

# Open Research Online

---

The Open University's repository of research publications and other research outputs

## Enhancing (in)formal learning ties in interdisciplinary management courses: a quasi-experimental social network study

### Journal Item

#### How to cite:

Rienties, Bart and Héliot, YingFei (2018). Enhancing (in)formal learning ties in interdisciplinary management courses: a quasi-experimental social network study. *Studies in Higher Education*, 43(3) pp. 437–451.

For guidance on citations see [FAQs](#).

© 2016 Society for Research into Higher Education



<https://creativecommons.org/licenses/by-nc-nd/4.0/>

Version: Accepted Manuscript

Link(s) to article on publisher's website:

<http://dx.doi.org/doi:10.1080/03075079.2016.1174986>

---

Copyright and Moral Rights for the articles on this site are retained by the individual authors and/or other copyright owners. For more information on Open Research Online's data [policy](#) on reuse of materials please consult the policies page.

---

[oro.open.ac.uk](http://oro.open.ac.uk)

Rienties, B., & Héliot, Y. (2016). Enhancing (in)formal learning ties in interdisciplinary management courses: a quasi-experimental social network study. *Studies in Higher Education*. **Impact factor: 1.037**.

# Enhancing (in)formal learning ties in interdisciplinary management courses: a quasi-experimental social network study

## Abstract

While interdisciplinary courses are regarded as a promising method for students to apply knowledge from other disciplines, there is limited empirical evidence available whether interdisciplinary courses can effectively “create” interdisciplinary students. In this quasi-experimental study amongst 377 Master’s students, in the control condition students were randomised by the teacher into groups, while in the experimental condition students were “balanced” by the teacher into groups based upon their initial social network. Using Social Network Analysis, learning ties after eleven weeks were significantly predicted by the friendship and learning ties established at the beginning of the course, as well as (same) discipline and group allocation. The effects were generally greater than group divisions, irrespective of the two conditions, but substantially smaller than initial social networks. These results indicate that interdisciplinary learning does not occur “automatically” in an interdisciplinary module. This study contributes to effective learning in interdisciplinary learning environments.

**Key words:** interdisciplinary learning, social network analysis, post-graduate management education, boundary crossing

In higher education there is a wide acknowledgement that graduates should be able to learn and apply interdisciplinary perspectives, approach problems from multiple vantage points ([Borrego and Newswander 2010](#), [Boni, Weingart, and Evenson 2009](#)), and to synthesise knowledge from different disciplines ([Kurland et al. 2010](#)) Higher education is “under growing pressure to provide graduates with opportunities to complement discipline-based competency with multidisciplinary and interdisciplinary skills” ([Pharo et al. 2012, 498](#)).

In higher education limited empirical evidence is available as to how interdisciplinary graduate programmes can effectively create and educate interdisciplinary graduates ([Borrego and Newswander 2010](#), [Kalfa and Taksa 2013](#)). In this article we use Klein's (1996) definition of interdisciplinarity: "a means of solving problems and answering questions that cannot be satisfactorily addressed using single methods or approaches". Establishing common ground amongst the different disciplines is typically achieved in interdisciplinary courses by common experience in coursework, seminars and other interdisciplinary activities (e.g., [Boni, Weingart, and Evenson 2009](#), [Kurland et al. 2010](#)). Moreover, employability has been linked to interdisciplinary teaching methodology in higher education ([Kalfa and Taksa 2013](#)).

However, according to [Borrego and Newswander \(2010\)](#) the vast majority of 134 interdisciplinary programmes reviewed lacked a system thinking approach of integration of knowledge from different disciplines, and an absence of evaluation mechanisms to understand whether or not the learning outcomes of the programmes were achieved. Although many "good practice" descriptions of interdisciplinary programmes have become available recently (e.g., [Boni, Weingart, and Evenson 2009](#), [Kurland et al. 2010](#), [Pharo et al. 2012](#)), [Kurland et al. \(2010\)](#) indicate that whether students actually learned from peers from different disciplines has received limited (empirical) attention.

Most interdisciplinary programmes that have been described used mechanisms of team- or group-learning to encourage interdisciplinary learning ([Decuyper, Dochy, and Van den Bossche 2010](#), [Michaelsen and Richards 2005](#)). By putting students from different disciplines together in groups to work on complex, authentic interdisciplinary tasks supported by a teacher, the assumption is that over time students will "acquire by osmosis" interdisciplinary skills and knowledge. Whether or not putting students into interdisciplinary groups actually matters in terms of nurturing social interactions between students from different disciplines, and eventually acquiring interdisciplinary knowledge and skills needs

further research ([Borrego and Newswander 2010](#), [Akkerman and Bakker 2011](#), [Decuyper, Dochy, and Van den Bossche 2010](#)).

Therefore, the prime goal of this study is to analyse whether students from different management, hospitality and health care programmes developed (or not) learning ties with students from the same or a different discipline over time in a large interdisciplinary organisational behaviour module. The second goal is to understand whether teachers, by means of an instructional design intervention, can actively encourage and intervene in interdisciplinary learning by adjusting the group selection method ([Chapman et al. 2006](#)). In this quasi-experimental study with 377 master students using Social Network Analysis (SNA: [Katz et al. 2004](#), [Rienties and Nolan 2014](#)), we compared how students from six different disciplines build and develop social relations with other students over time.

### ***Social network theory, group and interdisciplinary learning***

There is a wide-spread acceptance of the importance of group work ([Decuyper, Dochy, and Van den Bossche 2010](#), [Hommes et al. 2012](#), [Katz et al. 2004](#)). At the same time, there is increased recognition that the social networks students are embedded in have a substantial impact on their learning processes and academic performance ([Baker and Lattuca 2010](#), [Curşeu and Pluut 2011](#), [Baldwin, Bedell, and Johnson 1997](#), [Gasevic, Zouaq, and Janzen 2013](#), [Rienties, Heliot, and Jindal-Snape 2013](#)). A social network consists of a set of nodes (i.e. students in an interdisciplinary module) and the ties between these nodes ([Wassermann and Faust 1994](#)). In social network theory, the focus of analysis is on measuring and understanding the social interactions between entities (e.g., individuals, groups, disciplines), rather than focussing on individual or group behaviour ([Katz et al. 2004](#), [Bevelander and Page 2011](#), [Baker and Lattuca 2010](#), [Pilbeam and Denyer 2009](#), [Taha and Cox 2014](#)). A general

assumption of social network theory is that people's behaviour is best predicted by the web of relationships in which they are embedded.

By putting students from different disciplines together in groups and working on complex, authentic interdisciplinary tasks supported by a teacher, the assumption is that over time students will obtain interdisciplinary skills and knowledge. For example, [Baldwin, Bedell, and Johnson \(1997\)](#) indicated that social networks, and ties within groups in particular, strongly influenced academic performance, student satisfaction, and group project performance. In a study of 159 student groups, [Curşeu and Pluut \(2011\)](#) found that groups that were heterogeneous in terms of gender, prior knowledge and expertise obtained better group outcomes than homogeneous groups. In a longitudinal study of 592 students taking five business modules ([Rienties and Nolan 2014](#)), the primary predictor of how students developed social networks over time was their respective group allocation. In other words, previous research indicates that with whom students are enrolled in a group influences how students develop (inter)disciplinary networks. Therefore, this is formulated as:

H1: Group allocation impacts how students develop social networks.

### ***Boundary crossing and social identity theory***

Organisational science literature indicates that boundary crossing increases knowledge transfer and team learning ([Wong 2004](#), [Bresman 2010](#)). Even if students are assigned to a particular group, students will “naturally” also learn from students outside the group and informally share knowledge with those with whom they have developed ties ([Akkerman and Bakker 2011](#), [Decuyper, Dochy, and Van den Bossche 2010](#)). According to [Wong \(2004, 646\)](#), there might be a trade-off between between intragroup (formal) and intergroup (informal) learning, as both “promote different dimensions of group performance because they are likely to access and create different types of knowledge in the groups”.

Informal socialisation mechanisms are important means for facilitating knowledge sharing ([Bevelander and Page 2011](#), [Gasevic, Zouaq, and Janzen 2013](#)). Social identity theory ([Tajfel 1978](#)) indicates that people seek part of their self identity through affiliation to “groups” (e.g., social groups, disciplines, organisations). The ethnocentric property of social identity theory suggests the terms of group attachment may feature knowledge as a valued and favoured group attribute. [Tajfel \(1978\)](#) argued that people’s evaluations of their ingroups are relative in nature. ‘Us’ versus ‘them’, as one of the core ideas of social identity theory, impact people’s self-evaluations and their sense of worth. Furthermore, [Hewstone, Rubin, and Willis \(2002\)](#) clearly indicated that members of groups (especially of high-status groups) tend to favour other members of their own group, but to derogate members of other groups.

Students might identify themselves based upon the discipline/programme they belong to (e.g. International Hotel Management). According to social identity theory, this ingroup will lead to favouritism towards the ingroup and potentially “discriminatory” behaviour to the outgroup (e.g. International Hotel Management students reluctant to share knowledge with Health Care Management students). Some sense of subjective commitment to the group is crucially important for people to start acting in terms of their group membership ([Hewstone, Rubin, and Willis 2002](#)). In social network studies this is commonly referred to as homophily, whereby people will be attracted to work (formally/informally) together and develop ties when individuals are (perceived to be) similar in terms of surface-level attributes, such as same gender ([Bevelander and Page 2011](#)), similar interests ([Borgatti and Cross 2003](#)), similar academic performance ([Hommes et al. 2012](#), [Gasevic, Zouaq, and Janzen 2013](#)), or following the same discipline. We expect that in a strongly interdisciplinary module, even when students are enrolled in interdisciplinary small groups, students still prefer to work either formally or informally with students from the same discipline, as indicated by H2:

H2: Learning within disciplines is a stronger driver for social network development than the actual group allocation.

### ***Interdisciplinarity, group selection and (in)formal learning***

In order to counter students “natural” tendencies to focus on informal interactions with same discipline students and to encourage interdisciplinary learning, we experimented with the impact of two different group allocation methods, namely random vs. balanced selection by the teacher. Given that students in a random condition (i.e., random allocation of students in groups by the teacher) are “forced” to work together with students from different disciplines that they (perhaps) have not worked with before ([Chapman et al. 2006](#)), this gives them an opportunity to establish new ties that may challenge their perspectives and ways of thinking. When interdisciplinary groups are able to develop trust and cohesion amongst its members, interdisciplinary groups are more able to come up with creative solutions and insights ([Decuyper, Dochy, and Van den Bossche 2010](#), [Michaelsen and Richards 2005](#), [Boni, Weingart, and Evenson 2009](#), [Curşeu and Pluut 2011](#)). At the same time, an obvious risk of randomisation is that interdisciplinary groups might find limited common ground to work together, in particular when the duration of the module is relatively short ([Baldwin, Bedell, and Johnson 1997](#)). Indeed, our initial study on 201 students in the random condition ([Rienties, Heliot, and Jindal-Snape 2013](#)) indicated that most groups developed limited interdisciplinary group links. Qualitative analyses suggested that cultural differences and unspoken norms between disciplines prevented the interdisciplinary groups to develop common ground to encourage interdisciplinary exchange. Many students informally continued to work together with students whom they developed initial ties with.

As we aimed to encourage interdisciplinary learning while at the same time forming effective groups that construct and co-construct shared knowledge, in the balanced condition we attempted to combine the benefits of initial developed ties with some diversity in new ties

to students who are relatively further away in the social network ([Akkerman and Bakker 2011](#), [Borgatti and Cross 2003](#)). By forming groups that already had some initial ties amongst some nodes, we expected that it would be easier for these groups to develop common ground while also developing interdisciplinary exchange. As argued by [Reagans and McEvily \(2003, pp. 245\)](#), “an optimal network combines elements of cohesion and range ... The most productive teams are internally cohesive, but have external networks full of structural holes”. As a result, we expected that groups in the random condition would be very diverse in terms of the number of disciplines/programmes within each group, while due to pairing in the balanced group a more balanced but less diverse range of programmes within each group would be present. At the end of the module we expect that:

H3: In the balanced condition, students maintain more ties inside their group in comparison to the random condition.

H4: In the random condition, more interdisciplinary ties are maintained by students.

Finally, in line with recent findings ([Hommes et al. 2012](#), [Curşeu and Pluut 2011](#), [Bresman 2010](#)), we expect that students who develop more ties, in particular interdisciplinary learning ties, would perform better in terms of academic performance. In particular, we expect that the balanced condition has a positive effect on academic performance, as students formally and informally continue to work together in their groups with students from their initial social network, but at the same time are exposed to different ideas from group members from a different discipline. Therefore, we hypothesise that:

H5 Developing and maintaining more interdisciplinary ties (in particular learning) lead to better performance, in particular for the balanced condition.



## **Methods**

### ***Setting***

This study took place in a compulsory Master module of Organisational Behaviour at a UK business school during the autumn semesters of 2011 and 2012. This module was the first module in the programme and students had not formally worked together before. In this quasi-experimental study, the implementation of 2011 is referred to as the “random condition”, whereby the teacher randomly assigned students to groups, while the implementation of 2012 is referred to as the “balanced (experimental) condition”. In 2011, 41 small groups each consisting of 4 or 5 members were formed at random after Week 4. In 2012, the authors artificially balanced 37 groups based upon the initial friendship network that was measured after four weeks. In both conditions, during the eleven week module the 377 master students met formally once a week during a three-hour interactive lecture.

Students were given one group task per week at the end of each lecture to further develop their understandings of the lecture topics. The interdisciplinary nature of these groups (and the classroom environment in general) is therefore important; it can bring a more contextual understanding of the topics (e.g., how a lecture topic/theory can (not) be applied to a particular discipline/industry). There were eight tasks in total, including case studies, essay types of questions, and focused group discussions. These group activities aimed to facilitate knowledge sharing and to develop breadth and depth of students’ subject knowledge through an interdisciplinary lens. These group products were not formally assessed but the teacher provided formative feedback online (e.g. giving constructive feedback to each group) and in class (e.g. collectively comment on the group answers) each week. Except for the group selection method (i.e. random selection vs. balanced), the assessments, module materials and the teacher were the same in both conditions.

## **Participants**

All 377 students were included in the analyses. 67% of the participants were female, and the average age was 25.50 (SD = 5.10), ranging from 21 to 56. This module included students from six different programmes: International Hotel Management (IHM = 54%), Health Care Management (HCM = 13%), Entrepreneurship (EP = 12%), Food Management (FM = 8%), Intercultural Communication with International Business (ICIB = 7%), and a final group of students following a range of smaller programmes, which are clustered under the umbrella term Business Management (BM = 5%). Although the programmes were unbalanced in terms of size, with a majority of students from IHM, for each programme at least eight participants were present with whom students could develop disciplinary ties. Previous research has found that students developed on average 4-12 ties with others to learn and share knowledge ([Curşeu, Janssen, and Raab 2012](#), [Hommes et al. 2012](#), [Moolenaar, Slegers, and Daly 2012](#)), which indicates that even in the smallest discipline sufficient opportunities were present to develop disciplinary ties.

Alongside this module, students also followed either two or three modules in their own programme in the first semester. In the other modules students only met with students from their respective programme. Using the GLOBE geocultural classifications by [House et al. \(2004\)](#), 223 (59%) students were from Confucian Asia, followed by Southern Asia (11%), UK (9%), Eastern Europe (5%), Middle East (3%), and a range of countries from Latin Europe, Sub-Saharan Africa, and Germanic Europe (each 2%). This sample composition is fairly representative for master degree business programmes in the UK ([Higher Education Statistics Agency 2012](#)).

## **Measurements**

*Social networks and ties*

First, the 370 students answered the Social Network question stem “I am a friend of ...” after four weeks by using a “closed-network” analysis ([Krackhardt and Stern 1988](#), [Rienties and Nolan 2014](#)). A list with names of all the students was provided as is commonly done in SNA ([Curşeu, Janssen, and Raab 2012](#), [Bevelander and Page 2011](#), [Rienties, Heliot, and Jindal-Snape 2013](#)). Second, learning from group members and other members was also measured in Week 4 as measured by the question stem “I learn a lot from ...”. Third, working relations were measured by the question stem “I work a lot with ...”. Fourth, in line with [Bevelander and Page \(2011\)](#) we again measured the three networks at the end of the module at week 11 (i.e. post-test). Students who did not attend the classes when the questionnaire was distributed received the questionnaire(s) via email.

#### *Academic performance*

Academic performance was measured by a written essay of 1000 words (students chose one essay question out of three) and a closed book examination (students answered two questions out of a choice of six).

#### **Data analysis**

For the two measurement periods, a response rate of 89% and 84% were established in 2011 and 84% and 76% in 2012. First, graphical analyses using Netdraw of the social networks were conducted in order to identify the overall social network structure and identify possible patterns of sub-group development, as recommended by [Wassermann and Faust \(1994\)](#). Second, in order to determine the degree of interdisciplinary social interaction, we used the External – Internal (E-I) index developed by [Krackhardt and Stern \(1988\)](#). The E-I index takes the number of ties to members of a different discipline, subtracts the number of ties to members with the same discipline, and divided by the total number of ties. The resulting index ranges from -1 (all ties are only with same discipline members) to +1 (all ties are to students from other disciplines). Third, a quantitative analysis on a whole network level was

conducted in order to determine the dynamics of the social networks after four and eleven weeks using Multiple regression quadratic assignment procedures (MRQAP). MRQAPs were used to test whether pre-existing ties amongst students predicted learning networks after eleven weeks using 2000 random permutations. Basically, MRQAP tests are permutation tests for multiple linear regression model coefficients for data organized in square matrices of relatedness of friendship and learning, and the interpretation of the standardised betas is similar to more OLS regression analyses ([Rienties and Nolan 2014](#)). Data were analysed on a network level using UCINET version 6.445. Finally, using SPSS 21 for the individual-level analysis we conducted classical linear regressions, where we controlled for gender and cultural differences ([Taha and Cox 2014](#), [Rienties, Heliot, and Jindal-Snape 2013](#)) using [Hofstede \(1986\)](#)'s cultural dimension scores (individualism vs. collectivism; masculinity vs. femininity).

## Results

### *Descriptive statistics and visualisations of social networks*

→ Insert Table 1 about here

Blau IQV calculations indicated that groups in the random condition were more heterogeneous in terms of diversity in programmes ( $M_{\text{random}} = .60$ ,  $SD_{\text{random}} = .24$ ;  $M_{\text{balanced}} = .32$ ,  $SD_{\text{balanced}} = .26$ ,  $F = 111.087$ ,  $p < .01$ ,  $\eta^2 = .229$ ). On average, in the random condition after four weeks students had 5.06 ( $SD = 3.64$ ) friends from the same discipline, while they had 1.49 interdisciplinary friends ( $SD = 2.13$ ), as illustrated in Table 1. In terms of learning ties, students in the random condition had 2.37 ( $SD = 2.21$ ) discipline learning ties, and 0.52 ( $SD = 0.97$ ) interdisciplinary learning ties. The disciplinary and interdisciplinary learning

interactions between students are illustrated in Figure 1, whereby the number of disciplinary (black) and interdisciplinary (red) ties was relatively limited after four weeks. The colour and shape of the node represents the respective programme of each student. For example, in the top-right of Figure 1, three BM students (grey, square) learned from each other (see arrow), while two of the three BM students also had (red) interdisciplinary learning ties with in total three students from IHM (white, circle).

Please note that SNA is not based upon the perception of one participant alone. That is, although the three BM students indicated to only have a learning tie with each other and three IHM students, the other 201 students independently “confirmed” that they had no ties with these three BM students. In other words, SNA measures the (perceived) network interactions amongst all (207) participants simultaneously, which verifies and/or provides counter perceptions from all participants. Note that Netdraw positions nodes at random across the X- and Y-axis based upon the (perceived) social interactions between students, whereby students who share similar connections are positioned more closely together. Being on the left of the graph is not necessarily better or worse than being on the right, top or bottom, but students with similar connections are positioned closer together.

As a result, a relatively clear clustering for four (out of six) disciplines seemed present, whereby IHM students (white circle) were mostly positioned on the right, HCM students (green down-triangle) and EP students (red up-triangle) were positioned on the left, while FM students were positioned in the middle (blue box). The BM (grey square) and ICIB students (yellow circle in box) were scattered over both learning networks, indicating less strong disciplinary ties. Finally, some students were on the outer fringe of the learning network and were not well-connected to other learners, while other students were more central in the network in Figure 1, while 29 students had no learning ties after four weeks.

In Figure 2, after eleven weeks most students in the random condition were connected with more ties, and more interdisciplinary ties are visible, although most students were clustered closely to their discipline. This implies that students primarily seemed to learn with their discipline peers. Quite interestingly, Food Management students (blue box) seem to form a bridging function across the various disciplines, as they were positioned in the middle of Figure 2. The number of disciplinary learning ties increased significantly to 3.46 using paired-sample t-tests ( $t = 5.450$ ,  $p < .01$ , Cohen  $d = .41$ ), while the number of interdisciplinary learning ties also increased significantly to 1.05 ( $t = 4.970$ ,  $p < .01$ ,  $d = .36$ ). The external-internal index remained negative at  $-0.49$ , indicating that students were three times more likely to develop learning ties with students from the same discipline than with students from a different discipline.

➔ Insert Figure 1 about here

➔ Insert Figure 2 about here

In Figure 3, the learning network after four weeks is illustrated for the balanced condition, whereby most students were (again) clustered together in disciplines, where 17 students had no learning ties after four weeks. After eleven weeks a substantial number of (inter)disciplinary learning ties were established in the balanced condition. Learning ties increased significantly over time for the same discipline ( $t = 4.948$ ,  $p < .01$ ,  $d = .36$ ) and interdisciplinary ( $t = 2.008$ ,  $p < .05$ ,  $d = .16$ ). Similarly as in the random condition, students in the balanced condition were three to four times more likely to develop learning ties with same discipline students after eleven weeks.

➔ Insert Figure 3 about here

→ Insert Figure 4 about here

## **Hypothesis testing**

→ Insert Table 2 about here

As a first step to test the five hypotheses, we conducted MRQAPs of learning ties after eleven weeks for the random and balanced condition are illustrated in Table 2. The group allocation of students had a significant and consistent impact on learning in all six models, providing support for H1. The proxy for cultural backgrounds (GLOBE) had a small effect on learning ties in Model 1, but when incorporating additional variables in Models 2-6 cultural backgrounds no longer significantly predicted learning ties. Similarly, the proxy for same discipline positively predicted the six models, indicating that students learned primarily from same discipline students.

In terms of answering H2, the standardised betas of disciplines were always larger than those of the same group matrix, indicating that disciplines were a stronger predictor for the learning network after eleven weeks in our context than group allocation (H2). Adding initial friendships in Model 2 and Model 5 and initial learning and working in Model 3 and Model 6 substantially improved the fit of the model, whereby the largest predictor for the learning networks after eleven weeks in both conditions were the initial learning and friendship networks, followed by same discipline and same groups. Finally, the combined Model 7 indicated a similar pattern, whereby the intervention was not significant. In other words, in both conditions how social networks of learning developed over time was primarily related to initial friendship and learning networks established at the beginning of the master degree programme, which in part were related to following the same discipline programmes.

In terms of H3, students in the balanced condition developed slightly more group ties in comparison to students in the random condition after eleven weeks ( $M_{BC} = .79$ ,  $SD_{BC} = 1.06$ ;  $M_{RC} = .61$ ,  $SD_{RC} = 0.98$ ). Taking into consideration initial group ties, ANCOVA analysis indicate no significant impact of the intervention ( $\beta = -.156$ ,  $p > .05$ ,  $\eta^2 = .01$ ), thus providing no support for H3. Over time, the random condition developed more interdisciplinary learning ties in comparison to the balanced condition ( $\beta = .141$ ,  $p < .05$ ,  $\eta^2 = .02$ ), although with a small effect size, providing some support for H4.

➔ Insert Table 3 about here

Finally, in Table 3 academic performance in all models was significantly predicted by Hofstede's cultural dimension individualism, followed by gender. Students from western countries outperformed students from non-western, primarily Confucian Asian countries, as was found in previous studies ([e.g., Rienties and Nolan 2014](#)). Female students performed better, and the intervention did not have any impact on academic performance. In Model 2-4, the number of ties after four and eleven weeks, the (inter)disciplinary focus of these ties (E-I index), and the interaction effect of ties with (inter)disciplinary focus were added, which improved the fit of the model. The number of ties after eleven weeks significantly predicted academic performance, although the direction of the interdiscipline vs. discipline ties did not significantly predict performance, thus finding no support for H5.

## **DISCUSSION AND CONCLUSION**

Many higher education institutions now recognise the fact that graduates are the future leaders of society and therefore offer interdisciplinary courses to encourage graduates to obtain a broad skill set required for today's complex, dynamic and interdisciplinary world



[\(Boni, Weingart, and Evenson 2009, Kurland et al. 2010, Borrego and Newswander 2010\).](#)

Our quasi-experimental study contributes to further understand whether students actually develop interdisciplinary ties and learn from those exchanges with students from other disciplines and whether their social networks become more intertwined.

The prime goal of this study was to analyse whether (or not) students developed interdisciplinary ties and social networks over time in a large interdisciplinary Organisational Behaviour module. The second goal was to understand whether teachers, by means of intervening in the group allocation process, can actively encourage and intervene in interdisciplinary learning. The findings indicate that initial ties formed during the first couple of weeks in a postgraduate (Master) course have a strong impact on how students from different programmes learn over time. The instructional design indicated a small effect on how students from different disciplines developed formal and informal learning and friendship social networks. Given the proven importance of interdisciplinary learning for management courses, the understanding of effective network amongst management students deserves far more scholarly attention.

In terms of the first goal, although more interdisciplinary friendships and learning ties were developed over time in absolute numbers, in relative terms most students continued to primarily learn from their same-discipline fellow students, irrespective of the type of intervention. On average, students at the beginning of Organisational Behaviour module had 5.13 (SD = 3.51) disciplinary friends and 1.39 (SD = 1.95) interdisciplinary friends. Over the duration of the eleven week module, interdisciplinary friends increased significantly with 24% more disciplinary and 24% more interdisciplinary friends. Nonetheless, the E-I indexes in pre- and post-tests were identical, whereby students were three to four times more likely to develop disciplinary rather than interdisciplinary friendships and learning ties.

In line with social identity theory ([Tajfel 1978](#)) most students preferred to nurture ties with same discipline students. Even though substantial opportunities for interdisciplinary contact were established in the module (e.g., working in small interdisciplinary groups, joined teaching and learning activities), this did not “automatically” translate into increased interdisciplinarity. The individual seeking that identity must be an active participant in the community not only exhibiting the knowledge and behaviours associated with a given role in the community ([Baker and Lattuca 2010](#)).

Although the group allocation by the teacher had a significant impact on how students over time developed learning ties (H1), students were more likely to learn from peers from their own discipline (H2). More importantly, in line with previous findings ([Rienties and Nolan 2014](#)), the most important predictor of the social network of learning after eleven weeks were students’ initial friendship and learning networks, which were primarily based upon the programmes students were following. These informal ties are not always evident to teachers ([Hommes et al. 2012](#), [Krackhardt and Stern 1988](#), [Akkerman and Bakker 2011](#)), in particular in large modules. In terms of the impact of the intervention and the potential benefits of interdisciplinary tie-formation on academic performance (H5), limited support was found. Although the number of ties students developed with peers at the end of the module significantly predicted performance (in line with previous findings: [Gasevic, Zouaq, and Janzen 2013](#), [Hommes et al. 2012](#)), whether these ties were disciplinary or interdisciplinary had no impact on performance.

In other words, in our context we found that the creation of an interdisciplinary platform for students to meet and discuss and work together on a range of interdisciplinary projects did not lead to automatically increased interdisciplinary social networks or enhanced academic performance, providing limited support for H3-H5. To the best of our knowledge, we are the first to empirically test and verify that putting students into interdisciplinary groups

and classes does not “automatically” lead to the desired interdisciplinary exchange of ideas, developments of interdisciplinary social networks, or enhanced academic performance. Given the high response rates, the consistent findings in both settings, and the conservative SNA techniques used, our findings indicate that the developments of interdisciplinary social networks need more than just opportunities for interdisciplinary exchange and a range of group tasks.

Perhaps a more structured approach in terms of summative group assessments combined with extensive support and coaching ([Boni, Weingart, and Evenson 2009](#), [Decuyper, Dochy, and Van den Bossche 2010](#)) may help students to develop these interdisciplinary social networks. The issues of trust in the understanding of students’ social networking activities ([Bevelander and Page 2011](#)) may offer another explanation for the lack of increased interdisciplinarity. As the Organisational Behaviour module was the only module in the six programmes where these students worked together in an interdisciplinary setting, perhaps the incentive to develop interdisciplinary ties might have been limited. Future research should address whether students in interdisciplinary programmes who spend considerable time together in a sequence of modules will indeed develop more interdisciplinary ties, knowledge and skills.

Given limited resources and tight budgets at universities, most higher educational institutes may just pay lip-service to the need to encourage interdisciplinary skills and social networks amongst its graduates. In large interdisciplinary classes, universities will aim to capitalise on economies-of-scale of teaching multiple disciplines cohorts simultaneously core management topics, but without an explicit expectation to develop interdisciplinary links.

### **Limitations and future research**

A limitation of this research is that we did not specifically measure interdisciplinary knowledge and skills in a pre-post test design to verify whether increasing the number of

interdisciplinary ties indeed led to enhanced interdisciplinary knowledge (although of post-test academic performance results in Table 3 indicate no significant effect). A second limitation is that we did not measure the social network developments in the parallel modules that students were following in their respective programmes. However, a large body of research ([Borgatti and Cross 2003](#), [Curşeu, Janssen, and Raab 2012](#), [Hommes et al. 2012](#), [Katz et al. 2004](#), [Wassermann and Faust 1994](#)) has found that SNA techniques provide a robust predictor for actual social networks and learning outcomes, in particular given our high response rates.

This study promotes a friendship-sensitive view of student's knowledge sharing that recognises the importance of friendships/power within networks ([Katz et al. 2004](#), [Hommes et al. 2012](#), [Borgatti and Cross 2003](#)) of practices in interdisciplinary learning environment. This has important implications for course instructors, who need to consider the role of social identity (e.g., disciplines, groups) when designing interdisciplinary modules. Given that most students in our context preferred to continue to work with students from their same discipline (irrespective of the type of group selection method), if higher education wants to create graduates who are able to work across many disciplines, more than just lip-service to interdisciplinary learning is urgently needed.

## References

- Akkerman, Sanne F., and Arthur Bakker. 2011. "Boundary crossing and boundary objects." *Review of Educational Research* 81 (2):132-169. doi: 10.3102/0034654311404435.
- Baker, Vicki L., and Lisa R. Lattuca. 2010. "Developmental Networks and Learning: Toward an Interdisciplinary Perspective on Identity Development during Doctoral Study." *Studies in Higher Education* 35 (7):807-827. doi: 10.1080/03075070903501887.
- Baldwin, T.T., M.D. Bedell, and J.L. Johnson. 1997. "The social fabric of a team-based M.B.A. program: Network effects on student satisfaction and performance." *Academy of management journal* 40 (6):1369-1397.

- Bevelander, Dianne, and Michael John Page. 2011. "Ms. Trust: Gender, Networks and Trust— Implications for Management and Education." *Academy of Management Learning & Education* 10 (4):623-642. doi: 10.5465/amle.2009.0138.
- Boni, Arthur A., Laurie R. Weingart, and Shelley Evenson. 2009. "Innovation in an Academic Setting: Designing and Leading a Business Through Market-Focused, Interdisciplinary Teams." *Academy of Management Learning & Education* 8 (3):407-417.
- Borgatti, Stephen P., and Rob Cross. 2003. "A relational view of information seeking and learning in social networks." *Management Science* 49 (4):432-445. doi: 10.1287/mnsc.49.4.432.14428.
- Borrego, Maura, and Lynita K Newswander. 2010. "Definitions of interdisciplinary research: Toward graduate-level interdisciplinary learning outcomes." *The Review of Higher Education* 34 (1):61-84. doi: 10.1353/rhe.2010.0006.
- Bresman, Henrik. 2010. "External Learning Activities and Team Performance: A Multimethod Field Study." *Organization Science* 21 (1):81-96. doi: 10.1287/orsc.1080.0413.
- Chapman, Kenneth J., Matthew Meuter, Dan Toy, and Lauren Wright. 2006. "Can't we pick our own groups? The influence of group selection method on group dynamics and outcomes." *Journal of Management Education* 30 (4):557-569. doi: 10.1177/1052562905284872.
- Curşeu, Petru Lucian, Steffie Janssen, and Jörg Raab. 2012. "Connecting the dots: social network structure, conflict, and group cognitive complexity." *Higher Education* 63 (5):621-629. doi: 10.1007/s10734-011-9462-7.
- Curşeu, Petru Lucian, and Helen Pluut. 2011. "Student groups as learning entities: The effect of group diversity and teamwork quality on groups' cognitive complexity." *Studies in Higher Education* 38 (1):87-103. doi: 10.1080/03075079.2011.565122.
- Decuyper, Stefan, Filip Dochy, and Piet Van den Bossche. 2010. "Grasping the dynamic complexity of team learning: An integrative model for effective team learning in organisations." *Educational Research Review* 5 (2):111-133. doi: 10.1016/j.edurev.2010.02.002.
- Gasevic, D, Amal Zouaq, and Robert Janzen. 2013. "'Choose your classmates, your GPA is at stake!': The association of cross-class social ties and academic performance." *American Behavioral Scientist* 57 (10):1460-1479. doi: 10.1177/0002764213479362.
- Hewstone, Miles, Mark Rubin, and Hazel Willis. 2002. "Intergroup Bias." *Annual Review of Psychology* 53 (1):575-604. doi: 10.1146/annurev.psych.53.100901.135109.
- Higher Education Statistics Agency. 2012. "Statistics - Students and qualifiers at UK HE institutions." Accessed 22-05-2014. <http://www.hesa.ac.uk/content/view/1897/239/>.
- Hofstede, Geert. 1986. "Cultural differences in teaching and learning." *International Journal of Intercultural Relations* 10 (3):301-320. doi: 10.1016/0147-1767(86)90015-5.
- Hommel, J., B. Rienties, W. de Grave, G. Bos, L. Schuwirth, and A. Scherpbier. 2012. "Visualising the invisible: a network approach to reveal the informal social side of student learning." *Advances in Health Sciences Education* 17 (5):743-757. doi: 10.1007/s10459-012-9349-0.

- House, R. J., P. J. Hanges, M. Javidan, P. W. Dorfman, and V. Gupta. 2004. *Culture, leadership and organizations: The GLOBE study of 62 Societies*. Thousand Oaks, CA: Sage Publications Inc.
- Kalfa, Senia, and Lucy Taksa. 2013. "Cultural capital in business higher education: reconsidering the graduate attributes movement and the focus on employability." *Studies in Higher Education* 40 (4):580-595. doi: 10.1080/03075079.2013.842210.
- Katz, Nancy, David Lazer, Holly Arrow, and Noshir Contractor. 2004. "Network theory and small groups." *Small Group Research* 35 (3):307-332. doi: 10.1177/1046496404264941.
- Klein, Julie T. 1990. *Interdisciplinarity: History, theory, and practice*. Detroit: Wayne State University.
- Krackhardt, David, and R.N. Stern. 1988. "Informal networks and organizational crises: An experimental simulation." *Social Psychology Quarterly* 51 (2):123-140. doi: 10.2307/2786835.
- Kurland, Nancy B., Kristy E. H. Michaud, Mechelle Best, Erica Wohldmann, Helen Cox, Kyriakos Pontikis, and Ashwani Vasishth. 2010. "Overcoming Silos: The Role of an Interdisciplinary Course in Shaping a Sustainability Network." *Academy of Management Learning & Education* 9 (3):457-476.
- Michaelsen, L. K., and B. Richards. 2005. "Drawing conclusions from the team-learning literature in health-sciences education: A commentary." *Teaching and learning in medicine* 17 (1):85-88.
- Moolenaar, Nienke M., Peter J. C. Sleegers, and Alan J. Daly. 2012. "Teaming up: Linking collaboration networks, collective efficacy, and student achievement." *Teaching and Teacher Education* 28 (2):251-262. doi: 10.1016/j.tate.2011.10.001.
- Pharo, E. J., A. Davison, K. Warr, M. Nursey-Bray, K. Beswick, E. Wapstra, and C. Jones. 2012. "Can teacher collaboration overcome barriers to interdisciplinary learning in a disciplinary university? A case study using climate change." *Teaching in Higher Education* 17 (5):497-507. doi: 10.1080/13562517.2012.658560.
- Pilbeam, Colin, and David Denyer. 2009. "Lone scholar or community member? The role of student networks in doctoral education in a UK management school." *Studies in Higher Education* 34 (3):301-318. doi: 10.1080/03075070802597077.
- Reagans, Ray, and Bill McEvily. 2003. "Network Structure and Knowledge Transfer: The Effects of Cohesion and Range." *Administrative Science Quarterly* 48 (2):240-267. doi: 10.2307/3556658.
- Rienties, B., Y. Heliot, and D. Jindal-Snape. 2013. "Understanding social learning relations of international students in a large classroom using social network analysis." *Higher Education* 66 (4):489-504. doi: 10.1007/s10734-013-9617-9.
- Rienties, B., and E.-M Nolan. 2014. "Understanding friendship and learning networks of international and host students using longitudinal Social Network Analysis." *International Journal of Intercultural Relations* 41:165-180. doi: 10.1016/j.ijintrel.2013.12.003.

- Taha, Nashrawan, and Andrew Cox. 2014. "International students' networks: a case study in a UK university." *Studies in Higher Education*:1-17. doi: 10.1080/03075079.2014.927851.
- Tajfel, H. 1978. "Interindividual behaviour and intergroup behaviour." In *Differentiation between social groups: Studies in the social psychology of intergroup relations*, edited by H. Tajfel, 27–60. Academic Press: London.
- Wassermann, S., and K. Faust. 1994. *Social Network Analysis: methods and applications*. Cambridge: Cambridge University Press.
- Wong, Sze-Sze. 2004. "Distal and Local Group Learning: Performance Trade-offs and Tensions." *Organization Science* 15 (6):645-656. doi: 10.1287/orsc.1040.0080.

Table 1 Friendship and learning ties based upon (inter)discipline (random vs. balanced condition)

	Random		Balanced		F-value	$\eta^2$
	M	SD	M	SD		
<i>During the fourth week</i>						
Same discipline friendship ties	5.06	3.64	5.22	3.35	.196	.001
Interdisciplinary friendship	1.49	2.13	1.27	1.70	1.163	.003
E-I friendship ties	-0.52	0.55	-0.60	0.47	2.275	.006
Same discipline learning	2.37	2.21	2.84	2.30	4.043*	.011
Interdisciplinary learning	0.52	0.97	0.56	0.97	.183	.000
E-I learning	-0.55	0.55	-0.57	0.56	.082	.000
<i>After eleven weeks</i>						
Same discipline friendship	6.64	4.77	6.14	3.93	1.180	.003
Interdisciplinary friendship	2.07	2.53	1.52	2.05	5.217*	.014
E-I friendship relations	-0.52	0.53	-0.60	0.48	2.506	.007
Same discipline learning	3.46	3.09	3.79	2.95	1.107	.003
Interdisciplinary learning	1.05	1.81	0.73	1.21	3.996*	.011
E-I learning	-0.49	0.57	-0.60	0.52	3.809*	.010

ANOVA of Random (n= 207) vs. balanced condition (n= 170). \*p < .05.



Table 2 Multiple regression quadratic assignment procedures of learning after eleven weeks.

	Random condition			Balanced condition		Combined	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
GLOBE proxy	.019*	.004	.001	.017	.005	.001	.001
Same Group	.029***	.027***	.029***	.115***	.053***	.044***	.038***
Same Discipline	.095***	.049***	.050***	.127***	.071***	.064***	.070***
Initial Friendship		.311***	.169***		.379***	.209***	.203***
Initial Learn			.137***			.228***	.173***
Initial Work			.128***			.071***	.126***
Intervention							.005
R <sup>2</sup> adj.	1	11	14	3	17	22	20
ΔR <sup>2</sup> adj.	-	10	3	-	14	5	-

MRQAP of random (n = 207) vs. balanced condition (n=170). Combined consists of both networks (n=377), standardised betas. \* $p < .05$ , \*\*\* $p < .001$

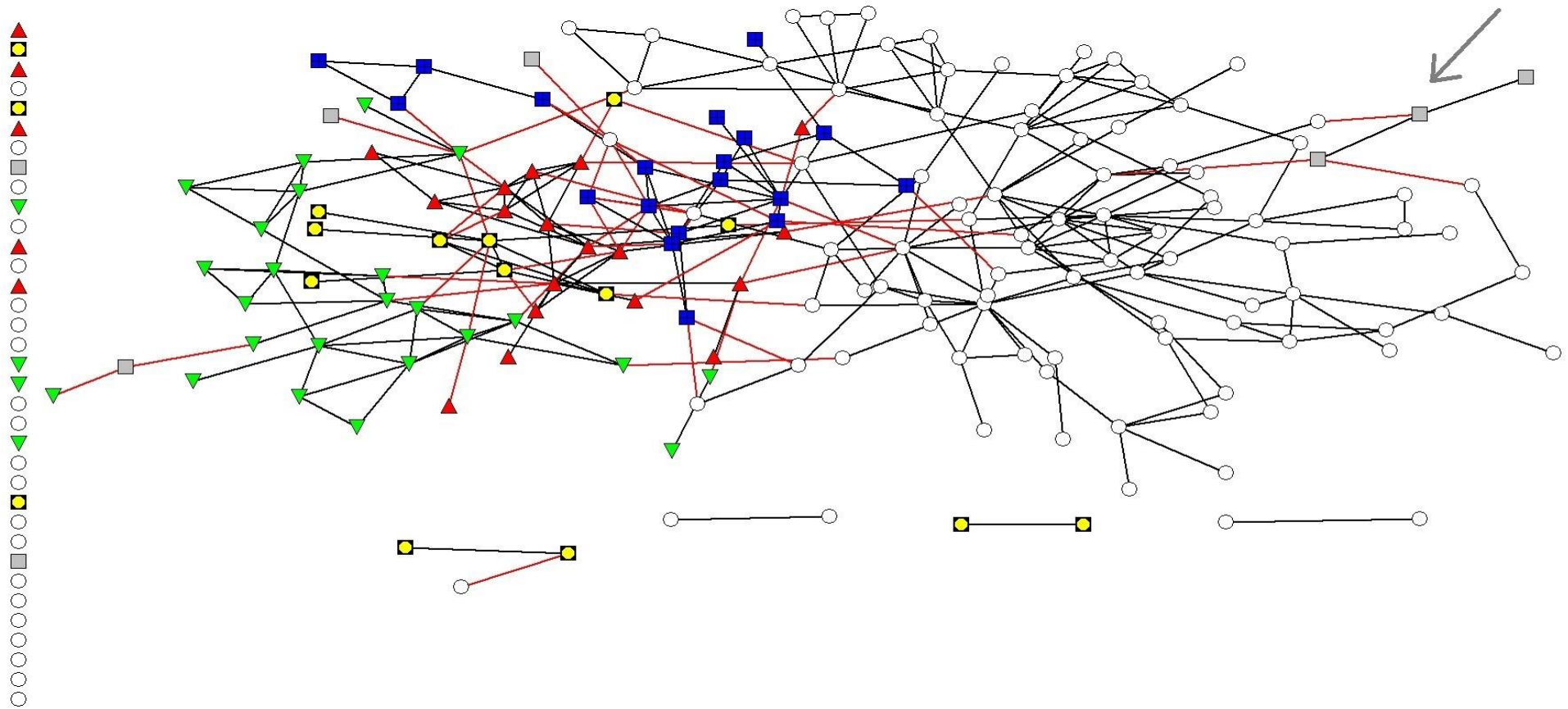
Table 3 Regression analysis of academic performance.

	Model 1	Model 2	Model 3	Model 4
Gender	.147**	.133**	.129*	.137**
Individualism (Culture) <sup>1</sup>	.296**	.308**	.307**	.310**
Masculinity (Culture)	-.054	-.066	-.068	-.064
Intervention	-.054	-.028	-.030	-.028
Number of ties (Pre) <sup>2</sup>		-.046	-.050	-.029
Number of ties (Post)		.239**	.240**	.247**
E-I discipline (Pre)			.001	
E-I discipline (Post)			-.028	
Ties (Pre) * E-I (Pre)				.023
Ties (Post) * E-I (Post)				.020
N	364	364	364	364
R <sup>2</sup> adj.	9	13	13	13
ΔR <sup>2</sup> adj.	-	4	0	0

<sup>1</sup>For controlling cultural differences, we used Hofstede's individualism vs. Collectivism and masculinity vs femininity index

<sup>2</sup>The number of ties and E-I Index for disciplines were computed as average score of the three social networks.

Figure 1 Social network of learning after four weeks in random condition



White circle = International Hospitality Management; Grey square = Business Management; Red up-triangle = Entrepreneurship; Blue box = Food Management; Green down triangle = Health Care Management; Yellow circle in box = Intercultural Communication with International Business



Figure 3 Social learning network after four weeks in balanced condition

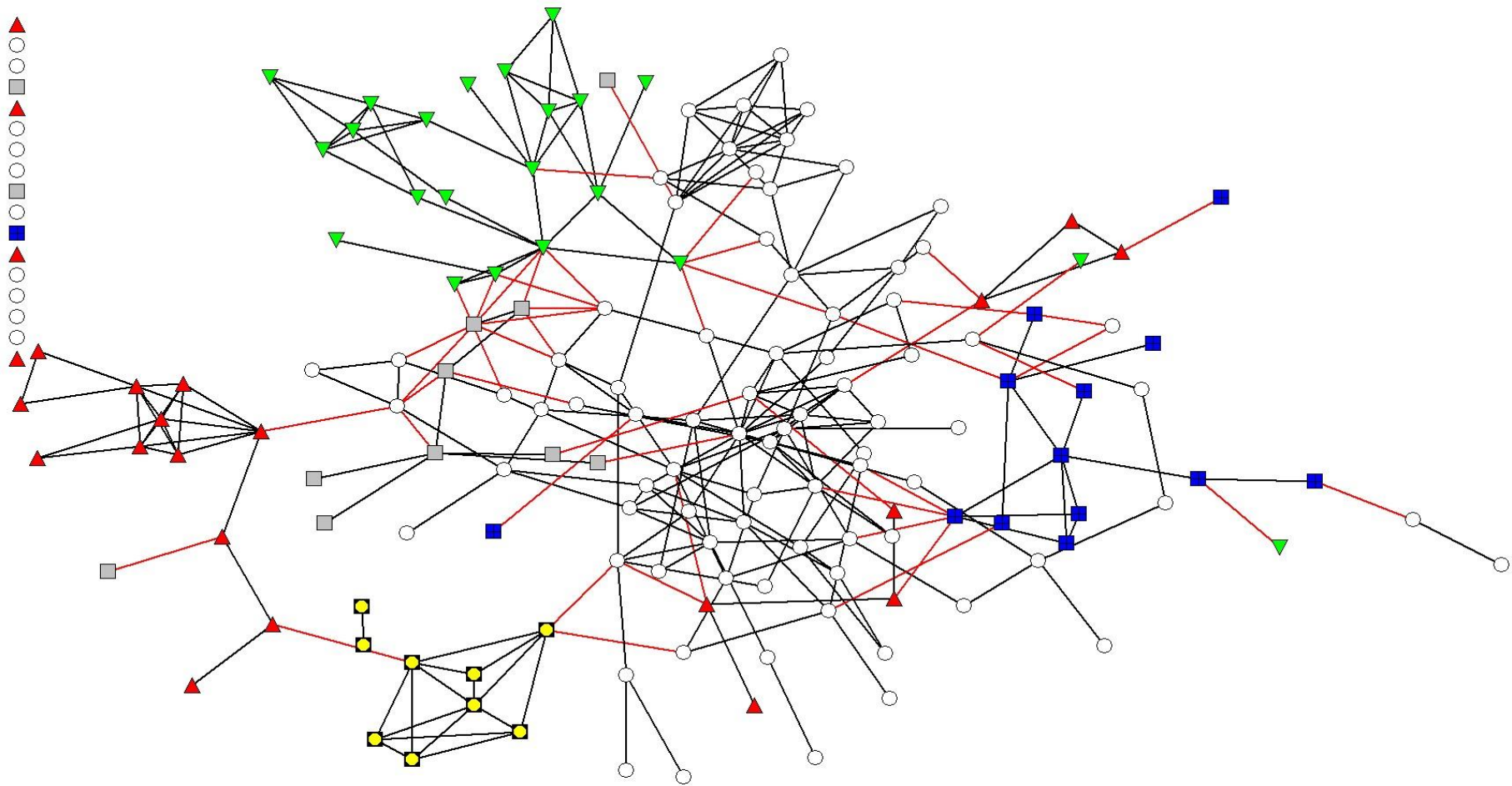


Figure 4 Social learning network after eleven weeks in balanced condition

