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Turning groups inside out: a social network perspective

Abstract

Most research related to learning in groups focuses on the unit of the group and/or its group members. However, students may benefit from crossing the boundaries of their own group, as students in different groups may provide access to new, non-redundant knowledge and opportunities for learning. Whether boundary crossing between groups is beneficial or not for learning and academic performance has received limited conceptual and empirical attention. Using SNA and SEM modelling, we contrasted pre-post network developments amongst 683 students (132 groups) across four modules at a UK business school. We examined whether it is better for students to invest in social relations in groups to learn and enhance academic performance, or if it is better to (continue to) invest in social relations outside groups. Our findings indicated that students seemed to learn more from learning relations outside their group than from their own group members. Students with more inter-group relative to intra-group learning relations performed better on module assessments and throughout the academic year than students with more intra-group learning relations. Boundary crossing and inter-group learning deserves more empirical attention and experimentation on how to balance boundary crossing and effective group learning strategies.

Keywords

Inter-group learning, boundary crossing, social network analysis, longitudinal analysis, structural equation modelling.

Collaborative learning is increasingly common in education and a vast body of literature has addressed the conditions for implementing effective strategies for group learning (e.g., Decuyper, Dochy, & Van den Bossche, 2010; Dochy, Segers, Van den Bossche, & Gijbels, 2003; Kimmel & Volet, 2010; Rummel & Spada, 2005; Suthers & Hundhausen, 2003). A steadily growing body of literature has found that learning in groups, in comparison to individual learning, leads to more (co-)construction of knowledge (Decuyper et al., 2010; Dochy et al., 2003; Schmidt, Van Der Molen, Te Winkel, & Wijnen, 2009; Suthers &

Hundhausen, 2003), enhancing students' creativity (Baer, Leenders, Oldham, & Vadera, 2010), motivation, (Hommes, Van den Bossche, et al., 2014; Kimmel & Volet, 2010) and self-regulation (Gasevic, Zouaq, & Janzen, 2013; Kimmel & Volet, 2010). At the same time, group learning does not always lead to the best possible learning outcomes due to free-riding, poor task design, and difficult group processes (Decuyper et al., 2010; Kirschner, Sweller, & Clark, 2006; Mittelmeier, Rienties, Tempelaar, & Whitelock, 2017).

While the majority of group research has focussed its analyses on the unit of the group and/or its group members, several recent studies have conceptually argued that students may also benefit by crossing the boundaries of their own group (Akkerman & Bakker, 2011; Decuyper et al., 2010; Kimmel & Volet, 2010). Furthermore, recent empirical studies (Author A, 2014b; Hernandez-Nanclares, García-Muñiz, & Rienties, 2017; Zhang, Scardamalia, Reeve, & Messina, 2009) have found some preliminary evidence that students working in groups indeed cross the boundary of their group and informally collaborate with and learn from peers in other groups. For example, in a three-year, design-based research study, Zhang et al. (2009) found that, when students were allowed to opportunistically form new groups depending on the specific tasks and knowledge expertise of its members, more classroom knowledge sharing, enhancement of ideas, and diffusion was established in comparison to students who were assigned to a fixed-group membership. In a Dutch medical programme using Problem-Based Learning, Author A (2014b) found that 80% of students had more learning relations (e.g., sharing and building on each other's ideas, learning goals, learning materials, summaries) to students outside their assigned group (i.e., inter-group learning) relative to those inside their group (i.e., intra-group learning). In other words, recent empirical studies have indicated that, beyond the boundaries of a formal group, many students maintain "informal" learning relations outside their assigned group that may enhance their cognitive development and learning.

One possible reason why students continue to work with peers outside their formally assigned group is that students do not necessarily join a new group with a “clean slate”, as previous experience of working in groups influences students’ attitudes towards group work (Chapman, Meuter, Toy, & Wright, 2006; Decuyper et al., 2010; Summers & Volet, 2008). In particular, several recent empirical studies have indeed found that whether (or not) students have already worked together with specific students (Gasevic et al., 2013; Hommes, Arah, et al., 2014) or with students with similar characteristics or social identities, such as academic performance (Mittelmeier et al., 2017), cultural background (Author A, 2014c, 2016a), or gender (Bevelander & Page, 2011; Valenti & Rockett, 2008), may influence with whom students develop and maintain relations within and outside their group over time. When students have successfully worked with specific students previously, they do not need to spend a lot of time getting to know each other and building trust if they are enrolled in a new group together in a different module (Hommes, Arah, et al., 2014; Hommes, Van den Bossche, et al., 2014). If the same students are enrolled in different groups, these relations may also still be (informally) used to inform each other about new insights developed in those different groups (Author A, 2014d; Hommes, Arah, et al., 2014). For these reasons, developing learning relations might be important for knowledge (co)construction.

Although the research field of group learning is well-established and mature, it may be surprising that relatively few researchers have taken into consideration these inter-group relations when unpacking the complex learning processes that occur when students work within and across groups. In this regard, there is an increased awareness in the group literature in recent years that boundary crossing is conceptually important (Akkerman & Bakker, 2011; Akkerman & Bruining, 2016; Decuyper et al., 2010) and recent empirical studies have indeed found that students both maintain intra-group and inter-group relations (Author A, 2014b; Hernandez-Nanclares et al., 2017). However, to the best of our knowledge, not a single study

has empirically tested whether boundary crossing has a measurable impact on learning, in particular cognitive learning outcomes. This leaves room for additional research, as a possible trade-off may exist between obtaining new, perhaps different, insights from inter-group students and building constructive insights within groups. One consideration might be that students need to develop and maintain a balance between intra- and inter-group learning relations to “optimise” knowledge construction (Hernandez-Nanclares et al., 2017).

In this study, we will use a method of pre-post longitudinal social network analyses (Author A, 2014c; Bevelander & Page, 2011; Emery, Daniloski, & Hamby, 2011) with 683 students from 55 countries in four modules at a UK business school who were distributed across 132 groups. Based upon the theoretical considerations described in the next section, we aimed to address the following two research questions:

- 1) To what extent do students primarily learn within or outside their assigned groups?
- 2) To what extent does intra- and inter-group learning positively or negatively influence short-term (within a module) and long-term academic performance?

In this article, we will start our theoretical narrative by briefly reviewing the literature on learning in groups and extending this into notions of boundary crossing using principles of social network theory. Afterwards, we will empirically test whether developing and maintaining more inter-group learning relations relative to intra-group relations is positively or negatively related to academic performance using a relatively large, naturalistic sample of 693 participants in four modules.

Learning inside and outside groups: a social network perspective

There is increased recognition in the learning sciences that students' social networks substantially impact upon their attitudes, actions, and behaviours (Baldwin, Bedell, & Johnson, 1997; Bevelander & Page, 2011; Hommes, Arah, et al., 2014; Hommes et al., 2012; Katz, Lazer, Arrow, & Contractor, 2004; Kimmel & Volet, 2010; Neri & Ville, 2008). In social network theory, the focus of analysis is on theorising, understanding, and measuring the social interactions between entities (e.g., individuals, groups, classes), rather than focussing solely on individual or within-group behaviour (Bevelander & Page, 2011; Katz et al., 2004), which is also common in educational psychology and group research. A general assumption of social network theory is that people's behaviours are best predicted by their web of relationships (Borgatti, Mehra, Brass, & Labianca, 2009; Coleman, 1988). As such, a social network consists of a set of nodes (i.e. students or groups in a course) and the relations (or ties) between these nodes (Wassermann & Faust, 1994).

Recent advances in social network analysis (SNA) (Borgatti et al., 2009; Katz et al., 2004; Moolenaar, Slegers, & Daly, 2012; Yoon, 2011; Zhang et al., 2009) provide educational researchers a much-needed holistic perspective on how students develop social relations over time. For some excellent examples in the learning sciences of how SNA tools can be used, we refer to Yoon (2011) and Zhang et al. (2009). In social network theory, the term homophily is commonly used to indicate that individuals have (subconscious) preferences towards building and maintaining social relations with individuals with similar surface-level attributes, such as gender (Bevelander & Page, 2011), personal interests (Borgatti & Cross, 2003), culture (Author A, 2013a; Neri & Ville, 2008; Stepanyan, Mather,

& Dalrymple, 2013), or academic performance level (Gasevic et al., 2013; Hommes et al., 2012).

In terms of group learning, several studies have highlighted that students prefer to work together with their friends (Author A, 2013a; Chapman et al., 2006) or with students with whom they have previously developed social relations (Bevelander & Page, 2011; Gasevic et al., 2013), for example in previous modules. An increasing body of research suggests that these previously developed social relations influence with whom students will continue to learn when joining a new module (Cela, Sicilia, & Sánchez, 2015; Gasevic et al., 2013; Hommes, Arah, et al., 2014). Given that we are particularly interested in this study in the intertemporal development of social network relations over time across the six cohorts, our first hypothesis posits that:

H1: Previously developed social relations are positively related to the number of social relations at the end of the module.

As indicated in the introduction, group learning is a common practice in higher education to encourage co-construction of knowledge and share different experiences and practices (Decuyper et al., 2010; Suthers & Hundhausen, 2003). Previous educational research using SNA has found that students who have more learning relations in general, relative to other students, receive more opportunities to share and co-construct knowledge (Baldwin et al., 1997; Stepanyan et al., 2013) and receive more social support (Emery et al., 2011). In particular, several SNA studies have found that high levels of connectedness between group members can encourage knowledge sharing. For example, in a study amongst 304 MBA students who worked together for a complete semester in the same group, Baldwin et al. (1997) found that communications levels within groups significantly predicted group learning

satisfaction and work sharing. In a study amongst 592 hospitality students, Author A (2014c) found that the primary predictor for (self-reported) learning relations at the end of the module was the students that they were assigned to small groups with at the beginning of the module. In other words, there is now widespread evidence in education, and in learning science in particular, that social relations in teacher-allocated or self-selected groups substantially influence learning processes (Cela et al., 2015; Decuyper et al., 2010; Dochy et al., 2003; Rummel & Spada, 2005; Suthers & Hundhausen, 2003). Therefore, our second hypothesis posits that:

H2: Group membership will positively influence the number of learning relations at the end of the module.

Boundary crossing and inter-group learning

Although a wide body of literature has found that prior social network relations and group allocations influence how students develop social network relations over time, several researchers have indicated that individuals and groups must engage in “external” learning activities in addition to engaging in internal group learning activities (Akkerman & Bakker, 2011; Decuyper et al., 2010; Hernandez-Nanclares et al., 2017). As such, building on H1, if students continue to learn from and engage with peers from previous modules and other social encounters, it is important to know the degree to which this happens in and outside the classroom. Building on the strength of the weak ties hypothesis developed by Granovetter (1973), it may also be useful to have access to “weak”, inter-group relations that can provide new and relevant knowledge and information. As recently argued within this journal by Akkerman and Bruining (2016, p. 246):

“a boundary crossing perspective allows a more fine-grained understanding of the required new relationships and cultural perceptions, as it is specifically targeted at analysing challenges and learning opportunities of situations in which diverse stakeholders (e.g., different disciplines or institutions) need to collaborate.”

According to Akkerman and colleagues (2011; 2016), boundary crossing can lead to a process of mutual identification, followed by a process of coordination, reflection, and, potentially, transformation. For example, Akkerman and Bruining (2016) found in a five-year analysis of boundary crossing in a professional development school partnership that key individuals (i.e., brokers) provided essential linkages and opportunities for boundary crossing between different groups and institutions. Similarly, in a two-year longitudinal study amongst 38 academics, Van Waes, De Maeyer, Moolenaar, Van Petegem, and Van den Bossche (2017) found that professionals actively develop formal and informal relations beyond their own group and discipline.

We expect that learning relations are essential for academic performance and (co-)construction of knowledge. When using the word inter-group learning in this article, we refer to social relations with peers from other groups in their module. We appreciate that the wider social environment outside a module (e.g., family, corridor mates, friends from high school) may have an important role in students' lives (See Author A, 2016a), but in this article we will focus only on relations within a module, as these are under the influence of teachers.

Recent experimental studies have provided preliminary support for the notion that the way groups are formed and constructed may impact on boundary crossing and sharing of knowledge between groups. For example, Zhang et al. (2009) showed that by opportunistically changing group membership depending on the specific task, students developed more knowledge and cross-group interaction over a period of three months in comparison to keeping students in the same group. In a recent experimental study amongst 280 students divided into 70 groups, Baer et al. (2010) found a U-shaped curve between

creativity and intergroup competition; groups with a swapped group member (i.e., more inter-group knowledge) outperformed groups who worked together with the same group members during the experiment under low or high levels of competition.

These inter-group relations are particularly useful for the transfer of new, innovative but tacit knowledge (Hernandez-Nanclares et al., 2017; Zhang et al., 2009). While trust and connectedness are essential for students to feel willing to share information with others, very high levels might negatively influence group interactions due to common group-think problems (e.g., desire to reach group consensus rather than pursuing innovative ideas, avoiding conflict). For example, Author A (2013a) conducted pre- and post-SNA analyses in a Spanish context to measure learning and friendship relationships among 59 third-year undergraduate economics students who were allowed to self-select their group members and were expected to work on a range of group tasks across fourteen weeks. The findings indicated that students not only maintained intra-group relations, but also developed inter-group relations with students from other groups over time in an “organic” manner. Similarly, Author A (2013a) found in a UK setting among 69 third-year undergraduate hospitality students that they developed strong intra- and inter-group relations over time when they were allowed to self-select their group members. This work was followed up with a follow-up fine-grained qualitative study in the same context by interviewing five students who maintained above average inter-group relations over time. The findings indicated that these students actively and consciously chose whether or not to invest in nurturing intra-group and inter-group relations (Author A, 2015a). However, if they group dynamics were difficult, some students resorted to focusing their efforts on inter-group relations, which were based upon their previously developed relations (Author A, 2015a).

As mentioned in the introduction, Author A (2014b) found in a Dutch medical programme with first-year undergraduate students who were randomly allocated to problem-

based learning groups that the vast majority of students had more inter-group learning relations than intra-group learning relations. In a follow-up two-year longitudinal study of 300 Dutch medical students who were allocated to different groups over time, Hommes, Arah, et al. (2014) found that altering the way students were enrolled into groups (i.e., creating groups from smaller cohorts of 50 students, while contrasting group developments amongst groups allocated amongst a larger cohort of 200) led to significant inter-group knowledge sharing within those cohorts. Subsequent fine-grained interviews indicated that most students maintained informal learning relations outside their formally allocated group, particularly with students from the start of their academic study with whom they had already developed a dense network (Hommes, Arah, et al., 2014). Therefore, our first research question explored the notion of whether students learn primarily inside or outside their assigned group. Given that preliminary evidence from our and other studies seemed to indicate that many students develop and maintain relations outside their assigned group, in our third hypothesis we propose:

H3: More inter-group learning relations relative to intra-group learning relations will be maintained during the module.

Boundary crossing and academic performance

An obvious critique of these previously outlined studies is that just “counting” the number of relations that students develop over time within and outside their groups may give limited insights into what was actually shared between students, whether this was useful, and whether this improved learning processes and cognitive learning outcomes. Recent research (Author A, 2015a; Hommes, Arah, et al., 2014; Montgomery & McDowell, 2009; Van Waes

et al., 2017) has indicated that it may be conceptually important not only to know who is connected with whom, but also what type of relationship exists between two nodes. After all, the type of knowledge shared within groups (e.g., detailed role divisions, fine-grained knowledge) might be different from the type of knowledge shared with peers from different groups (e.g., comparison of key concepts discussed in groups). One potential solution to this critique is to be more specific and precise about what we mean with social relations.

Several researchers make a distinction between friendship, working, and learning relations (Author A, 2013a, 2014b, 2014c, 2014d; Curşeu & Pluut, 2011; Hommes, Arah, et al., 2014; Hommes et al., 2012; Moolenaar et al., 2012). According to Hommes et al. (2012, p. 747), friendships “explore passive information diffusion” between students, while working and learning networks explore with whom students formally and informally communicate about task-related activities (Author A, 2014b). As such, when comparing the effects of intra- vs inter-group learning, distinguishing between working relations (which are inevitably present in groups as students are “forced” to work together within their respective group) and actual learning relations (which can be present in their group, but also may exist with peers outside their formal assigned group) may be important.

Another potential solution to the critique of “counting” social network relations is to test the construct validity of these social interaction proxies on what perhaps matters most in learning in the eyes of many teachers and students: cognitive learning outcomes. In this regard, previous research indeed found that social network relations significantly predicted learning outcomes (Baldwin et al., 1997; Gasevic et al., 2013; Hommes et al., 2012; Poldin, Valeeva, & Yudkevich, 2016; Tomás-Miquel, Expósito-Langa, & Nicolau-Juliá, 2016). For example, Hommes et al. (2012) found that the best predictor of academic performance amongst 301 medical students was students’ social network relations.

Furthermore, in an analysis of enrolment data across 10 years from 505 students in an online degree, Gasevic et al. (2013) found that previously developed social network relations (i.e., relationships with peers from modules taken previously) significantly predicted academic performance. Similarly, Poldin et al. (2016) found in a Russian third-year undergraduate business degree that academic performance of 169 students was significantly predicted by their social connections with peers and academic ability. Tomás-Miquel et al. (2016) also found in a Spanish third-year undergraduate business and creativity degree that academic performance of 154 students was significantly predicted by their social network relations and position in the network. Therefore, we expect that social network relations developed within the module, and in particular learning relations, will have a significant impact on short-term academic performance (i.e., within the respective module), as well as long-term academic performance as measured by GPA. Our fourth hypothesis posits:

H4: Developing and maintaining more learning relations during the module is positively related to short and long-term academic performance.

Building on the principles of boundary crossing described earlier, the core contribution of our study (as expressed in Research Question 2) focussed on whether (or not) maintaining more intra-group learning relations or more inter-group learning relations is beneficial for students' performance. While the above research has indicated that social network relations significantly influenced learning processes within a module (Author A, 2013a; Hernandez-Nanclares et al., 2017; Zhang et al., 2009) and learning outcomes at the end of the module (Hommes et al., 2012; Poldin et al., 2016), no study has empirically tested whether the positive relationship between learning relations and academic performance is influenced more by allocated group divisions or by boundary crossing between groups (or perhaps both).

Given that our own research (Author A, 2013a, 2014b, 2014c, 2015a, 2016a) and others (Hommes et al., 2012; Poldin et al., 2016) has found that most groups develop relatively more inter-group learning relations, we tentatively assume that this must have a positive impact on their learning. Therefore, our fifth hypothesis posits:

H5: Developing and maintaining more inter-group learning relations relative to intra-group relations is positively related to short and long-term academic performance.

Using Structural Equation Modelling (SEM), in this study we will analyse whether intra- and inter-group relations predicted short-term and long-term academic performance, controlling for cultural factors and gender (Author A, 2013b). To the best of our knowledge, we are the first to empirically model the longitudinal impact of intra- and inter-group relations on academic performance amongst several cohorts of students, thereby providing a much needed intertemporal perspective on whether boundary crossing might have a positive or negative impact on cognitive learning outcomes across different cohorts and levels of study.

Methods

Procedure and setting

This study focused on data gathered within the context of a business school in the south of England. In this naturalistic setting 693 participants from three undergraduate modules and one postgraduate module were incorporated in this study in the academic years 2011-2013. 316 undergraduate students across three modules participated in a pre-post test design after four and twelve weeks (Undergraduate Year 1 (UG1), $n = 54$), after 12 and 15 months (UG2, $n = 112$), and 30 and 33 months during their Bachelor programme (UG3 first implementation

n = 81, second implementation n = 70). Furthermore, 377 postgraduate participants (PG1 first implementation n = 207, second implementation n = 170) in a pre-post test design after four and twelve weeks were included. As students in UG1 and PG1 were completely new to the programme and did not have any pre-existing relations, we distributed the first SNA questionnaire after four weeks in order to give students a chance to develop some initial relations. 72% of the participants were female, and the average age was 23.83 (SD = 4.66), with a range of 18-52.

In line with group literature recommendations (Chapman et al., 2006; Decuyper et al., 2010; Kimmel & Volet, 2010), small groups with an average size of 5.24 (SD = 1.98) were constructed in all four modules, resulting in 132 total groups. Students were randomised into groups by the teachers in UG1 and PG1. In UG2, students were allowed to self-select their group members. In UG3, students from different parts of the network were merged together in groups by the teacher based upon their initial friendship networks, thereby creating diverse groups while ensuring that students would know at least one or two group members in each group. In this naturalistic setting, the researchers had limited control over how teachers created groups (i.e., random allocation, self-selection, balancing), but SNA allowed the authors to control for clustering of students into their respective groups. Groups worked on a range of complex and authentic inter-related tasks in business, hospitality, organisational behaviour, and HR management for the duration of eleven weeks. These group products were formatively assessed by their teachers and discussed in class as well as online in the Learning Management System. Summative assessments were based on individual reports and written exams, but formative assessment and feedback was provided on both an individual and group level. In all four modules, students followed at least one parallel module at the same time, thereby allowing for multiple team perspectives (O'Leary, Mortensen, & Woolley, 2011). For a detailed description of the pedagogical designs of these four modules, see Appendix A.1.

Instruments

Academic performance

As recent research has indicated that students continue to maintain their previously-established social relations even when they are enrolled in different groups in the next module (Author A, 2014c; Hommes, Arah, et al., 2014), we distinguished between short-term performance, final marks obtained in the respective module, and long-term performance, Grade Point Average (GPA) was obtained for the academic year that the data was gathered. All written exams were double marked by the respective teacher and an independent external examiner from another institution. Final marks and GPA scores were standardised per module in order to correct for potential differences in marking across the four modules.

Social Network Analyses

A vast number of rich, diverse methodologies and tools are available in social network theory (Cela et al., 2015; Wassermann & Faust, 1994), from more ethnographic, fine-grained approaches following individual encounters (Montgomery & McDowell, 2009) to content analyses of each dyad (Zhang et al., 2009), from open (e.g., who is your hero?) to closed network approaches (e.g., in your class, whom would you consider to be your friend?), to triangulation of SNA-metrics with rich document analysis (Yoon, 2011) or qualitative interviews (Author A, 2016a), to objective SNA measures of engagement in online discussion forums (Cela et al., 2015) to self-reported networks (Author A, 2013a, 2014c, 2014d; Hommes, Arah, et al., 2014; Moolenaar et al., 2012). In this study, we were primarily interested in understanding whether, how and with whom students in four large modules developed intra- and inter-team relations over time. Given the relatively large scale of our samples across different levels within a business programme, we opted for a quantitative self-

reporting approach (Borgatti et al., 2009). A list with names of all the students in their respective module was provided, as is commonly done in SNA (Curşeu & Pluut, 2011). A main advantage of using this approach is that it is a relatively quick, rather unobtrusive tool that allows participants to report both pre-existing and newly formed relations (Author A, 2014c).

In contrast to other self-report methods where common non-response and self-selection bias may be present, SNA provides a counter-perspective from responses from other participants. For example, when participant X in UG1 reports that he is friends with all 53 peers in the module, a counter-perspective is provided if only 2 peers reciprocate this relationship while the other 51 peers indicate no relationship. Similarly, if participant Y does not complete the questionnaire, but five peers have indicated they are friends, this data can be used to construct the missing information (Neal, 2008). An obvious disadvantage of this approach is that it lacks fine-grained information about the specific nature and type of knowledge shared. Although technically-specific follow-up methods (e.g., open comment boxes in surveys, interviews, logbooks) about the type of relationship can be included, in large classes this would substantially lengthen the administration process and lead to questionnaire fatigue.

In line with previous SNA research, we distinguish in our hypotheses between the amount of relations that students develop, the “type” of social relations, and the balance between inter- and intra-group relations. Students answered three distinctive social network questions (i.e., “I am a friend of ...”, “I have worked a lot with ...”, and “I have learned a lot from ...”) in a check-box manner. In UG1 and PG1 (where most students had not worked together before), the pre-questionnaire was distributed after four weeks in order to give students time to get to know each other. For 262 students who already worked together for at least one year (UG2 and UG3), this was measured on day 1 of their respective module. In this

way, any pre-existing social relations (e.g., friendship, having worked together in previous modules, living in the same student accommodation) could be controlled for. In line with Bevelander and Page (2011), all students completed the same questionnaire again after eleven weeks. Students who were “checked” by respondents were coded with 1, while not-checked students were coded with 0. Those who did not attend the classes when the questionnaire was distributed received the questionnaire(s) via email. For the two measurement periods, an average high response rate across the four modules of 86% and 83% was established.

The number of relations per student (ego) at the pre- and post-test were measured for the three network types (friend, work, learn), which were transformed into natural logarithms to ensure normal distributions. In order to answer H4 - whether maintaining more inter-group learning relations relative to intra-group learning relations (or vice-versa) is more important for learning - we calculated for each of the 24 (pre-post, learning-friend-work, 4 modules) networks the External – Internal index (E-I index, Krackhardt & Stern, 1988). Basically, the E-I index takes the number of relations of members of the group to students outside the group (i.e., inter-group), subtracts the number of relations to members within the group (i.e., intra-group), and divides by the total number of relations. The resulting index ranges from -1 (all relations are intra-group) to +1 (all relations are inter-group).

Control variables: cultural dimensions and gender

A culturally diverse mix of 560 (81%) international students from 60 countries and 133 (19%) host students was present across the four modules. This is representative of a recent phenomenon in higher education, whereby an increasing number of students from across the globe participate in cross-cultural learning activities (Hofstede, 1986; Joy & Kolb, 2009; Kimmel & Volet, 2010). Even though many opportunities of cross-cultural learning are present in international classrooms, previous research has found that establishing relations

with students from similar cultural backgrounds is easier, due to a “common language” or shared cultural experience and understanding (Author A, 2013a; Hofstede, 1986; Joy & Kolb, 2009; Kimmel & Volet, 2010; Stepanyan et al., 2013; Summers & Volet, 2008). Therefore, it is important to “control” for cultural dimensions and social network development.

Students were primarily from Confucian Asian (51%, e.g., China, Indonesia), Eastern European (12%, e.g., Poland, Estonia) and Southern Asian (7%, e.g., India, Pakistan) countries. This sample composition is fairly representative for business programmes in the UK (Higher Education Statistics Agency, 2017). In order to control for the impact of culture on how students developed social relations, we used the four cultural dimensions of Hofstede (1986) (power distance, individualism-collectivism, masculinity-femininity, and uncertainty avoidance in line with previous studies (Author A, 2013b; Joy & Kolb, 2009). These scores were based on available information in the management system related to students’ country of origin, as outlined in the Appendix. In line with previous research (Author A, 2013b; Bevelander & Page, 2011), we also controlled for gender, as common differences in social network patterns and academic performance has been found between female and male students.

Data analysis

As a first step, graphical analyses using Netdraw of the social networks were conducted to identify the overall social network structure and possible patterns of sub-group development in each of the four modules, as recommended by Author A (2013a).

Second, separate ANOVAs were conducted to determine whether respondents were different from non-respondents in terms of age, gender, nationality, and academic performance. Men were less likely to complete the pre- and post-test ($F = 5.434$, $p < .05$). Students who responded also had on average higher final marks ($F = 20.109$, $p < .01$) and

GPA ($F = 38.819$, $p < .01$) for both pre- and post-test, though all with a small effect size. This is a common finding in educational literature, with previous work highlighting that better performing students are intrinsically more interested in engaging with psychometric questionnaires (Richardson, 2012). However, even if a student did not complete a SNA questionnaire, there were on average 85% of his/her classmates who did participate, which also provides insights into the social networks of non-respondents (Neal, 2008). As students at this respective university were allowed to switch modules within 14 days, we generated pre- and post networks based upon students who participated in the final assessment. Dropout or switching to another module was in general low in this programme ($< 2\%$) and those students were removed from the analysis.

Third, a cross-lagged panel type structural equation model (Cole & Maxwell, 2003) was constructed to integrate the longitudinal aspect of social network development with the antecedental role of gender and cultural dimensions, and academic achievement as outcome variable. The intertemporal nature of social networks of both the total amount of links across the three networks in pre-post test measures and the E-I scores were investigated by path modelling using autoregressive model specifications (Geiser, 2012). Path models, estimated with Lisrel version 8.8, were assessed by Chi-square and degrees of freedom values, the Comparative Fit Index (CFI), the Non-Normed Fit Index (NNFI, also known as TLI) and the Root Mean Square Error of Approximation (RMSEA) as indicators of goodness of fit. Hu and Bentler (1999) suggested CFI/TLI values should be larger than .90 for a satisfactory fit and RMSEA values should not exceed .08 and preferably be .06 or lower. Model search started from the simple structure that only pre-test measurements are linked to post-test measurements. To prevent capitalization on chance, additional paths were adopted if they satisfied the conservative benchmark of significance levels below 0.01.

We estimated an autoregressive path model directed at the growth in all three E-I indexes, as well as total number of the three relations types. Our SEM path model had a good adequate fit with regard to a variety of fit indexes commonly used in SEM modelling: Chi-square being 490 with 151 degrees of freedom, RMSEA=0.051, NNFI=0.95, and CFI=0.96. Two different structural models were subsequently compared: the reported model below, specified in terms of total number of relations (of learning, friendship, and working types) and the E/I indexes for each versus a second specification based on counts of both intra-group and inter-group relations. Model characteristics such as fit indices of these two models were very similar. The reported model specification did have the advantage over the second model specification that it facilitated the interpretation of the role of the index constructs, and the balance between intra- and inter-group relations, whereas the message on the second specification was primarily that having more relations, of whatever type, predicted performance. Next, it had the advantage of avoiding collinearity of predictor variables and was, therefore, preferred.

Results

Descriptive statistics and visualisations of social networks

In order to illustrate how learning networks of students developed within and across groups, using Netdraw we displayed the social networks of one exemplary module namely UG3. By using the network visualisation option (*group by Group Attribute*) in UCINET, Figures 1-2 visually illustrate that most students maintained both intra- and inter-group learning relations over time. For example, at the start of the module members of group 5 (green triangle), who are positioned on the bottom left of Figure 1, already had four previously developed “black”

intra-group relations, while two group members were not yet connected to group 5 in Figure 1. All members of group 5 had several “red” inter-group learning links with students in other groups (25 inter-group relations in total). For example, one member of group 5 has no pre-existing links with the other group members, but had 3 links to members from group 3, 2 with group 6, and 1 each with group 10 and group 9.

At the end of the module, 11 black intra-group relations were present in group 5 and all group members were at least connected to another member of group 5. At the same time, 32 red inter-group relations were maintained by the group 5 members. Comparable patterns were visible in the other 11 groups of UG3, whereby most students developed more intra-group learning relations over time, while at the same time maintaining substantial inter-group learning relations. Similar trends were present in the other modules, whereby over time most students developed more relations within groups, but also maintained more inter-group learning relations.

➔ Insert Figure 1 and Figure 2 about here

Social relations within and outside groups over time

We next compared the intra- and intergroup friendship, working and learning relations amongst the 683 students using E-I index calculations. On average, most students had more friends outside their own group than inside their group, as illustrated in Table 1 by the positive E-I of 0.69. Over time, the number of friendships within groups increased significantly to an average of 1.75 (using paired sample t-tests), while the number of friends outside the group also increased significantly to on average 8.86. The E-I index remained strongly positive, although slightly lower than during the pre-test. Similar trends were present in terms of working and learning relations, whereby most students had more inter-group learning relations than intra-group learning relations (research question 1).

➔ Insert Table 1 about here

Separate analysis on a group level indicated that only five out of 132 groups had more intra-group learning relations (i.e. $E-I < 0$) than inter-group relations at the start of the module. Nine (7%) groups in the post-test had more intra-group learning than inter-group relations. In other words, although most groups developed more intra-group learning relations over time, at the same time most groups had a relatively stronger focus on learning relations outside the formal group structure, as was previously found in medical education in the Netherlands (Author A, 2014b).

Academic performance

In order to answer research question 2, we first compared academic performance across the four years. In Table 2, small but significant differences were found in terms of gender in final marks of the modules, whereby, except for UG1, females outperformed male students. Significant differences were also found in terms of academic performance and culture, whereby UK and Western European international students on average performed better than non-Western international students. As indicated in Table 3, both final mark and GPA were significantly correlated with the Hofstede cultural indicators of power distance (PDINat) and individualism (IDVNat), and positively correlated with the E-I learning relations at the post-test (M2). In other words, students' cultural backgrounds influenced academic performance, whereby UK and Western international students (lower PDI, higher IDV) performed better than non-Western, primarily Asian students. Gender was only positively correlated with final marks, indicating that female students outperformed male students on the respective module, but not in GPA.

➔ Insert Table 2 about here

➔ Insert Table 3 about here

Structural Equation Modelling

In Figure 3, short term academic performance (i.e. Final Mark of module) was primarily predicted by the cultural dimension of IDVNat, followed by learning relations at the end of the module and gender. Long-term academic performance was primarily predicted by final module mark, followed by initial learning relations and post learning E-I. In terms of the control variables, the cultural dimension IDVNat had a negative relationship with the working network E-I index at the start of the modules, but had a positive relationship with the number of learning relations. This indicates that Western (UK and European) students had a relatively more inward focus to their respective group, while non-Western students from more collectivist cultural backgrounds had a stronger focus on inter-group relations. Furthermore, Western students had more learning relations in comparison to other students. Previous research indicates that Confucian Asian students primarily developed social relations with students from similar cultural backgrounds (Author A, 2014c; Neri & Ville, 2008). The strong direct relation of IDVNat to Final Mark indicated that Western students performed better in the modules, as previously found in a context of nine Dutch universities (Author A, 2013b). The other three cultural indexes had no significant paths with our core variables. No significant influence with respect to gender was found in relation to how students developed social relations over time, but female students outperformed male students in terms of short-term (module) performance.

➔ Insert Figure 3 about here

In terms of the five hypotheses, the paths of the pre- and post total number of relations were positively related, whereby pre-existing working, friendship, and learning relations were positively related to post working, friendship, and learning relations, respectively (H1). More specifically, the number of working and learning relations at the start positively related to the number of learning relations at the post-measurement. Learning relations at the end of the module were positively related with learning relations at the beginning and separate correlation analysis of pre- and post learning E-I indexes on a group level indicated a positive correlation ($r = 0.60$, $p < .01$) (H2).

The core focus of this research was how students and groups balanced intra- and inter-group learning over time (H3), and whether intra- or inter-group (H5) relations predicted academic performance. As indicated in Figure 3, the paths of the three social network E-I indexes at the pre- and post-test were all positive, indicating inter-group relations were more prominent than intra-group relations (H3). In particular initial inter-group working relations were related to all three E-I indexes at the end of the modules, implying that students became more focussed on relations outside the formal group.

In line with previous findings (Hommes et al., 2012; Poldin et al., 2016), having more post-learning relations was positively related to short-term and (indirect) long-term performance (H4). In other words, students who started with more working and learning relations at the start of the modules developed and maintained more learning relations over time, which enhanced (academic) performance, in line with previous findings (Emery et al., 2011; Hommes, Arah, et al., 2014; Hommes et al., 2012). However, a stronger balance towards inter-group learning (Learning Relations E/I index) was positively related to both short-term and long-term performance (H5) at the same time. In line with our expectations, neither friendships nor working relations E-I indexes were (directly) related to academic performance. Follow-up SEM analyses per module indicated similar trends within the four

modules (not illustrated). In other words, students who developed relatively more inter-group relative to intra-group learning links over time had, on average, better short- and long-term performance in comparison to students who had relatively more intra-group learning relations.

Discussion

While the majority of group research analysis has focussed on the unit of the group and/or its group members (Akkerman & Bakker, 2011; Decuyper et al., 2010; Kimmel & Volet, 2010), students and groups can gain competitive advantages by crossing the boundaries of their own group (Akkerman & Bruining, 2016; Hernandez-Nanclares et al., 2017; Hommes, Arah, et al., 2014). In our naturalistic setting, we used longitudinal social network analyses (Author A, 2014c; Bevelander & Page, 2011; Emery et al., 2011; Halatchliyski & Cress, 2014) amongst 683 students in four modules who were working within 132 groups to analyse whether students primarily learned within or outside their groups, as measured with self-reported closed SNA questionnaires, and whether this influenced (short- and long-term) academic performance.

Perhaps our most important research finding was the indication that students with more (self-reported) inter-group relative to intra-group learning relations performed better on their respective module assessments and throughout the academic year than students with more intra-group learning relations (H5). Several researchers have recently provided arguments for a need for boundary crossing by students (Akkerman & Bakker, 2011; Akkerman & Bruining, 2016; Decuyper et al., 2010; Hernandez-Nanclares et al., 2017) and this analysis has provided some initial empirical support for this suggested impact of boundary crossing on academic performance.

A large body of social network research has already found that having many relations to people is beneficial in terms of social capital (Coleman, 1988; Gasevic et al., 2013),

gaining access to new information (Borgatti & Cross, 2003; Granovetter, 1973; Halatchliyski & Cress, 2014), and learning in particular (Baldwin et al., 1997; Hernandez-Nanclares et al., 2017; Hommes, Arah, et al., 2014; Hommes et al., 2012). This was again confirmed in our study (H1, H2, H4). A relatively unique feature of our study is that by linking social network formations over time (i.e., friendships, working, and learning relations), we found that social network relations, and learning relations in particular, matter for academic performance. In all six implementations of these modules, self-reported inter-group learning relations were more important for predicting short-term and long-term performance than self-reported intra-group learning relations. In terms of generalisability, similar trends and developments were found across the different cohorts, task designs, assessments, and group allocation mechanism.

On the one hand, this finding makes some intuitive sense, as many students will naturally work with peers and friends outside the classroom and group environment (Hommes, Arah, et al., 2014; Hommes, Van den Bossche, et al., 2014; Mittelmeier et al., 2017; Poldin et al., 2016). By sharing and comparing notes and ideas with inter-group peers, students can learn from different perspectives and ideas, which might further strengthen their own cognition and, possibly, that of the other group members. On the other hand (as reflected by comments from reviewers), it may come as a surprise that our quantitative approach has suggested that self-reported learning relations developed within a group seem “less important” than inter-group learning relations. This raises important questions around whether we should raise more attention to boundary crossing rather than focussing students’ and teachers’ attention on supporting group processes. Three possible explanations -- limited focus on boundary crossing in group research, methodological limitations of SNA, and contextual limitations -- can provided insight into why our findings might be different from (some of the) previous findings in group research (Baldwin et al., 1997; Schmidt et al., 2009) and why investing in both in intra- and inter-group relations may be important.

First, most group research has paid relatively limited attention to the notion of boundary crossing, thereby potentially underestimating the impact of social network relations outside groups (Akkerman & Bakker, 2011; Akkerman & Bruining, 2016; Decuyper et al., 2010). For example, the reason why group member 1 learned a lot from group member 2 could, in part, be explained by their social and cognitive contributions to the group, but could perhaps also be explained by their simultaneous access to inter-group learning relationships and the subsequent social capital that these relations may bring. (Poldin et al., 2016). Similarly, breakdowns in group communication could perhaps be the result of the external relations of one or two group members who prefer to learn with inter-group peers who share comparable ideas or mind-sets (Author A, 2015a). Recent studies have indeed found the boundary crossing is important for groups (Akkerman & Bakker, 2011; Gasevic et al., 2013; Hernandez-Nanclares et al., 2017) and fine-grained studies using in-depth qualitative interviews have indicated that some group members actively engage or withdraw from group processes to focus more on inter-group relations (Author A, 2015a; Mittelmeier et al., 2017). This present research indicated that students developed on average 1.32 intra-group learning relations, but also maintained 4.01 inter-group learning relations during their module. An important contribution of our SEM-modelling is that previous social relations, with a special role for (previous) working relations, influenced how students and groups develop learning relations over time (H1-H3). This has highlighted the need for learning scientists to take into consideration the wider social environment in which students are learning (Emery et al., 2011; Hommes, Van den Bossche, et al., 2014; Kimmel & Volet, 2010; Van Waes et al., 2017).

Second, a methodological limitation of this research is that our social network analyses were based upon self-reporting instruments, whereby perceived socially desirable behaviour might influence the results. Furthermore, we did not measure the strength of network relations or the actual type of knowledge exchanged; the E-I index compared all inter-group versus

intra-group relations, irrespective of the actual quality of the relations and types of knowledge shared. Therefore, future research should explore whether all inter-group relations are equally important. In addition, we did not control for previous academic performance and potential favourable individual traits (e.g., extroversion, strong communication skills, cross-cultural awareness) for inter- and intra-group learning in our study. Follow-up psychometric and qualitative research is needed to unpack the type and quality of knowledge exchanged between students, in particular why and with whom students are sharing deep, meaningful knowledge and insights, and why and with whom students were building more surface-level relations, such as by simply sharing notes or learning materials.

However, a large body of research (Borgatti & Cross, 2003; Curşeu & Pluut, 2011; Hommes et al., 2012; Katz et al., 2004; Wassermann & Faust, 1994) has found that SNA techniques provide a robust predictor for actual social networks and learning outcomes. This is particularly relevant to our study, given the high response rates and consist findings across the four modules. By taking into consideration both the amount of relations and the balance between inter- and intra-group relations in our SEM modelling, and by measuring these social relations in a pre-post manner, we were able to control for prior relations and the typical beneficial network effects of “having more relations”. As similar trends were visible across the four years of modules and recent findings in Spanish (Author A, 2013a; Tomás-Miquel et al., 2016), Russian (Poldin et al., 2016), and Dutch (Hommes, Arah, et al., 2014; Hommes et al., 2012; Mittelmeier et al., 2017) contexts have found similar effects (though not specifically focussing on inter-group learning and academic performance), our study does highlight the need for learning scientists to take boundary crossing into consideration.

Third, our context might have influenced how students developed intra- and inter-group relations over time, thereby potentially limiting generalisations to other settings. An important limitation of our naturalistic setting is that group products in the four modules were

not summatively assessed. Furthermore, the duration of group work was limited to eleven weeks, and a strong diverse international classroom was present. Perhaps if group work was graded or students worked for a longer period of time together, such as in Baldwin et al. (1997), students might have invested more in group relations. Nonetheless, as for example illustrated in Figure 2, most students did develop substantial relations with their assigned group members over time, but also maintained relations with peers outside their group. In many other group-learning settings like problem-based learning (Dochy et al., 2003; Schmidt et al., 2009) or computer-supported collaborative learning, most assessments are also individually-focussed, which nonetheless lead to substantial discourse and group interaction. Furthermore, our naturalistic context was internationally diverse and previous research (Author A, 2013a; Curşeu & Pluut, 2011; Kimmel & Volet, 2010) has highlighted that several barriers to culturally mixed group work need to be overcome, while at the same time many international students maintain strong relations with co-national students (thus ‘artificially’ raising the number of inter-group relations). In our context, we found that Western students (who were a minority in most modules) developed more social relations over time, but in particular more group relations. Perhaps in more culturally homogenous groups, students may be more inclined to focus on group work tasks, although recent research in homogeneous classroom environments amongst Dutch medical students (Author A, 2014b) and Spanish students (Hernandez-Nanclares et al., 2017) found similar levels of inter-group learning.

Although our findings indicated that all E-I indexes were positively related to each other and, in particular, inter-group learning relations significantly predicted (short & long-term) performance, none of the betas were close to 1. In line with the strength of weak relations theory of Granovetter (1973) and boundary crossing (Akkerman & Bakker, 2011), it is useful to have inter-group relations that can provide new and relevant knowledge and information. At the same time, in line with Coleman (1988) having strong and close relations

in groups is beneficial for effective group processes, co-construction of knowledge, and creative, productive group outcomes. As evidenced by a wide range of findings in group learning and learning sciences in general, beyond inter-group relations, individual student characteristics, the learning design, and the role of the teacher are important for learning during the module and academic performance over time. Furthermore, in line with previous findings (Chapman et al., 2006; Decuyper et al., 2010; Hommes et al., 2012; Schmidt et al., 2009), learning in groups has strong benefits for students in terms of motivation, self-confidence, social cohesion, co-construction of ideas, and preparing students for the future workplace, where being able to work in groups and teams is an essential graduate skill.

Conclusion

Research on learning in groups often ignores the importance of the external environment within which groups operate. In line with notions of boundary crossing (Akkerman & Bakker, 2011; Akkerman & Bruining, 2016) and social network theory, our longitudinal study has suggested that having more inter-group learning relations relative to intra-group relations over time is a predictor for academic performance in the short- and long-term. Having more learning relations within groups did not significantly predict learning and performance over time.

Recent advances in social network analysis (Borgatti et al., 2009; Katz et al., 2004) allow learning scientists, teachers, and organisations a much-needed perspective to look beyond the boundaries of groups in order to understand whether students and groups learn more within or outside groups. By measuring intra- and inter-group interactions over time, the use of SNA allows learning scientists many new angles in understanding the complex social interaction processes in and between groups. For example, by differing group allocation mechanisms amongst 400 medical students over two years, recent research by Hommes, Arah,

et al. (2014) indicated that institutions can actively influence inter- and intra-group learning relations. In addition, Yoon (2011) found by showing SNA visualisations of actual interactions that children became more reflective of their network formations and specifically started to connect with peers with “different” perspectives and ideas to further enhance their understandings.

In many educational programmes, students are required to take multiple modules at the same time, thereby allowing them to develop multiple team memberships across modules. Furthermore, most students actively use social media to keep in touch and share relevant (and perhaps less relevant) learning materials beyond the formal boundaries of the group or classroom (Hommes, Arah, et al., 2014). These multiple relations may not be apparent to all group members and teachers, but inevitably students may need to balance multiple goals when working in different group formations in concurrent groups or modules (Zhang et al., 2009). Visualising these formal and informal network data to students and teachers could potentially improve our support of students’ needs and our understanding of boundary crossing. For teachers, it may be important to step beyond the focus on group learning and what is happening in and outside the classroom, as peer learning and boundary crossing seemed to be a common practice amongst students in this study.

By actively experimenting with different intra- and inter-group compositions, assessment methods (Author A, 2014d), group allocation mechanisms (Author A, 2014d; Chapman et al., 2006), or task structures (Curşeu & Pluut, 2011) in conjunction with deep, qualitative analyses of students’ lived experiences, the relative costs and benefits of establishing and maintaining intra- and inter-group learning relations can be mapped in future research. By “turning our groups inside out”, we found that boundary crossing is an important factor for learning and instruction that future research and practice should consider.

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Table 1 Social relations within and outside groups (pre- vs. post measurement).

	Pre-test		Post-test		t	Cohen D
	M	SD	M	SD		
Internal friendship	1.39	1.48	1.75	1.73	7.426**	0.29
Internal work	1.08	1.42	1.90	1.98	13.775**	0.54
Internal learning	0.91	1.26	1.32	1.53	8.900**	0.35
External friendship	8.04	5.62	8.86	6.53	3.100**	0.12
External work	4.22	3.25	4.77	3.34	4.668**	0.18
External Learning	3.68	3.29	4.01	3.33	2.773*	0.11
E-I Index friendship	0.69	0.36	0.63	0.41	-3.738**	0.15
E-I index work	0.58	0.51	0.43	0.55	-7.976**	0.31
E-I Index Learning	0.57	0.50	0.46	0.54	-5.437**	0.21

Paired sample t-test (n= 683), ** p < .01; * p < .05, whereby calculations on the change in amount of ties were conducted based upon natural log transformations.

Table 2 Academic performance across four modules by gender

		Final Mark 1	Final Mark 2	Final Mark 3	Final Mark 4	GPA1	GPA2	GPA3	GPA4
Male	Mean	62.06	62.15	63.15	56.17	63.08	60.02	61.09	62.37
	SD	21.50	16.34	20.67	14.36	10.11	8.07	9.09	7.83
Female	Mean	59.21	65.52	64.49	59.27	65.97	63.82	61.49	62.80
	SD	30.27	14.08	16.89	9.32	8.52	9.45	7.66	6.55

Table 3 Correlation Matrix of gender, cultural dimensions, social network E-I relations at M1 and M2, and academic performance.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Gender	1											
2. PDINat	.020	1										
3. MASNat	.066	-.038	1									
4. UAINat	-.115**	-.024	-.471**	1								
5. IDVNat	-.022	-.869**	.105**	.018	1							
6. Learn relations E/I Index M1	-.065	.177**	.010	-.008	-.200**	1						
7. Friendship E/I Index M1	-.034	.177**	-.083*	.049	-.221**	.611**	1					
8. Work relations E/I Index M1	.025	.230**	.031	.028	-.269**	.636**	.665**	1				
9. Learn relations E/I Index M2	-.041	.170**	.008	-.011	-.199**	.445**	.368**	.445**	1			
10. Friendship E/I Index M2	-.018	.205**	-.025	.034	-.216**	.398**	.482**	.484**	.628**	1		
11. Work relations E/I Index M2	-.024	.205**	.036	-.033	-.224**	.406**	.423**	.551**	.704**	.694**	1	
12. Final Mark	.096*	-.264**	-.011	.009	.307**	.074	-.049	.035	.085*	.068	.034	1
13. GPA	.070	-.308**	-.048	.041	.337**	.017	-.030	-.002	.121**	.075	.059	.627**

*p < .05, ** p < .01

Figure 1 Learning relations at day 1 for UG3 (layout based upon group division)

Figure 2 Learning relations after 11 weeks for UG3 (layout based upon group division)

Figure 3 Academic performance, inter-group learning and amount of relations

Appendix:

A.1 Description of four modules

Module	Group tasks	Group allocation (Mean and range of groups in brackets)
UG1 Hotel Management and catering	Groups work intensively together in either kitchen or serving to customers (switch in roles every two weeks)	Random (M = 13.50; 12-14)
UG2 Introduction to Organisational Behaviour	Group work in face-to-face (f2f) lectures and seminars as well as in online tools on 5 weekly tasks (discussed in lecture and afterwards online by teacher)	Self-selected (M = 4.07; 3-5)
UG3 Human Resource Management	Group work in f2f lectures and seminars and online tools on 6 weekly tasks (discussed in lecture and afterwards online by teacher) Presentation of results group tasks (2)	Selected by teacher based upon pre-friendship network in first implementation (M = 8.1; 7-10) Self-selected by students in second implementation (M = 5.83; 6-7)
PG/ 4 Organisation Behaviour	Group work in f2f lectures and seminars and specific group online tools on 8 weekly tasks (discussed in lecture and afterwards online by teacher)	Random in first implementation (M = 4.81; 3-7) Selected by teacher based upon pre-friendship network in second

implementation (M = 4.72; 2-7

A2 Common Hofstede dimensions of five largest nationalities in dataset

	Power Distance	Individualism	Masculinity	Uncertainty avoidance	Long-term orientation
UK (133)	35	89	66	35	25
China (288)	80	20	66	30	118
India (20)	77	48	56	40	61
Russia (18)	93	39	36	95	0
Thailand (17)	64	20	34	64	56
Mean	66.63	40.14	60.12	44.91	83.04
SD	19.73	27.69	12.71	24.46	41.29
Range	11-104	6-91	5-110	8-112	13-118

Based on an analysis of attitude survey questions obtained from IBM employees in more than 50 countries, Hofstede (1986) identified four major dimensions on which cultures differ. Power-distance (PDINat) refers to the extent to which less powerful members of organisations and institutions accept and expect unequal distribution of power. Individualism versus collectivism (IDVNat) signals the degree to which individuals are integrated into groups: from loose relations between individuals, and everyone expected to look after themselves and immediate family, to students being integrated into strong, cohesive in-groups. In masculinity-femininity (MASNat), emotional gender roles are rather distinct in masculine societies, whereas in feminine societies these roles overlap. Uncertainty avoidance (UAINat) refers to society's tolerance for uncertainty and ambiguity, indicating the extent to which members of a culture feel threatened by ambiguous and uncertain situations.

Source: Hofstede (1986)