[O13] Student networks and learning styles: a case study exploring investigative projects

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Abstract

There are many potential benefits of initiating independence and empowerment of students relating both to the learning experience and its management. Monitoring networking behaviour can provide insights into what happens when tutors 'let go' of a community of learners. Investigative research projects are a prominent element of science degrees, and when initiated and completed by a student can be rewarding for both students and tutors. This study explored the characteristics of learning networks using data gathered opportunistically on an undergraduate residential course for 2nd year Biology/Environmental students from two Universities, taught in an Enquiry Based Learning format. Individual, student-led projects were completed in four stages. Information was collected to explore who was interacted with, for how long and how important interactions were perceived to be. Questionnaires during student project development indicated that students distributed themselves fairly evenly between tutors, with total tutor-student fidelity throughout the project stages very rare. There were no obvious gender effects on networking (peer or tutor) and also no obvious association between networking behaviour and the learning (personality) styles of the tutors or learners. The quality of interactions from tutor and learner perspectives and the use of tutors as resources are discussed.

Introduction

There are many good reasons to enhance student independence (away from tutors and towards peers) and encourage learner communities. It is widely accepted that a great deal of learning is fundamentally social in nature. Learner-centered designs encourage social learning (e.g. Bransford *et al*. 1999) and can nurture autonomy in students, reduce some pressure on tutors and facilitate the management of large cohort sizes. Student networking and learning circles are receiving increasing attention in light of e-communication (Levin 1995). Studies into online modes of delivery have provided evidence for several shifts in learning behaviour: Philosophically from objectivism to constructivism; theoretically from behaviourism to socio-cognitive views of education; and, pedagogically from direct instruction to facilitation of collaborative learning (Shea *et al* 2007).

Networks of learners can be encouraged in more traditional teaching forums, for example through Enquiry Based Learning (Kahn and O'Rourke, 2004) and Collaborative Enquiry (Wenger, 1998) approaches. Increasingly in modern HE, cohorts comprise individuals

from very different social backgrounds/personality types with differing abilities/approaches to learning. There is scope to explore and highlight how learners interact and use their peers and tutors as resources to help to achieve their learning goals. Residential courses provide a useful opportunity to explore learner-learner and learner-tutor interactions for several reasons: (1) learner trust is high; (2) there are no absences in the observed group; (3) resources are limited to the essential and there is room for creativity in basic equipment development (other than a potential surplus of tutor time); (4) EBL and PBL formats (e.g. Blumhof *et al*. 2001) encourage problem-solving and discussion; (5) the emphasis is strongly on the student; (6) there are fewer distractions from academic work.

Personality types are complex, but represent appealing factors to consider when exploring how individuals interact to progress their projects. Decades of research into learning styles has generated a controversial picture of the appropriateness and usefulness of categorising learners (Coffield *et al*. 2004; Mortimore 2005). However, it is appealing to use them as one line of evidence to explore patterns of differences between individuals (and their tutors) particularly in terms of their learning strategies (Felder and Silverman 1988).

This paper describes a selection of key data gathered whilst monitoring undergraduate students (and the supporting teaching team) during the development of investigative projects on a residential course. This develops previous research into factors that influence how students evaluated themselves and their peers during the development of these investigative projects (Langan *et al*. 2005; Langan *et al*. in press). Previous work has indicated that gender effects and other social factors affect self, peer and tutor grades of the summative assessment in this course. Consideration of the learning network and inclusion of a measure of personality type were anticipated to clarify how students achieve their learning goals. Using questionnaire surveys at four stages of project development, the frequency and perceived value of interactions between individuals were recorded. Information about gender, university affiliation, learning style and final attainment in the summative assessment are used to further explain the networking patterns.

Methods

Data were collected during a residential field course to southern Spain (July 2nd - 18th 2005). Students originated from two Manchester universities ($n_{uni1} = 15$, $n_{uni2} = 5$). Tutors ($n = 14$) represented three Universities and all had experience of teaching and assessing field biology. One member of staff was a research technician and was included as a tutor in this study as she interacted with all students at some point and provided advice in terms of technical and sometimes methodological bases. Another female tutor joined the course at its mid-point. Full, voluntary participation in the study was given by all staff and students and participants willingly volunteered personal information. Most students were studying for biological or environmental degrees and this was reflected in the research and teaching specialisms of the tutors.

The course format has been detailed previously (Langan *et al*. 2005). It can be considered to be Enquiry Based Learning in format as students devise their own investigative research projects, develop their methodologies and set their own goals. There is a structure to the course that has four deadlines that need to be met. These were used to time the delivery of questionnaires (coded to be anonymous) that surveyed the frequency and duration of interactions associated with project development during the prior stage. The stages comprised; Stage 1 – formulate research questions (with a scheduled discussion group); Stage 2 – complete methods development (including submission of ethics and health and safety documentation; Stage 3 – data collection and collation (check spreadsheets/proposed

analyses); Stage 4 – statistical analyses (including graphical outputs and oral presentation preparation).

A meeting was held with all participants of the field course both at the very start to explain our research aims/approach and after each stage to gather the questionnaire and answer any questions to clarify our requirements. For the purposes of this paper it is sufficient to note that questions explored who was interacted with in order to progress the investigative projects, for how long, and an opinion (a 7 point scale with descriptors) of how useful the interactions were. Tutor:student interactions were further classified depending on whether they were tutor or student-initiated. For the purposes of this paper the tutor questionnaires can be considered to be identical (deviating only by a few additional questions such as opinions of how much of the progress was deemed to be tutor-driven).

On the final day of each course, students delivered five minute presentations summarising their individual research projects; assessed by tutors, a subset of peers and themselves. The presentations challenge students to distill their intensive two-week projects into concise, clear, informative dialogue aimed at a 'scientific' audience. The marks are used in this study as a measure of student attainment for the field course and were gathered as a triangulated assessment approach, thus all speakers were assessed by all tutors, all students who are not speaking in sessions and by themselves. Full details of this process and the assessment criteria are in Langan *et al*. (2005). At the end of the course we carried out a more general 'exit' questionnaire (used in this paper to provide anecdotal evidence) and also carried out a survey of learning styles (Felder and Silverman 1988) of all students and tutors participating in the course.

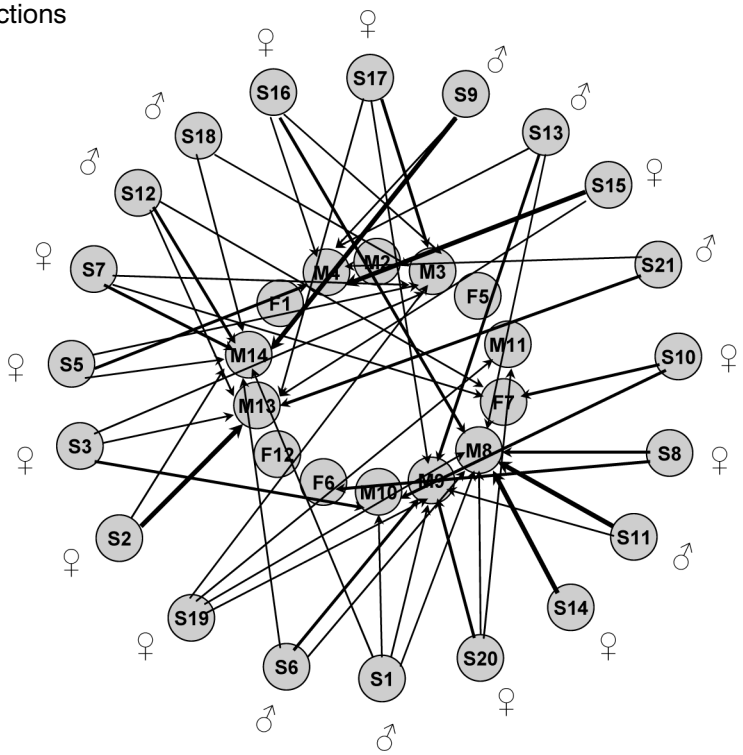
Results

Network diagrams generated to visualise the complex learning interactions were simplified to include only data about perceptions of who provided the most important advice at each of the four learning stages (**Figure 1**). Numbers of student-tutor interactions suggested that students tended to disperse themselves fairly evenly between available tutors, with total fidelity between students and tutors very rare (**Figure 1a**). There were no obvious effects of gender occurring during networking with tutors (**Figure 1a**) or peers (**Figure 1b**). It is noteworthy that the two tutors who were never cited as 'most important' were the research technician and the member of staff who joined the course at the mid-way point.

Overall, almost 90% of students were cited by their peers as having provided the most important advice at (at least) one stage, with only one complete student:student interaction repeatedly being the most important for all four project stages. The highest number of citations as 'most important peer advisor' across the four surveys was eight (received from five peers). There were no significant differences between male and female students in the mean number of tutors they interacted with during surveys when considering tutor-initiated interactions (t = 1.01, df = 18, P = 0.33) or student-initiated interactions (t = 1.58, df = 18, P = 0.13). There were also no sex differences in terms of number of students that a student interacted with (t = 0.37, df = 18, P = 0.71).

Students that interacted with more tutors assessed themselves more highly (r = 0.57, df = 18, P = 0.009). However, there was no relationship between student attainment and number of tutors interacted with (for all interactions, r = 0.08, df = 18, P = 0.73, or for student initiated interactions, r = -0.25, df = 18, P = 0.28). Self-assessment was also not associated with the number of students a student interacted with (r = -0.27, df = 18, P = 0.25). Tutor marks were associated negatively with the number of students that a

a) Student-tutor interactions



(b) Student-student interactions

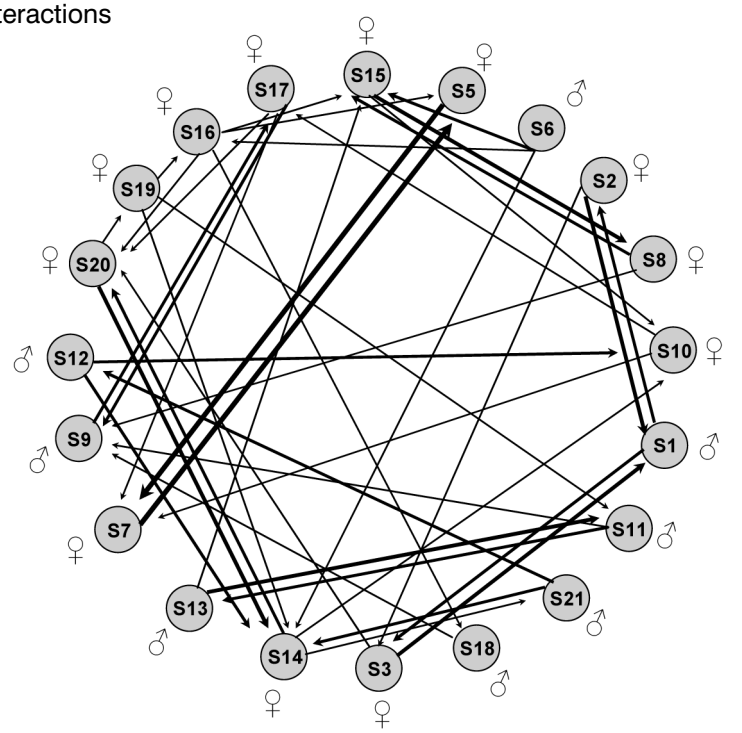


Figure 1. Network diagrams indicating who was cited during questionnaires as providing the most important advice at each of the four stages of project development. Line thicknesses indicate number of stages that (a) tutors, and (b) peers were cited (thickest - always cited as most important at all four stages; thinnest = cited as most important at only one stage). Both diagrams show student codes (S1-S20) and in (a) the inner circle represents the 14 tutors with 'M' denoting males and 'F' denoting females.

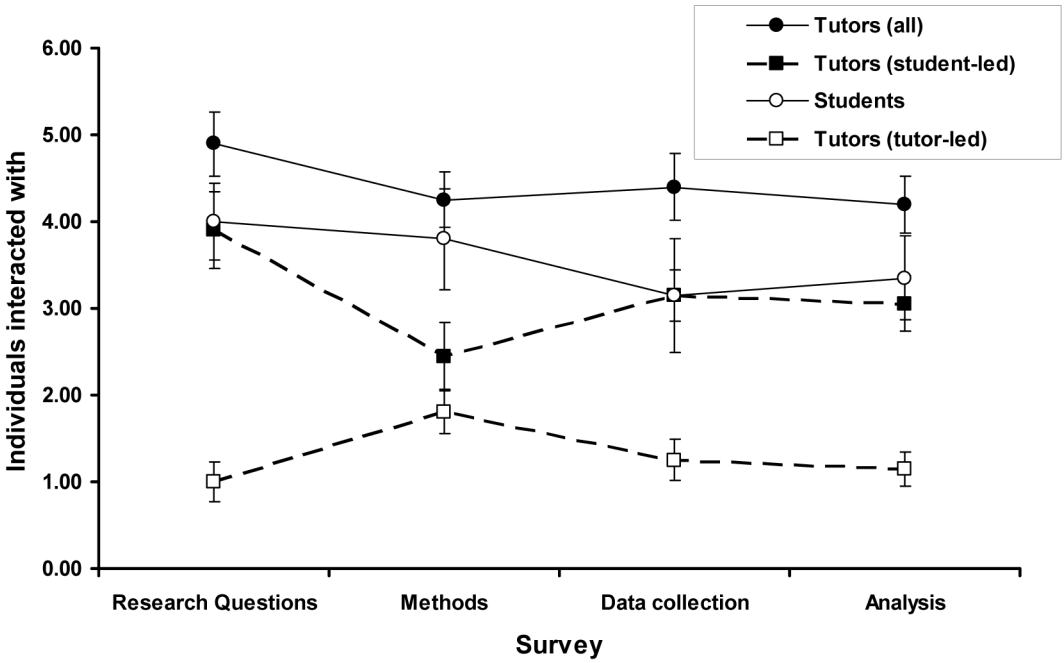


Figure 2: Mean numbers (± standard errors) of individuals a student interacted with over the four study periods varied in terms of both tutor and peer interactions

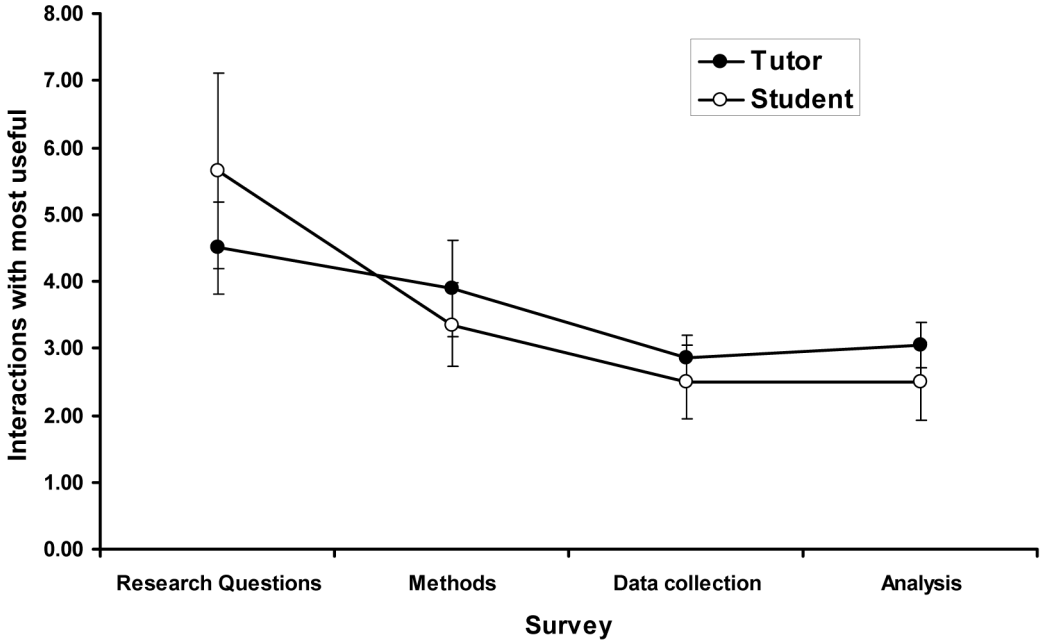


Figure 3: Mean number (± standard errors) of interactions with the most useful tutor and most useful student followed a very similar pattern across the four study periods

student had interacted with, such that students that interacted with more students received lower marks ($r = -0.46$, $df = 18$, $P = 0.04$).

The total numbers of people interacted with ('educationally'; i.e. in order to develop their projects) remained fairly constant during the course (**Figure 2**) typified by advice from 4-5 (29-36%) of tutors, mostly student initiated, and with about 3-4 (15-20%) of their peers. The only major change across the course was the increase in tutor-led advice (and drop in student-led interactions with tutors) after Stage 2 when methods were developed (alongside risk and ethical documentation). Consideration of the most important people

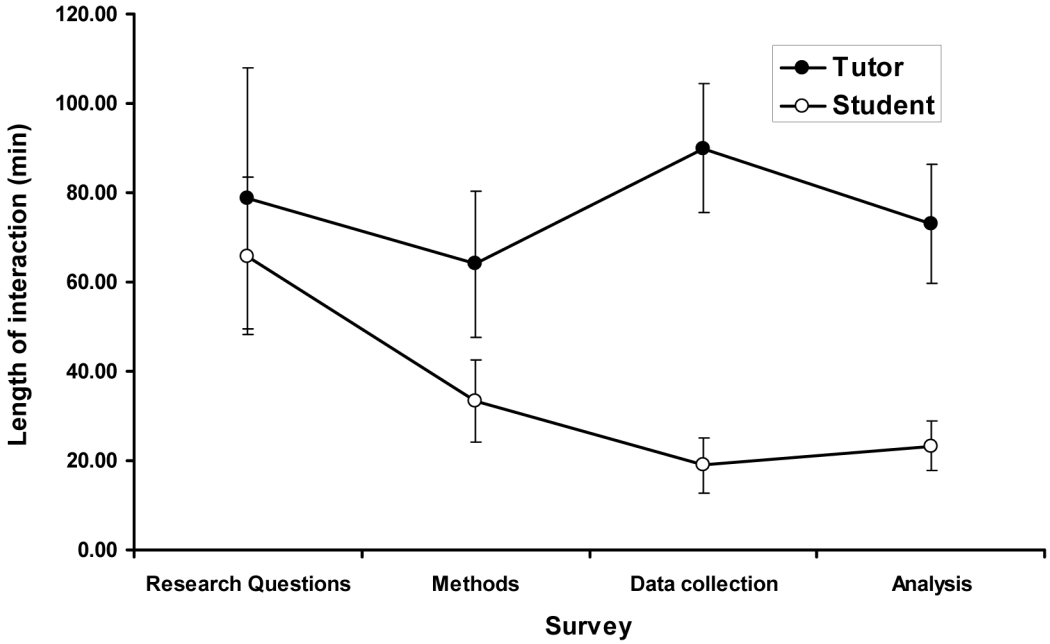


Figure 4: Mean duration of interactions (± standard errors) reported by students with tutors and students with students varied between survey periods. Duration of interactions was consistently longer with tutors than with other student and there was a general trend of shorter student:student interactions as the project progressed

that were interacted with suggests a general decrease in the number of tutors and peers interacted with as the projects developed (**Figure 3**) with (the most useful) tutors being engaged with more after the development of project ideas stage. Lengths of interactions with peers markedly reduced over the projects (**Figure 4**), whereas tutor discussions were lengthier than student:student interactions throughout the course. Interaction time peaked for tutors during the analysis phase when fewer, but longer, discussions about statistical tests and their outputs took place.

Discussion

Social and academic interactions during residential courses are complex and it would be very difficult to document and interpret complete network diagrams. There are many well detailed methodologies to explore social networking, notably 'Social Network Analysis' (de Nooy *et al* 2005). This study presents a preliminary and basic look at the some of the 'educational' interactions that took place. Working opportunistically and using a 'lighter touch' questionnaire approach (in four key stages) and 'indicative' measures of interactions (such as the person who provided the 'most useful interactions') we feel that we captured useful insights into networking behaviour of students. This study was made possible (and enhanced) by the residential setting and benefited from considerable choice of peers and tutors by students to interact with to progress the projects.

As educational researchers we attempted to remain independent and objective as members of the teaching team and the learning network under investigation. One benefit was that we experienced how difficult it was to estimate the timings of interactions, or remember more minor interactions. However, overall we feel that the importance of key interactions (which were most likely recorded) were useful to examine this study's aims and we accept losses of more peripheral information, such as exact durations of interactions, will likely have occurred.

Levin (1995) provides insights into the development of learner communities (from learning circles) and suggests a common published theme about notions of learning networks is the importance of a social structure for supporting network interactions. The process to achieve this is suggested as best designed to include clear, episodic phases with associated timelines. This fits well with the structure for the course we investigated, and may explain the perceived success of students that we gained from unstructured discussions with students (both in their own opinions and those of the tutors) of a productive social networking function to the field course (with perceived benefits to the quality and direction of their own research).

The findings suggest tutor interactions were longer than those with peers, and peer discussions reduced in duration over the field course stages. For many students, the project initiation stage catalysed student debate and a willingness to share ideas of potential projects. There were few tutor-led discussions in these early stages, this type of interaction growing in the next stage when tutors helped to confirm methods, resources and risk/ethical outputs. After settling on a project theme, there was a good dispersal of learners between tutors and a decrease in the number and length of interactions (the latter only for students). Fidelity throughout the project between student and the tutor considered 'most important advisor' a rarity. Using visual interpretation of the network diagrams as a preliminary (first line) of evidence, no obvious patterns arose to explain choices of people interacted with, when considering learning style types, gender or university affiliation. There is scope here for more detailed quantitative analyses. Anecdotal evidence supported an a *priori* expectation - that networking decisions were related to tutor subject specialisms and also the friendships in peer groups (that either developed on the field course or existed previously). However, we were wrong to anticipate that friendships would lead to many occasions when students cited friends as the most important interaction.

These factors need to be more carefully considered for future research. From the stage that students developed their methods to project completion there was a steady decrease in how often they interacted with the most important person at each stage. People cited as important usually changed during project development as learners became familiar with the social group. It seems that students had a fairly stable 'norm' in terms of the numbers of people they interacted with during project stages (4-5 tutors, 3-4 peers). The only significant variation in this pattern was identified only at a finer scale; i.e. tutor-led interactions increased during methods development maybe as a consequence of ensuring safe/ethical work. The general decrease in numbers of interactions could indicate greater independence in learning as the course progressed. This was balanced by an increase in the duration (and often depth) of discussions in the latter stages when the project's findings became available.

There were misconceptions by those students that interacted most with tutors that they had achieved higher grades in the summative assessment. This raises questions that learners understood what comprises quality in the learning task and that tutor advice needs to be utilised (developed) and not reiterated without being questioned/transformed. It is feasible that in their previous learning experiences, incorporating a single tutor's advice (who then marked the work) could have such a direct association. It is interesting to note that tutors discuss student projects on an *ad hoc* basis during the course, and it may be that it is known when students have increased assistance. If this knowledge is being used during assessment of the presentation then this should be built into the learning outcomes and the assessment criteria. Tutor marks also correlated negatively with the number of student interactions. In the absence of further evidence it may be over-simplistic to assume that this simply reflects that the 'weaker' students needed more support and this requires further

exploration. This study provides a preliminary look at the complex networks and it is noteworthy that a broader aim of this work and previous studies (e.g. Langan *et al* in press) is to elucidate how students perceive their academic progress (for example comparing tutor and self awarded grades) and identify mechanisms to enhance learner autonomy (such as the network used to reach the final summative assessment).

These findings can inform practice, providing evidence of stages that need brief, focused advice from tutors and times when fewer, longer discussions are needed. We support the use of techniques to catalyse collaborative learning and learner networks and feel that highlighting the need to be receptive to approaches from peers (tutors and students) at key stages could be valuable. It is also recommended that cohorts are educated about how/why students and tutors should approach collaborative work to form interactive learning networks; and that rules for working are agreed in advance of study. Further work is currently being undertaken to classify learners and tutors using multivariate techniques, primarily in an attempt to combine the four learning style indices, with other basic classifiers (e.g. gender, university affiliation) to potential sub-groups within the network and further explore the networks observed.

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