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What makes a 'good group'? Exploring the characteristics and performance of undergraduate student groups.

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Abstract

Group work forms the foundation for much of student learning within higher education, and has many educational, social and professional benefits. This study aimed to explore the determinants of success or failure for undergraduate student teams and to define a 'good group' through considering three aspects of group success: the task, the individuals, and the team. We employed a mixed methodology, combining demographic data with qualitative observations and task and peer evaluation scores. We determined associations between group dynamic and behaviour, demographic composition, member personalities and attitudes towards one another, and task success. We also employed a cluster analysis to create a model outlining the attributes of a good small group learning team in veterinary education. This model highlights that student groups differ in measures of their effectiveness as teams, independent of their task performance. On the basis of this, we suggest that groups who achieve high marks in tasks cannot be assumed to have acquired team working skills, and therefore if these are important as a learning outcome, they must be assessed directly alongside the task output.

Keywords

Assessment; Group work; Small group learning; Small group Teaching; Teamwork

Introduction

Group work forms the foundation for much student learning within higher education. Small group learning (SGL) has many proposed benefits which include developing students' social and professional abilities, as well as clear educational advantages. Socially, working together in groups from early in an undergraduate education helps students form relationships with one another (Russell, 2008), builds trust and a support structure and reduces student anxiety (Topham and Russell, 2012). Educationally, it can aid development of student conceptual progress and problem solving skills (Crouch and Mazur, 2001). The verbalisations that take place during 'active learning' type activities are considered to improve understanding (Michael, 2001), and SGL generally is widely considered to improve student retention, attitude to study and performance (Springer et al, 1999). Professionally, working in small groups is considered to provide an authentic learning experience, preparing students for the future requirement to interact with others in the workplace (Hilton, 2004; Cornell, 2008). This is particularly important on 'professional' degree programs such as Medicine or allied subjects, since these often include substantial work placements in hospitals and clinics as part of the course itself, where students are part of multidisciplinary teams and exposed to authentic team working at an early stage.

Despite the clear support for SGL as a means to enhanced student performance, there is evidence that SGL does not benefit all students equally. Low-achieving individuals have been shown to profit most from the introduction of SGL (Gaudet et al, 2010), with students in the top 20 % receiving little benefit (Carini et al, 2006). Additionally there is a broad range of evidence that suggests that not all student groups work well together

(Norman, 1992; De Grave et al 2001 and 2002; Houlden et al 2001; Hendry et al 2003; McHarg 2011) and there is wide variation in student group work experiences (Hall and Buzwell, 2013). Commonly reported problems have been associated with both individual students and group dynamic (Kindler et al, 2009), and range from the presence of dominant/ quiet students (De Grave et al, 2001, 2002; Hendry et al, 2003) to the most common student complaint, the phenomenon of 'free riding' (Latane, 1979; Latane et al, 1970; Kerr and Bruun, 1983). Studies indicate that dysfunctional groups not only impact upon student enjoyment of group work but can result in inhibition of learning (Bacon, 2005).

In addition to the importance of internal factors such as group dynamic, external factors also influence the outcomes of student group work. Most notably, a student's experience of group work is significantly affected by the amount and quality of faculty support provided (Lizzio and Wilson, 2005; Dolmans and Wolfhagen, 2005; Norman and Schmidt, 2000) and this is especially important if groups are experiencing difficulties (De Grave, 2001). The clarity of instruction provided to student groups is considered to be of particular relevance (Bacon et al, 1999) for facilitating desirable outcomes both in terms of task and process. As such, despite the general collective benefits of group work for students, we should be mindful that there may be educational consequences of a good or bad group dynamic, or poor instructional strategy. It therefore remains critical to understand the factors that influence good and bad group work within an educational setting in order to ensure the use of SGL can maximise academic and professional skills development, in particular teamworking, and is fair for all students.

Many past studies of group work in the classroom or workplace have considered the outcome of a specific task (e.g. quality or quantity produced) as a major determinant of the success of a team. Consequently, many of the studies intended to assess teamwork in students have also considered task output as the key outcome measure of the success of group processes (e.g. Huxham and Land, 2000; Rhee et al, 2013). Task output may indeed be an important indicator of group success, however it gives little information on how much the output relates to the students working well together as a team. For example, if tasks are disjunctive or conjunctive (Steiner model; Steiner, 1972) rather than additive, then the most or least able student respectively may disproportionately influence task output making any conclusions about the effectiveness of a group questionable. Similarly, especially when considering an academic task within an educational setting, group performance as a whole can often be overly influenced by the cognitive abilities of individuals within a group (Ellis et al, 2003; Devine and Phillips, 2000).

Team effectiveness is not only expressed by the quality of the team's outcomes, but also includes the quality of the team's processes as well as the perceived satisfaction of the needs of individual team members (Hackman, 1990). Adair (1973) also proposed that in managing teams, three factors were important: The task, the individual and the team. Other authors also advocate a multivariate model approach to understanding group behaviour, for example Heslin (1964) who reached the conclusion that

> "Such a model must be able to account for (a) variation in individuals along relevant personality dimensions...; (b) variations in the group's social characteristics such as freedom of interpersonal communication....and attraction

toward the group; and (c) variations in situational demands on group members, especially task" (Heslin, 1964, p255).

Based on these theoretical models of team efficacy, it seems that multiple measures of team performance are required to fully understand the mechanisms behind successful student study groups – in particular, consideration of process as well as product.

Our aim for this study was to explore the determinants of success or failure for undergraduate student teams via consideration of the task and associated outcome, the individuals within the team, as well as how they work collectively as a group. We aimed to quantify and explore associations between group dynamic and behaviour, demographic composition, member personalities and attitudes towards one another, and task success in order to better understand the complexity of how we define a good SGL team in undergraduate education.

Materials and Methods

Context for Study

Thirty-six groups were studied composed of 5 to 7 first year undergraduate students enrolled on the Bachelor of Veterinary Medicine (BVetMed) course at the Royal Veterinary College (RVC), London, UK. Following registration, students were randomly assigned to groups, in which they worked during small group teaching sessions and academic tutorials for that academic year. The demographic makeup of each group was

recorded: the numbers of male and female, home and international (split further into North American, Far Eastern, and 'Other'), 'direct entry', 'mature'(> 21 years of age at point of entry), and 'Gateway' (a one year access course for students from UK Widening Participation backgrounds) students. Students completed an induction teaching session on Group Work during week 1 of their curriculum. During this induction they were encouraged to complete the BBC for Business Self-Perception Inventory (BBC, 1994; Belbin, 1981) which provided participants with a numerical score for each possible team role preference (the various team roles are listed in Table 1). Students were asked to declare their primary and secondary team roles (roles for which their highest and second highest scores were obtained).

Three small group teaching sessions were selected and employed for this study, one in each of Term 1, 2 and 3 of the academic year (RVC weeks 4, 21 and 31). The sessions were selected such that they were of equal length (1.5 hours), similar in subject matter (integrated anatomy, physiology and biochemistry) and comparable in format (group problem solving task facilitated by an instructor, followed by hand in of the groups 4, 21 anwritten task output, grading and a group feedback session).

Teaching sessions were case-based, encompassing concepts that had been introduced prior to the group work session during a lecture. Groups were required to complete a series of structured questions relating to the case, which were formulated to drive discussion and encourage problem solving (typical questions included phrases such as 'Which organ system do you think is dysfunctional?', 'What is the prognosis?', 'Suggest why…', 'What management advice would you give the owner?sing concepts that had been introduced prior to the group work session during a lecture. Groups were h group to complete the set

of questions and to document their discussions (or answers where applicable) prior to hand in.

Instructor to student group ratio was 1:8 throughout the session, rather than provision of one tutor per group [as in a typical PBL based curriculum]. The instructor's brief was academic; the instructor interacted as required with groups in order to clarify understanding, develop problem solving skills, or aid in knowledge acquisition. The instructor made no explicit attempts to remediate or encourage group working skills. The role of the instructor for this study was the same as in all group working sessions experienced by these students at our institution – no changes were made specifically for this study.

This study was approved by the Royal Veterinary College Ethics and Welfare Committee under reference number URN-2012-0063-H.

Group process

Data on the group process were collected in three ways: through observation, student peer evaluation, and through grading of the task output.

During each of the three teaching sessions the 36 student groups were observed to allow us to document both quantitative and qualitative features of each group. Observations were carried out by members of RVC teaching and support staff, who had all been briefed and

trained in the data collection requirements, and who were independent of the class instructor to ensure facilitation of student learning was not compromised. Observations were 'light touch' in order to minimise intrusion and encourage normal behaviour; however students were aware that they were being observed. Since the data collection took place in an authentic classroom environment, it was not possible to create video or audio recordings of the groups. The observer used a semi-structured observation pro-forma to record information about each group on six occasions during the course of the session – these occasions were evenly distributed throughout the course of the teaching session for all observed groups to ensure representative behaviour was captured. The recorded information included: number of students present, time keeping (e.g. late students, time students started/finished the task), observations regarding the actions/activities of the students and notes on group dynamic/interactions and individual behaviours.

At the end of each observed session, students were asked to carry out an assessment of their peers using a paper based peer assessment form. The form required students to independently and anonymously grade one another on a 1-4 scale for seven different collaborative work skills, based on a peer evaluation exercise described in Doyle (2011). The identified skills were: working with others, task focus, quality of work, effort, attitude, contributions, and time management. Peer evaluation (PE) scores across all skills were combined for the purposes of this study, and an overall peer assessment score was recorded for each student. These scores were summed for all students in each group and divided by the number of students in the group to provide a group PE mean score for each task. The range of the individual scores within each group was also recorded (PE spread).

At the end of each observed task, groups were asked to electronically submit one copy of the completed task output to the instructor. Following submission, each output was graded by two assessors using the RVC 0-10 point marking scheme and the mean score for the work was recorded. Time and date stamps following electronic submission were used to determine if the output was submitted on time. If a group did not submit the output, they were awarded a mark of 0.

Data analysis

Data were analysed by pooling the observational data with peer evaluation scores and group demographic information, and using these data to divide the groups into clusters of similar 'type'. Task output was then statistically evaluated against all of the variables, as was 'cluster' against task output and the variables

Observational data

Observers gathered both qualitative and quantitative observational data. The quantitative or categorical observations (for example number of students present, number of students arriving late, whether the task was completed on time) fed directly into data analysis. A thematic approach was taken to analyse the qualitative data. Data were coded by two independent researchers with arising themes used to subsequently generate quantitative or categorical variables that appropriately described the group work processes that took place (for example if there were any dominant individuals noted within a group, these were counted). Thematic data were later revisited and analysed directly to further explain quantitative trends that emerged and provide context to the descriptions of group behaviour.

Variables

A summary of the variables that fed into subsequent analysis and how these variables contributed to assessment of Task, Individual, and Team outcomes is provided in Table 2.

Cluster analysis

A cluster analysis of the data was undertaken, allowing a model, or, taxonomy of group behaviour to be developed. Groups were divided into clusters using a Two-step cluster analysis of the collected data, undertaken in PAWS Statistics Version 19.0. To ensure a robust cluster solution, multiple cluster analyses were carried out to ensure the appropriate cluster number was selected and a stable profile was generated.

Exploring associations

Relationships were explored between each variable and task output and comparisons made between the different clusters identified. Following the selection of an appropriate cluster solution, differences in cluster characteristics were evaluated using Independent samples Analysis of Variance (ANOVA) followed up with Fishers Least Significant Difference (LSD) post hoc tests, or Kruskal-Wallis tests, as appropriate.

Observational, demographic and peer evaluation data were evaluated against task output for each of the three tasks and as an average across all tasks using ANOVA and followed up with Fishers LSD post hoc tests. Spearmans rank correlation was undertaken to

ascertain the relationship between ordinal variables and task score. A p-value below 0.05 was considered significant. All statistical procedures were carried out in PAWS Statistics Version 19.0.

A cluster analysis finds structure in data, but does not provide an explanation for that structure. Hence, in order to understand group processes and interactions in the clusters of groups considered to be successful, or less so, we first identified a meaningful pattern of clusters and later revisited the qualitative classroom observations for these groups

Results

Descriptive summary

A summary of the demographic characteristics and teamwork characteristics of the student cohort studied can be found in Figures 1 and 2. The mean task score for all groups at each task occasion was 63 $\pm$ 14 %, 57 $\pm$ 32 % and 61 $\pm$ 32% respectively, with a combined task score averaged across all testing occasions of 60 $\pm$ 16 % [all values are mean and SD]. All groups submitted a task assignment in term One; however 7 groups failed to submit a task in term two, and 7 in term three. In addition, in terms two and three, 2 and 3 groups respectively handed in their task late. Mean peer evaluation scores for the whole cohort at each testing occasion were 87 $\pm$ 6 %, 83 $\pm$ 7 % and 89 $\pm$ 7 %. Seven groups showed a general pattern of improving peer evaluation scores over the course of the study, whilst fifteen groups showed a general reduction in peer evaluation scores between the first and last test occasions.

Codes that arose from the observational data were used to create the following quantitative variables: Number of observed leaders; Number of dominant isolated students; Mentions of active/passive learning; Mentions of a positive / negative atmosphere; Number of electronic devices in use; Mentions of independence (+/-); Number of quiet students observed; Number of students present and/or late.

Interactions of individual and team with task output

The presence or absence of individuals offering a particular teamwork characteristic (Table 1) within a group was found to influence task output. Specifically, the presence of a Shaper was found to increase the overall average task score (71 + 6 % with, compared to 66 + 8 % without; $p = 0.05$) and the presence of a Chairperson increased the task score in Term 1 by 18% (66 + 14 % for those with a Chairperson compared with 48 + 4% for those without; $p = 0.0001$). The presence of a Plant also significantly influenced task score (76 + 3 % with and 67 + 6 % without; $p = 0.0001$).

When number of individuals with a particular teamworking characteristic was considered, positive correlations with task output were observed for the number of Shapers (Overall average score; $r = 0.322$; $p = 0.05$; Figure 3a), Chairpersons (Term 1 score; $r = 0.420$; $p = 0.01$; Figure 3c) and Plants ($r = 0.614$; $p = 0.001$; Figure 3b) present within a team. Additionally, a negative association was found between the number of Chairpersons in a group and task score in Term 3 ($r = -0.418$; $p = 0.024$; Figure 3d).

The number of international students within a group was positively associated with task score ($r = 0.334$; $p = 0.047$; Figure 3e). This was largely attributable to numbers of NA students ($r = 0.460$; $p = 0.005$) with no association found between task score and other sub groupings of international students ($p > 0.05$).

The task score was found to be associated with some observed team characteristics. The mean score obtained in Term 3 ($r = -0.496$; $p = 0.006$) and mean task score overall ($r = -0.514$; $p = 0.001$) were found to be negatively associated with the number of observed leaders.

Cluster Analysis

A cluster analysis was chosen for exploratory analysis of the data since it allows identification of groups of individuals (or in this instance, groups of teams) that are similar or different from others. A six cluster model emerged as the most stable cluster solution; six clusters were deemed appropriate since beyond this number cluster sizes became very unequal or too small. The Silhouette Measure of Cohesion and Separation for the favoured and reported solution was 0.3. Table 3 shows the resulting model, reporting cluster sizes, and the predictors used by the clustering algorithm when assigning student groups to a particular cluster. Half of the clusters (A –HC) achieved high task output scores and half were low scoring (D – F). Cluster profiles were reviewed, and used to rate the 'proficiency' of each team in each of the areas 'Task', 'Individual' and 'Team' (Table 4) All clusters exhibited differences from one another in relation to their group processes (observational data) and the characteristics of the individual members. Figures 1 and 2

illustrate the differences between clusters at the 'Individual' level with respect to the whole population. Observational data were revisited for identified groups within each cluster and is reported to illustrate the membership profile and 'Team' attributes of each cluster. An artist's representation of each cluster is also given in Figure 4.

Cluster Profiles

Cluster A clearly represented the high performing groups of students, where the ir group processes (observational d requirements of a good group seemed to successfully come together. They consistently obtained high scores in tasks, had a high opinion of one another's team working skills (high scores with minimal spread in peer evaluations) and were observed to have positive group processes. Groups in Cluster A achieved on average 76 % across all tasks which was significantly higher than clusters D, E and F ($p = 0.013$). Groups in this cluster were characterised as having a clear demographic make-up (Figures 1 and 2) containing a minimum of one international student, and a median of one Far Eastern and one North American student (a greater number than in any other cluster: $p = 0.015$). They had good gender balance given the demographic of the student cohort (2 male students; Figure 1), no Gateway students, and often a mature student. These groups also had a relatively even spread of teamworking characteristics within the group, with significantly fewer missing roles than clusters D and E ($p = 0.022$).

Groups in this cluster were observed to have few dominant individuals and minimal observations of a negative atmosphere. Students in these groups also exhibited behaviours that could be considered to be typical of a group exhibiting positive interdependence:

"One member reads lecture notes. One types in the answers. Others are contributing to this by clarifying what should be written down. There is a separate conversation between two members as one asks the other to explain something" (Group 1; Cluster A)

"One girl makes a nice diagram. 3 others discussing the task at one end. 2 looking at the computer and talking about arginine and whether it is required" (Group 9; Cluster A)

Cluster B was characterised by groups that achieved high scores in task outputs, particularly in Task 3 (average 80 %), yet appeared to have a negative group atmosphere and problematic processes. Teams in this cluster were considered to be working with a high degree of independence (which was reported in a negative light). They were observed to have a highly unconstructive atmosphere (significantly more so than groups in other clusters, $p = 0.015$), with few positive impressions noted by observers comments (fewer than other clusters, $p = 0.037$). Observers of groups in this cluster considered them to be passive in their learning in comparison to groups in other clusters (notably A, C, D and F; $p = 0.018$). The following observations illustrate the negative atmosphere and passive nature within groups in Cluster B:

"There's a girl with some notes trying to talk with two boys but they're talking over her so she stops trying" (Group 8; Cluster B)

"Quiet girl not talking but on iPad reading; She moves in and out of the group and is angled away from the others..... One girl makes a comment – the other three just stare at her or the PC. Very little acknowledgement of her comment! Completely

blank faces when she stops talking – no verbal reaction at all. One types what she just said." (Group 4; Cluster B)

"One girl is just staring at the sheet and screen – looks uninterested. Now examining her pen. Another student leaves the room for a few minutes" (Group 11, Cluster B)

It is notable that groups in this cluster were observed to be lacking a clear leader, which was not the case for groups in other clusters ($p = 0.039$).

Groups in **Cluster C** were characterised by high task scores, but they appeared to lack crucial individuals and were highly critical of one another in peer evaluations. These groups achieved especially well in Term 3 (83 %). The pattern of task scores shows consistent improvement from Term 1 where they scored significantly lower than groups in other clusters (average 50 %; $p = 0.07$). Groups in this cluster were found to be missing a high number of teamwork characteristics (median of 3 roles missing: significantly higher than Clusters A and B; $p = 0.022$; Figure 2b). Students in these groups gave low peer evaluation scores and there was a high spread of these scores within each group. During Terms 1 and 3 their peer assessment spread was significantly higher than for all other clusters ($p = 0.017$ and $p = 0.003$ respectively).

Observations of groups in Cluster C suggested a preference for working individually and their individuals demanded very high standards of one another:

bStudent buries head in notes. She is explaining there's two different conversations going on: 'I'm writing what I know and listening to her'. Lack of unity in this group" (Group 24, Cluster C)

"Clarifying what they have learned. One says 'YES!....because' – tone of exasperation and trying to justify standpoint. Other challenges and gets quite stroppy. Clarified by another student. The instructor is called in to settle." (Group 28, Cluster C)

"Student that needed explanation has left – perhaps to seek the clarification she needed??" (Group 28, Cluster C)

Cluster D was characterised by groups that achieved average task scores, and contained many dominant/ quiet individuals as well as those with Chairperson characteristics. Groups in Cluster D typically had average task scores (64 %); their evaluation scores of one another tended to be low, and deteriorated as the year progressed. Peer evaluation scores fell by 4 % between Terms 1 and 2 and by Term 3 this cluster showed higher spread in peer evaluation scores than other clusters (compared with Clusters A, B, F and E; $p = 0.003$). The cluster was characterised by groups which contained a high number of individuals who were observed to be dominant than Clusters A, B, C and E ($p = 0.001$), and a median of 3 Chairpersons, higher than in any other cluster ($p = 0.0001$; Figure 2a).

The presence of dominant individuals appeared to create some conflict within these groups, disrupting team processes:

"Leader girl draws attention of chap by hitting him on the arm with a pen" (Group 2, Cluster D)

"One of the leaders is verifying information – she is questioning the other fact finder and making sure she understands. She grabs the iPad from the boy who acquiesces and gets his phone out instead" (Group 21, Cluster D)

The compliance of the student when his iPad was removed from his possession illustrates a key characteristic of the groups in this cluster: that often the students who were not leaders or dominant were in the minority and therefore very quiet and isolated from the rest of the group:

"One dominant student doing most of the talking – to one other student! (not the whole group); One chap has his hand on head." (Group 21, Cluster D)

"Leader girl has gone to get netbook. Very quiet without her to instigate conversation.... [On return] girl uses netbook for her own research" (Group 14, Cluster D)

"The fifth student is staring into space, even when the others are laughing at one of the boys who has got something wrong.... One boy challenges the quiet girl to laugh and she smiles briefly. I found this group very difficult to watch, the main four were such robust characters and the fifth looked so frail and quiet" (Group 2, Cluster D)

Many of the groups in this cluster were indeed observed to contain isolated individuals (85 %).

Groups in **Cluster E** achieved low marks in tasks and exhibited non-attendance even though these groups appeared to be highly effective in terms of group processes. Cluster E groups typically achieved a low score in the Term 1 task (52 %) and showed a large dip in student attendance in Term 2 (median of only 3 students present at this session; significantly lower attendance than both Clusters A and D; $p = 0.04$). Despite this, observations of groups in Cluster E tended to report positive group processes and atmospheres with signs of high agreeableness and group cohesion:

> "*Seems a very collaborative group; happy to challenge each other and learn from each other. All being quite self depreciating and agreeing with each other. Very collaborative group – slipped in and out of different roles"* (Group 7, Cluster E)

> *"Very open group; there's a container of shared pens in the middle; relaxed; good balance between questions and answers. Lots of checking back that everyone has understood"* (Group 13, Cluster E)

Groups in Cluster E were lacking in both diversity and certain key individuals. The cluster demographic exhibited few or no international students, Gateway students, or mature students, and a low number of male students present within these groups (Figure 1). They also lacked a clear leader with no person able to fulfil the Shaper or Chairperson role (Figure 2a,c). Other clusters had significantly more students that fulfilled one of these two roles ($p = 0.0001$) and fewer unfulfilled teamwork characteristics ($p = 0.022$; Figure 1).

Cluster F was characterised by groups with exceptionally low average task scores (36 %). They had a clear problem with absenteeism and when these groups did attend, they often handed in the task late, or not at all. Dominant individuals and irrational peer assessment

scores were also seen. A fall in student numbers within Cluster F groups (by a median of 1) was noted from Term 1 to Term 2. By Term 3 many of these groups did not complete or hand in the task at all, or it was late; this was not a feature of groups in the other clusters ($p = 0.0001$). Despite this these groups scored one another highly in peer evaluations and with minimal spread – which on the basis of the other evidence must be either a deliberate attempt to deceive, or perhaps indicates a severe lack of collective efficacy (and self efficacy) skills. Groups in this cluster were found to have a greater number of dominant individuals compared with other clusters (compared to clusters A, B, C and E; $p = 0.001$). They were also observed to have non-cohesive timing. The qualitative observations shed some light on the ineffectual group processes present in Cluster F groups. Observers commented on several interesting behaviours; in particular, when present, these groups often appeared distracted or to lack task focus:

> *"Students are laughing as a student has broken her nail....Talking about diets....Giggling and talking about eye colour and other things"* (Group 10; Cluster F).

The lack of cohesion in Cluster F groups is also clear from observational comments:

> *"One works on laptop in isolation – the group do not try to engage her"* (Group 30, Cluster F)

> *"Group appears to continually break into pairs rather than work as a group"* (Group 10, Cluster F)

There are also some observations of dominance, overconfidence and further indications of an apparent lack of collective efficacy and meta-cognition:

"Boy tells the girls to calm down when they don't know the answers" (Group 10, Cluster F)

"Boy in shirt is talking very confidently even if he isn't right." (Group 18, Cluster F)

Discussion

Defining a 'Good Group'

Our results serve to illustrate the key principle that academic task output, individual and team processes are, in many student groups, not directly correlated. In particular, high quality task output is not a good proxy of high quality team processes. Good or poor aspects of team processes in one of these areas during completion of a group work task do not necessarily result in either good or poor task outputs. The six clusters of student groups that emerged from our data all exhibited different attributes within the construct of Adair's Action Centred Leadership model (Adair, 1973; Table 4). Only one cluster emerged as successful at all three levels [task output (Task), team members (Individual) and group processes (Team)], whilst others exhibited varying levels of success in each of the three spheres. This serves to reinforce the previously held belief that team effectiveness is not only determined by the quality of group outcomes but also is portrayed by the quality of the team's performance (Hackman, 1990). If team working skills are therefore considered to be important in healthcare professional education, these need to be assessed and/or taught explicitly *in situ*. In the ensuing discussion, we examine the specific attributes of successful and less successful groups in our study, and offer some practical recommendations based on our findings.

The most successful groups (in all three spheres) in this study exhibited diversity and interdependence. Many studies have considered the influence of culture on group performance, and support diversity in groups (Watson et al, 2002; Johnson et al, 1981). They suggest that differences in experience, culture and knowledge provide enhanced opportunity for questioning, discussion and debate, which are all beneficial activities in SGL (Cohen, 1994; King, 1992). A number of studies have illustrated that team effectiveness is enhanced in groups exhibiting positive interdependence (Gully et al, 2002; Katz-Navon and Erez, 2005), illustrating the importance of team processes in facilitating an effective outcome. This emphasises the inappropriate nature of any assumption by educators that a successful task output equates to successful group work; additional measures of group work processes are required to effectively measure teamwork success.

Three clusters of groups in this study serve to highlight that task output alone is an inappropriate metric for defining group success – those with good grades and poor processes (B and C) as well as those with apparently good processes but poor grades (E). The apparent task failure of groups in Cluster E, despite the good group work processes observed in these teams, highlights the over simplicity of solely using a team's task output for assessment purposes if the aim of a curriculum is to reward and encourage good teamwork. Observations and peer evaluations in cluster E revealed high agreeableness and group cohesion in these groups – both of which have previously been positively linked with group performance (Slavin, 1996; Johnson et al, 1998; Neumann and Wright, 1999; Bell, 2007; Prewett et al 2009; Thompson et al, 2015). Some level of conflict may be desirable in teams however, creating opportunity for debate, diversity of opinion and

perspective (De Dreu & Weingart, 2003). It has also been suggested that whilst status struggles are detrimental to team performance, a strong hierarchy within a group is preferable to insufficient differentiation of status or a diffuse authority structure (Overbeck et al, 2003). Perhaps in our study, the productivity of groups of this nature (E) suffered from their agreeable characteristics and apparent lack of leadership These groups may require additional individuals that can drive progress, plant ideas and mould the team (Shapers, Plants) in order to achieve, or some pastoral support and coaching to help develop these characteristics within the group. If student groups are to be randomly assigned, further measures such as leadership training may be required for some teams, to ameliorate the effect of absent key individual personalities.

Two clusters, B and C, characterised teams that were capable of good output despite problems with either processes or individuals (such as passivity and independent working). 'Free riding' (or 'social loafing'; Latane, 1979; Latane et al, 1970; Kerr and Bruun, 1983) is of concern not only because it affects students' enjoyment of study but also their ability to learn (Bacon, 2005). Often students may be perceived by others to be free riders, however there is evidence that students are often mis-labelled as such when in fact instead they exhibit 'lone wolf' characteristics (Barr et al, 2005), and simply prefer to work individually. Both are undesirable traits for small group learning activities, and effective course/class design and teaching should aim to make task success unlikely if team members do not all collectively contribute. Assuming that development of team-working skills is desirable in healthcare education, if a group with poor processes can be successful at a task, by definition the task must have been badly chosen or designed. This represents a basic curriculum and educator failure because task design is so fundamental to the successful delivery of teaching by small group means.

Task Design

The type and characteristics of the task have been proposed to be critical in terms of the ensuing team performance and output that are generated. Steiner (1972) identified a taxonomy of group tasks (one of many such classifications in existence) which he proposed to be a key source of problems and process losses within groups. He proposed that tasks have three properties: their Components (or divisibility), their Focus (quantity or quality), and their Interdependence (combinatorial strategies required for success). This latter category contains several classes of task: Additive tasks, where team performance should be the sum of all of the individual performances of team members; Compensatory tasks, where team performance should be indicated by the average of all participant's individual contributions; Conjunctive tasks, where all team members have to reach a certain minimum level for success to be possible (and hence task outcome is limited by the worst performing individual); and Disjunctive tasks, where team performance is defined by the best performing individual in the team. Arguably, additive or compensatory tasks are likely to produce the most effective measure of true team performance, substantiated by Prewett et al (2009) who showed that personality composition of teams becomes a better predictor of team performance when tasks are truly interdependent. On the basis of Steiner's model, educators should ensure all group learning tasks are unitary (i.e., cannot be broken into subtasks for individual members), require a high rate of production quantity, and interdependence among members to yield a group product. This should maximise potential for good group performance and ensure that output more closely represents process.

Other features of task design are also important in a group work setting. Clearly stating the problem, and establishing clear goals leads to increased motivation and improved performance (Harkins and Szymanski, 1989; Sockalingham and Schmidt, 2010). Medical students suggest that tasks should be clinically relevant and integrative and that the cases should promote thinking and problem solving (Steinert, 2004). Tasks should also be realistic, deeper than usual, and they should elicit controversies and contradictions (rather than simply exploratory and cumulative discussions; Visschers-Pleijers et al, 2005).

Dysfunctional groups

Clear examples of where both individual and process failure hindered team output were visible in this study. Inequity of roles and poor division of labour were common themes in some groups, causing breakdown of group processes, and potentially hampering the task output that these groups were truly capable of. Teams with too many dominant individuals can result in disputes over status and ownership that ultimately undermine performance (Bendersky & Hays, 2012). Such competition and conflict can lead individuals to focus their attention on status struggles rather than on the team and task at hand (De Dreu & Weingart, 2003; Greer et al, 2011). This phenomenon is similar to the experience of Meredith Belbin when observing the g the . This phenomenon is similar any highly capable individuals (Belbin, 1981). A 'too much talent' effect is also evidenced in the sporting world, where many talented team members appear to facilitate performance up to a point, after which the benefits of more talent decrease and eventually become detrimental (Swaab et al, 2014). Conflict within teams has been seen to lead to individuals actively marginalising and undermining other team members' efforts in order to advance their own standing within the group hierarchy (Overbeck et al, 2005; Porath et al, 2008). These

previously documented events are mirrored strongly in our observations of some student groups.

The most concerning student groups in our study (Cluster F) lacked collective efficacy (and self-efficacy) skills, which have been proposed as important for successful teamwork (Gully et al, 2002; Stajovic et al, 2009). There is strong evidence that collective-efficacy and group performance are interrelated (Gully et al, 2002; Stajkovic, 2009), which combined with apparent deficits in meta-cognition (unreliable peer evaluation scores) may explain the poor task results for these groups. Meta-cognition – "knowing about knowing" (Metcalfe and Shimamura, 1994) - is influenced by and can be changed by social persuasion (Larkin, 2006). Thus, the maladaptive meta-cognition exhibited by students in these groups may improve as the students continue to participate in group work activities. It has been argued that 'learning by doing' in the context of teamworking activities promotes coordination and team stability (Reagans, et al, 2005) but further studies considering how best to support the longitudinal development of learning teams would be beneficial.

Task output is directly influenced by group membership characteristics

Alongside the analysis of groups by cluster, we also considered direct relationships between Task output and the other variables indicative of Team processes and Individual characteristics. The presence or absence of individuals offering a particular teamworking characteristic within a group was found to influence task score, with the presence (and number) of individuals with Shaper and Plant characteristics within a team positively

influencing overall success on tasks during the study, and the number of Chairperson characteristics positively influencing success in the first task. This finding supports previous studies which suggest that leadership is important in determining team success (Henry and Stevens, 1999). It also appears that the first task a team undertakes may be key in terms of the establishment of team roles. In particular for a new group, the 'forming' stage of group development, where groups "identify the boundaries of both interpersonal and task behaviours"e(Tuckman, 1965; p396) requires leadership and coordination in order to delegate roles and responsibilities. It may be for our students that the presence of multiple Chairpersons at this early stage eased the progression of group development and hence enhanced initial task outcome. In fact there is evidence that collective leadership may be the most effective form of leadership for a learning team (Sivasubramaniam et al, 2002) rather than individual directive leadership, which has been associated with undesirable (Fransen, 2011) and potentially disastrous outcomes (Kayes 2004).

Interestingly, when the Term 3 task was considered alone, a negative association was found between both the number of Chairpersons in a group and the number of observed leaders with task score. This suggests that at this advanced stage in the group's development, too many individuals demonstrating leadership (specifically Chairperson) characteristics were detrimental to the group processes and consequently task output. Low performing teams have previously been shown to be abundant in individuals with Chairperson characteristics (Chong, 2007) and it appears that teams may require a different role set at different stages of development. Perhaps an excess of Chairperson role behaviours at a more advanced stage of development is inappropriate. Partington and Harris (1999) suggest that a predominance of Chairpersons may lead to dependency and inactivity from others within the group who may have otherwise contributed to the team's

performance. If the role requirement of a learning team evolves over the course of time, perhaps the traditional notion of static team membership is not appropriate in this context. Indeed many medical environments, especially in emergency situations require development of 'teams on the fly' (Edmonson, 2012), and perhaps educational settings could attempt to recreate such an environment for team work training.

Strengths and Limitations

This study is not without its limitations. The single biggest limitation is that we examine a limited number of student groups (36) within a single undergraduate cohort of Year One students, in one UK veterinary school. A degree of caution should be applied therefore when generalizing our findings to other cohorts of students and other types of group work setting and curricula. Despite this, the cohort studied was large (>200 students), all of whom were observed working with their groups, and all of whom contributed team role preferences to the study, which is a considerable achievement. We are also confident that our findings are sound since they are in broad agreement with the existing vast literature on group work in education.

Due to group work sessions taking place in large open plan teaching areas, it was not possible to make video or audio recordings of the sessions. This meant that an observer was required to gather observational data; observations were not continuous (i.e. each group was visited on several occasions throughout the session), and so not every group interaction was logged. Students were also aware that they were being observed – this did not appear to, but had the potential to, affect their behavior.

Regrettably, this study could not consider individual academic outcomes on a task by task basis, so we were unable to use individual academic performance as a variable in our analysis – this would have been ideal given that the cognitive ability of group members has previously been shown to be important when considering, specifically, teams for learning (Ellis et al, 2003; Devine and Phillips, 2000). Neither did we consider the influence of facilitator intervention on group work - this was deliberate to ensure intervention did not confound our findings, but this is an important area and future studies will consider the type of support and teaching required by students for optimum group work skills development.

Despite its limitations, this study has a number of strengths: primarily, it is multidimensional in approach, uses mixed methods, and makes use of multiple observations over the period of a year. This approach allowed us to consider many of the important aspects of the group work process, providing a unique insight into the characteristics of student groups. We are able to make some clear and important recommendations on the basis of our findings, and thus there is considerable potential for this study to have direct applicability for driving and informing institutional change and faculty/student development.

Application and Future Work

The results reported here give insight into group function and processes within student groups on an undergraduate Veterinary Medicine program. In order to prepare our

students for the workplace, and their professional futures it is important that they are able to work together in teams of varying composition. If we wish to develop individuals as 'team players' we must not measure or acknowledge task output alone. Output is important, since we want our students to successfully complete educational tasks; however educators must decide when designing tasks and learning outcomes whether this is sufficient. If learning to work as part of a team is also an objective of small group learning, then assuming that successful completion of a good group project will equate to successful teamwork is naïve. In designing the curriculum, team working tasks should not be seen simply as a delivery vehicle for content or specific skills, but also as an opportunity for students to learn to work collaboratively with others. As such, task design should be carefully considered and assessment of group work should be closely aligned to assess not only academic output but also other measures of group effectiveness.

This study highlights the key features of a "good group" in undergraduate health science education. A temptation for educators may be to use this information to pre-select student groups to mirror the ideal composition, by selecting for specific combinations of demographic characteristics. A considered drive to broaden the cultural demographic on professional courses may facilitate this in part and could enable an educational institution to better prepare students for their future roles in society as medics, professionals, and citizens (Bollinger , 2003). Caution should be applied however when considering social engineering of SGL group composition. Such schemes may be valuable initially for students: by placing students in a group that is expected to be successful, positive academic and group work outcomes are likely to follow. However, in the light of future working by students on professional programmes with a multitude of personalities, in varied and difficult environments, it is vital that we equip our students with the resilience,

coping strategies and skills to deal with working in these more challenging situations as well (Delany et al, 2015). If students experience group working challenges whilst still under the guidance of supportive faculty, what might otherwise be a negative experience has the potential to become a transformative educational opportunity. A compromise must therefore be made, between avoiding barriers in group work that could threaten student learning, and equally allowing students to practice challenging group work in a structured, safe and supportive environment. This might be achieved by providing engineered or self-selected groups in the earlier years of the course, moving to random allocation later on.

Highlighting 'types' of student group and the problems they face during SGL has provided us with a platform to more effectively monitor and predict the performance of student groups. Identifying 'risk-factors'isuch as lack of a leader, lack of diversity (in terms of team roles or demographic), or low peer assessment scores may allow for tailored and appropriate intervention at an early stage in order to help groups deal with process problems when they arise. Explicit training and 'on task' support for students in effective team work is crucial to developing group working skills. A student's experience of group work is significantly affected by the degree of facilitator support provided (Lizzio and Wilson, 2005; Dolmans and Wolfhagen, 2005) with evidence that this is particularly important if groups are diverse and multicultural (Sweeny et al, 2008; Li and Campbell, 2008) or if the groups have difficulties interacting with one another (De Grave et al, 2001). This presents an additional responsibility for teaching staff, and if the role of the educator in designing and implementing group learning tasks is to extend beyond that of an academic facilitator, it is likely that additional teacher training will be required in many institutions. This is particularly pertinent in modern medical curricula where Problem Based Learning (PBL) and more recently Team Based Learning (TBL) are gaining

popularity. Ensuring facilitators are prepared for the pastoral and team development elements of group work as well as being well versed in the pedagogy of good task design is a significant challenge.

Conclusion

The aim of this study was to explore the determinants of success or failure for undergraduate student teams in order to better understand the complexity of how we define a good SGL team in undergraduate education. In doing so, we considered each of: the task and associated outcome, the individuals within the team, and how they work collectively as a group. We report associations between group dynamic and behaviour, demographic composition, member personalities and attitudes towards one another and task success and we provide a model outlining the attributes of a good SGL team in undergraduate veterinary education. In finding six clusters of groups, all featuring different characteristics and attributes, we highlight that high scoring and low scoring student groups differ in other measures of their effectiveness as teams. This is an especially important conclusion if learning outcomes of SGL are broader than simply being able to produce a group output, and we also wish to teach students to work as a member of a team. On the basis of our evidence, we cannot assume that such process skills are automatically acquired through participation and task success alone. It follows that if process skills are important as a learning outcome, these must be assessed directly alongside task output.

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Figure Legends

Figure 1. Demographic composition of all student groups (Box and whiskers) in relation to median characteristics of Clusters A to F (markers). (a) Number of international students; (b) number of students of Far Eastern residency; (c) number of students of North American residency; (d) number of mature students; (e) number of 'Gateway' students; (f) number of male students. Key: Cluster A - Blue; B – Orange; C - Purple; D - Brown; E – Red; F - Green.

Figure 2. Teamworking characteristics of all student groups (Box and whiskers) in relation to median characteristics of Clusters A to F (markers). (a) Number of Chairperson characteristics; (b) number of Plant characteristics; (c) number of Shaper characteristics; (d) number of Company Worker characteristics; (e) number of Resource Investigator characteristics; (f) number of Team Worker characteristics; (g) number of Completer characteristics; (h) number of Monitor-Evaluator characteristics. Key: Cluster A - Blue; B – Orange; C - Purple; D - Brown; E – Red; F - Green.

Figure 3. Task scores against group composition. (A) Number of shapers with average task score ($r = 0.322$; $p = 0.05$); (B) Number of Plants with average task score ($r = 0.612$; $p = 0.001$); (C) Number of Chairpersons with Term 1 Task score ($r = 0.420$; $p = 0.01$); (D) Number of Chairpersons with Term 3 Task score ($r = -0.418$; $p = 0.024$); (E) Number of international students with average task score ($r = 0.334$; $p = 0.047$). Bar represents median; box represents interquartile range; whiskers indicate range of data; outliers are represented by stars. N= 36

Figure 4. Artist's representation of a typical group from each of the six clusters A to F.

Tables

Team Role	Proposed Characteristics
Shaper	Task-focused, energetic, will to achieve. Challenge the team to improve. Dynamic and extroverted.
Chairperson	Chairperson. Confident, stable and mature. Delegator. Clarifies decisions.
Plant	Creative, unorthodox and generators of ideas. Bright and free-thinking. Imaginative.
Team Worker	Good listeners and diplomats. Smooth over conflicts.
Monitor Evaluator	Fair and logical observers. Impartial. Can see all available options. Analytical. Strategic.
Resource Investigator	Vigorously pursues contacts and opportunities. Focused outside the team. Outgoing, an excellent networker.
Completer	A perfectionist. Accurate and with high standards. Conscientious.
Company Worker	Turn ideas into positive action. Efficient and self-disciplined. Reliable. Timely. Loyal to the team.

Table 1. Team Roles as assigned by the Self Perception Inventory (BBC, 1994) and their associated characteristics (Belbin, 1981)

	Task	Individual	Team

Quantitative variables	Task score (Term 1 – 3) Sum of all task scores	*Number of students present at tasks* *Number of students late for class* *Number of dominant students observed* *Number of quiet/passive students observed* Number of unfulfilled team role preferences within the team *Number of leaders observed*	Total group peer evaluation scores (Term 1-3) Sum group peer evaluation scores Range of peer evaluation scores Change in peer evaluation score between task occasions
Categorical variables	Task hand in late? (Y/N) Task complete? (Y/N)	Gender Home/international status (and nationality) Entry status (Direct entry/Mature/'Gateway') Team role preferences	*Positive/negative atmosphere observed* *Independence of team members observed (+/-/o)*

Table 2. A summary of the variables that fed into data analysis and how these variables contributed to assessment of Task, Individual, and Team outcomes. Variables derived from observational data are italicized.

Cluster	**A**		**B**		**C**		**D**		**E**		**F**	
	Predictor	Value	Predictor	Value	Predictor	Value	Predictor	Value	Predictor	Value	Predictor	Value
# groups In cluster	8		6		6		5		6		5	
Most important predictors used to assign cluster membership	Sum task scores	76%	Independence	75% Negative	# dominant students	1.8 (2)	Term 3 Task score	83%	Task score Term 1	52%	Task submitted on time Term 3	No 100%
	Term 1 PE mean	96%	Term 3 Task score	80%	# coordinators	3.2 (3)	Term 3 PE spread	17%	Term 1 PE spread	3%	Term 3 PE spread	2.50%
	Term 2 task score	78%	# unfulfilled Belbin roles	1.38 (1)	Isolated individuals	85%	Term 1 PE spread	22%	# Chairpersons	0.4 (0)	Sum task scores	36%
	# dominant individuals	0.17 (0)	Observed # leaders	0.38 (0)	PE improvement 1 to 2	-4%	Term 1 PE mean	78%	# Shapers	0.2 (0)	Cohesive timing	No 75%
	# negative atmosphere observations	0.83 (1)	# positive minus negative observations	-0.38 (0)	Task score/ number completed	64%	# positive atmosphere observations	3.2 (3)	# students present Term 2	3.4 (3)	Term 3 PE mean	92%

Least important predictors used to assign cluster membership	*# females*	*4.17 (4)*	*Term 2 PE spread*	*16%*	*# Gateway students*	*0.6*	*Difference in group size, task 1 to 2*	*-1*	*Number of Far Eastern students*	*0*	*On time Term 2*	*Yes 75%*
	# 'other' international students	*0.17 (0)*	*PE improvement 2 to 3*	*-5%*	*# Completer-finishers*	*1.8 (2)*	*# Far Eastern students*	*0*	*# International students*	*0*	*# students present Term 1*	*5.25 (5)*
	Term 2 PE mean	*89%*	*On time term 3*	*Yes 75%*	*# students present Term 3*	*5 (5)*	*# International students*	*0*	*# 'other' international students*	*0*	*# students present Term 3*	*4.25 (4)*
	Term 2 PE spread	*17%*	*# Shapers*	*0.88 (1)*	*# North American students*	*0*	*# North American students*	*0*	*# of Plants*	*0*	*# Far Eastern students*	*0*
	Observed # of quiet students	*1.17 (1)*	*# students*	*6 (6)*	*# Plants*	*0*	*# Belbin characteristics missing*	*3 (3)*	*# leaders*	*1 (1)*	*# North American students*	*0*

Table 3. Cluster Analysis Output: Characteristics and associated values for the six different clusters, ranked in order of predictor importance for that particular cluster. Most important features (Predictors) were highly influential when the clustering algorithm assigned cluster membership to student groups. Least important predictors were not influential in determining to which cluster a student group belonged. . Values are presented as means, with median where appropriate in brackets.
Abbreviations: Peer Evaluation score (PE); Number (#)

Cluster	A	B	C	D	E	F
Task Output	++	++	+	-	--	--
Team Process	++	-	-	-	+	-
(Attendance)	(++)	(+)	(+)	(+)	(-)	(--)
Individuals	++	+	-	-	-	-

Table 4. Analysis of Clusters by the three pillars of group work: The Task, Team and Individuals. ++ denotes excellent; + good; - poor; -- very poor.

Figures

Figure 1. Demographic composition of all student groups (Box and whiskers) in relation to median characteristics of Clusters A to F (markers). (a) Number of international students; (b) number of students of Far Eastern residency; (c) number of students of North American residency; (d) number of mature students; (e) number of 'Gateway' students; (f) number of male students. Key: Cluster A - Blue; B – Orange; C - Purple; D - Brown; E – Red; F - Green.

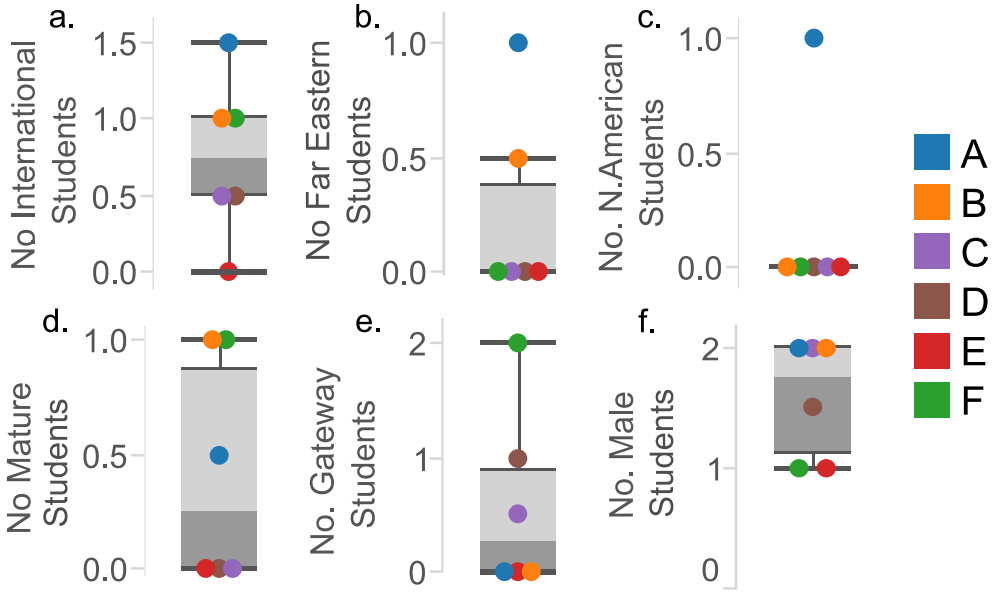


Figure 2. Teamworking characteristics of all student groups (Box and whiskers) in relation to median characteristics of Clusters A to F (markers). (a) Number of Chairperson characteristics; (b) number of Plant characteristics; (c) number of Shaper characteristics; (d) number of Company Worker characteristics; (e) number of Resource Investigator characteristics; (f) number of Team Worker characteristics; (g) number of Completer characteristics; (h) number of Monitor-Evaluator characteristics. Key: Cluster A - Blue; B – Orange; C - Purple; D - Brown; E – Red; F - Green.

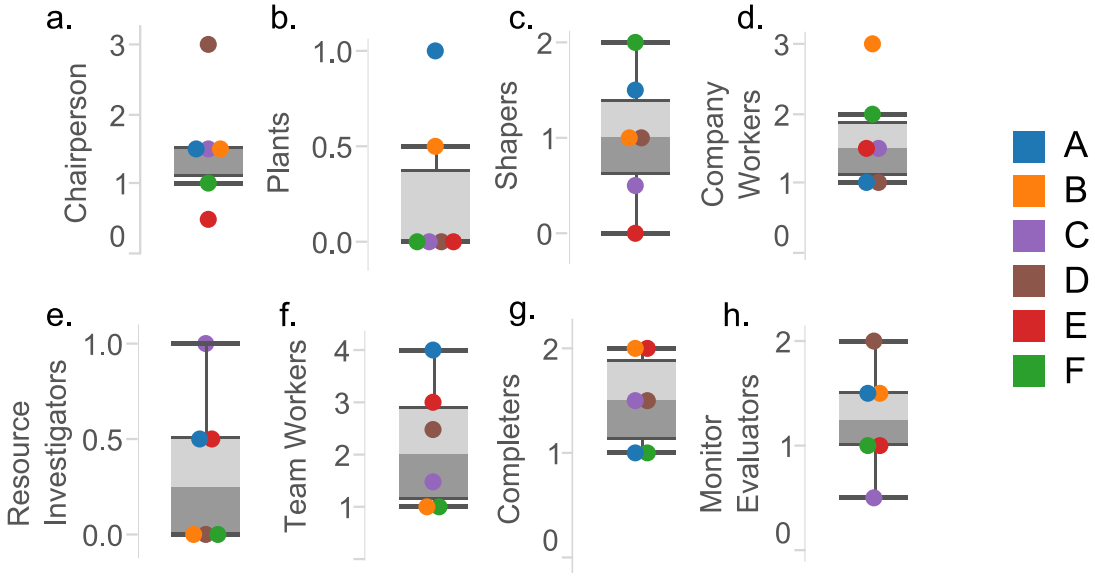


Figure 3. Task scores against group composition. (A) Number of shapers with average task score (r = 0.322; p = 0.05); (B) Number of Plants with average task score (r = 0.612; p = 0.001); (C) Number of Chairpersons with Term 1 Task score (r = 0.420; p = 0.01); (D) Number of Chairpersons with Term 3 Task score (r = -0.418; p = 0.024); (E) Number of international students with average task score (r = 0.334; p = 0.047). Bar represents median; box represents interquartile range; whiskers indicate range of data; outliers are represented by stars. N= 36.

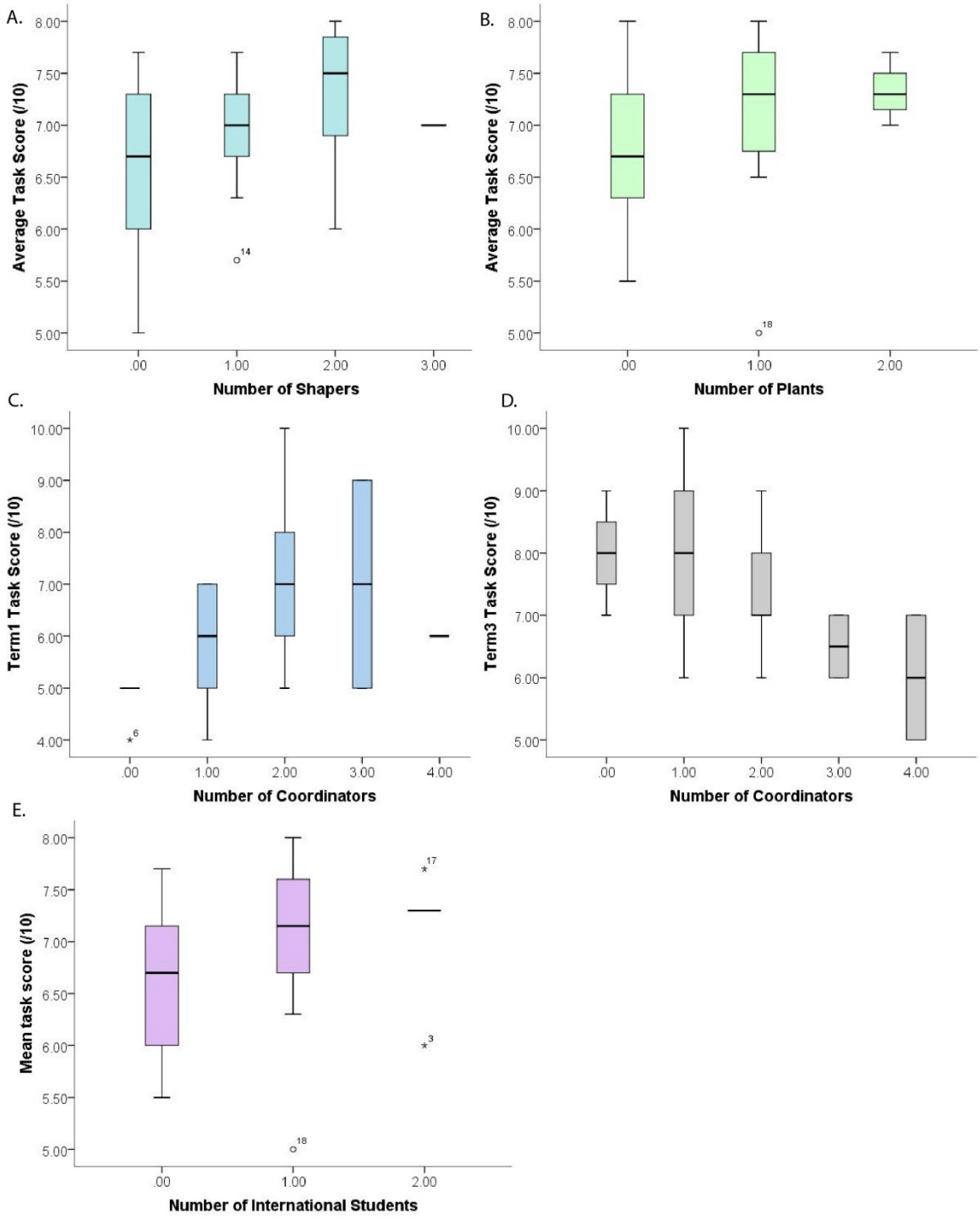
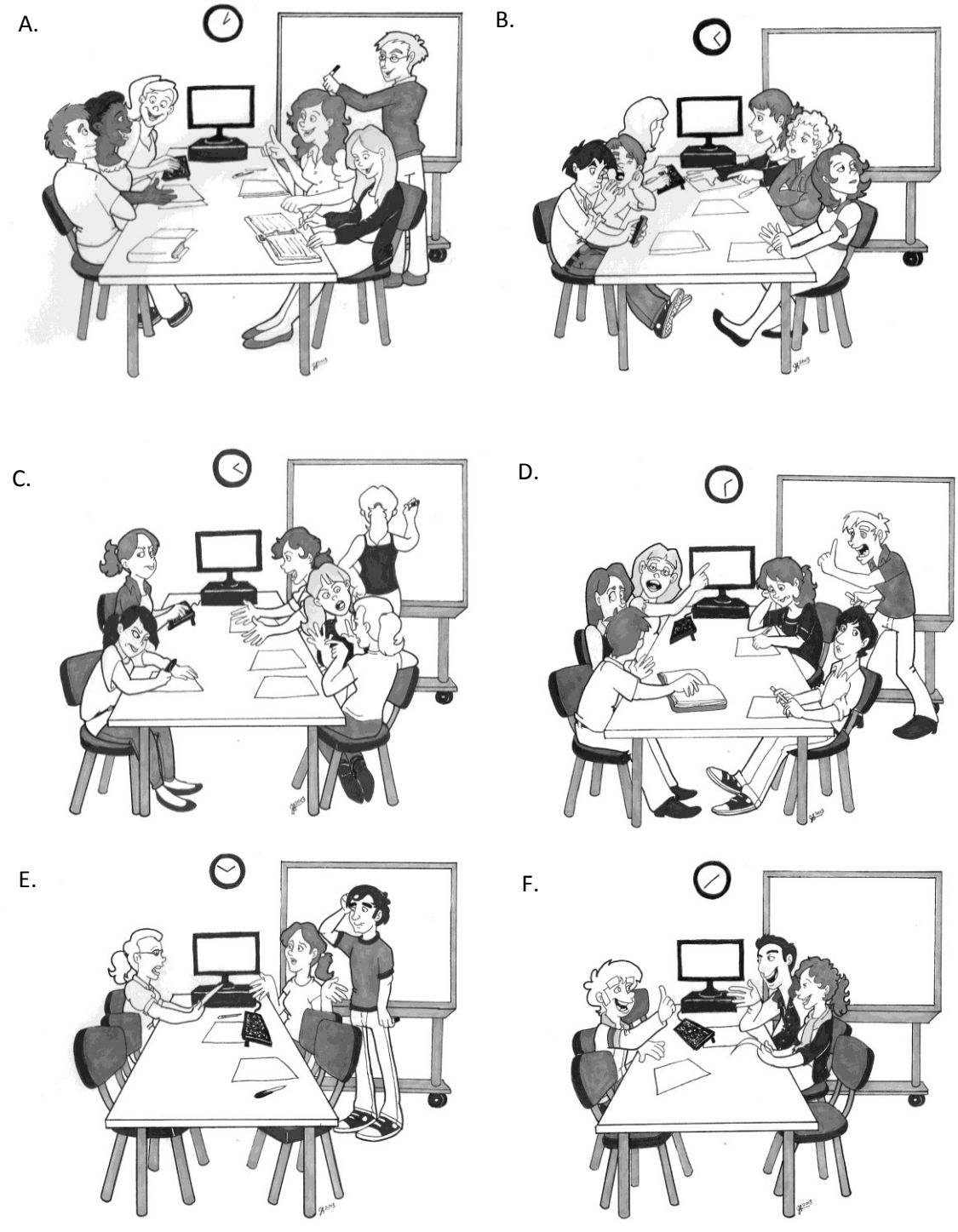


Figure 4. Artist's representation of a typical group from each of the six clusters A to F.



Appendix 1: Sample Group Work Task (Term 2)

Cat Metabolism

George, a 6 month old Persian kitten, is presented at surgery with a complicated history of periods of listlessness, and sometimes he walks in circles. On closer questioning, the owner says that these episodes occur after meals, and have occurred for several months, but are getting worse. On examination, George appears dazed, but has normal functional cranial nerve tests. He is small for his age and in poor condition.

a) Which organ system do you think is dysfunctional, producing the clinical signs of listlessness and circling? Give reasons for your answer.

b) Blood biochemistry tests reveal blood ammonia levels of 270micromoles/litre (normal <40micromoles/litre). Does this information suggest another organ that is deficient in function, causing the disease?

c) How are ammonia levels kept low in the normal animal? Blood ammonia concentrations also rise to toxic levels when cats are fed an arginine deficient diet: why is arginine an essential amino acid? Is it essential to other animals?

d) Another abnormal result from George's blood tests is a fasting bile acid level of 76microM (normal <2microM). Does this help in deciding on the primary defect?

e) Given the age of the kitten, is there a likely inherited anatomical cause in this case?

f) What is the treatment?

g) What is the prognosis in this case? Why is the prognosis poorer in the cat than in a dog with the same condition?