2011 interview comments were placed in the collaboration category, and this was more than in any other category. Some of these comments related to the requirement in the assessment question to compare their own populations quantitatively with those of other students. Others related to the qualitative comparisons and the opportunity to build on the suggestions made by other members of the group in answering questions on the wiki. The free text comments on the online questionnaire verified that many students appreciated the opportunity to read and reflect on other students' suggested answers. Moreover 62.3% of the 30 respondents gave this aspect (C2) a high importance score. Only 40.0% gave the collaborative aspect (C1) a high importance score, indicating that some did not perceive the opportunity to build on other students' comments, or to compare their results with those of other students, to be a form of collaboration.

One student's comment might provide a useful explanation for another. Some students discovered points they had not thought of, and others used the comments of others to elaborate on their own ideas or to resolve problems. It can be difficult for students to recall, identify, articulate and discuss exactly what it was that enabled them to undertake a task effectively (Eraut, 2000). Moreover it can be difficult to establish whether learning has actually taken place, and Kirkpatrick's model of training evaluation (Kirkpatrick, D., 1959, 1996, 2006) identifies four levels for

evaluating learning (reactions, learning, behaviour and results) the first of which involves their reaction to a task, which is influenced by their level of satisfaction. It may be that students who had enjoyed the 'fun' aspects of the activity and found it a pleasurable activity gave positive comments because of this reaction, and therefore that their comments do not necessarily reflect a true learning experience. Although it is difficult to be sure that students really did learn from their engagement with the activity, they were stimulated to engage in a process of reflection, questioning and processing of their learning through the asynchronous online environment, and this engagement is very likely to have led to improved understanding (Thorpe and Godwin, 2006).

The interacting roles of learner, peer and tutor have been described by Pachler *et al* (2009). In this activity, the tutors were asked to give encouragement, making it clear when a student's contribution was particularly astute or helpful. Some also gave detailed guidance on the more mathematical aspects of the activity if students had made mistakes in their calculations. Students could draw on the contributions made on the wiki by others in order to answer an assessment question. They were required to have contributed data to the wiki, and compared their own data both qualitatively and quantitatively with that of at least one other student in order to complete the assessment; they were not assessed on the quality of their actual contribution to the wiki, but rather on demonstrating their understanding of the issue it focussed on. There was therefore no necessity for individual student contributions to the wiki to be identified and verified, in contrast to the situations explored by Trentin (2009) and by Caple and Bogle (2013). Individual students were not given specific sub-tasks to complete on behalf of the group, so all students could contribute answers to any of the questions. They were encouraged to draw on their data and observations from their own individual populations to provide evidence to support their suggested answer, so there was no need for students who joined the activity late to feel that all the questions had already been answered. There was always more evidence which could be provided so all students could add useful contributions. Nevertheless there were some less confident students who felt they had nothing to add if a large number of contributions had already been made. Some students were concerned that others would be able to see if they made a mistake, and this was a particular worry where there were calculations involved.

Assignments based on group work can have a motivational effect if students are reluctant to let others down (Bloxham and Boyd, 2007), but since there are no other group activities which require the students in this study to contribute to the community, it is perhaps surprising that so many felt a sense of responsibility to the group; there were 13 comments from the 2011 interviews in the R (responsibility) category (Figures 3 and 5). It was particularly interesting that the weaker students felt more of a responsibility to the group than those who were more able. Although this was one of the less important aspects of the activity according to the online

questionnaire responses, ten students still reported this aspect to be quite important and 5 felt it to be very important (Table 5).

Some students are intrinsically more capable than others, and moreover, some are more competent and more confident in the online environment (Macdonald, 2003). The results of the 2011 interviews indicated that the proportion of comments relating to the collaborative nature of the activity was considerably lower from the higher achieving grade 1 students than from those who achieved a grade 2 or 3 pass (Figure 4), implying that the opportunity to build on the comments made by other students was less important, and less appreciated by students in this group. It is suggested that this activity allowed weaker, less confident students who reported finding the questions challenging to build on comments made by others, and enabled them to add their own valuable contributions. The first task (to claim a population and add initials beside it on the wiki) was simple, low risk and non-intimidating but gave a sense of achievement, so encouraged less confident students to continue with the activity and contribute their own comments, building on answers given by others. There is some evidence that mixed-ability grouping, as was the situation for the tutor groups in this study, is more beneficial to the learning experience of weaker than stronger students, and that group assignments improve the achievement of lower-ability students in subsequent assignments (Lejk *et al*, 1999). Students learn a great deal about a subject when they are working collaboratively, and Lejk *et al* suggested assessing students individually on learning undertaken in an extended group activity project as a possible sensible way forward. This is effectively what has been undertaken in this activity, and students' comments indicated that weaker students were able to improve their understanding through interaction with others in the group, in particular by seeing and reflecting on other students' interpretations of the group data.

There is great potential for activities based on this format to be used in other contexts, and some of these possibilities are being explored for new Open University modules currently in production. Any situation in which students are asked to tackle a complex question or issue, which could be approached from different angles, presented as a series of guided questions on a wiki would enable students build on each other's responses. Reading answers from others is likely to enable students to produce a more rounded answer than they might have done alone, especially if different students have approached the issue from different angles and addressed different aspects of it. It is suggested that this could be particularly beneficial to weaker, less confident students, in helping them to get a better grasp and gain a deeper understanding of challenging concepts.

Conclusions

This assessed collaborative activity which was based on student contributions to a wiki and mimicked an authentic practical exercise, provided an asynchronous online environment, in which students could read, reflect and build on the contributions of others. Telephone interviews and an online questionnaire indicated that it enhanced their understanding of a challenging concept in evolution theory and that the collaboration was particularly appreciated by and beneficial to weaker students.

Statement of ethical approval

Ethical approval was obtained according to the Open University's code of practice and procedures before embarking on this project. (reference number HREC/2012/1095/Haresnape/1)

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