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Additional Information

The social relations of university students: Intensity, interaction and association with academic performance

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Abstract: In recent years, the literature has stressed the importance of relational factors in students' academic performance. Thus, the networks of assistance and exchange in academic matters and the expressive or friendship networks established in the classroom can have a significant influence on students' academic performance. For this reason, we thought that it might be interesting to explore the intensity, structure and interaction of these networks, as well as their ties with students' academic performance. Using social network analysis, we performed an exploratory study on the relations in a sample of students from the Universitat Politècnica de València. The results show that students' academic assistance and exchange network and friendship network show a high density and mutual correlation, and that the way students integrate socially into the academic network determines their university performance. These results can guide universities in the development of activities aimed at shaping the form and quality of students' relational capacity.

Keywords: Social relations; Academic performance; Social network analysis; University studies

Studying the factors that influence university students' academic performance is a subject that has captured the attention of both educators and professionals in recent decades (among others: McKenzie & Schweitzer, 2001; Mafokozi, 2011; Tomás-Miquel, Expósito-Langa & Sempere-Castelló, 2014; Mora, García & Molina, 2016). Among these factors, the literature has stressed the importance of students' relations on their academic performance (Yang & Tang, 2003; Smith, 2010; Chen, Wang & Song, 2012); that is, the bonds that students develop shape informal networks of contacts through which they develop bonds of friendship and trust and exchange information and knowledge.

Additionally, the importance of these relations is reinforced in the context of higher education in Spain due to the inclusion of new teaching methodologies within the framework of the European Higher Education Area. These methodologies more intensively develop team activities, which promote students' participation, involvement and interaction.

Despite the importance of relational factors in university students, we believe that the existing literature has not examined the morphology of these networks in great enough detail, nor has it delved into their relational intensity or its relation with other variables. Thus, there are questions yet to be answered. In consequence, this study aims to contribute to decreasing this dearth by using social network analysis to explore the degree to which university students develop relations of academic assistance and exchange and friendship networks. This will allow us to study the intensity, structure and interaction of these networks, as well as their link to academic performance. To conduct this empirical study, we chose students in their last year of the Bachelor's of Industrial Design and Product Development Engineering (abbreviated, GIDIDP in Spanish) at the Alcoy campus of the Universitat Politècnica de València (UPV).

The study is organised as follows. First we will outline the theoretical framework and justify the questions being studied. We will then describe the methodology and the empirical study

conducted. After that we will outline the main results, and we will end with the conclusions and implications of this study.

Theoretical development

Much of the literature on academic performance has focused on analysing variables like students' skill and motivation to explain their performance (Meece, Anderman & Anderman, 2006; Kassim, Hanafi & Hancock, 2008; Pekrun, Elliot & Maier, 2009), while less attention has been paid to the social influence exerted by other students in university settings (Rizzuto, LeDoux & Hatala, 2009; Biancani & McFarland, 2013). However, some studies have highlighted social relations as one of the critical factors that can influence the learning process (Gašević, Zouaq & Janzen, 2013). In fact, this learning process does not emerge in an individual context but instead through interpersonal communication processes (Lave & Wenger, 1991; Haythornthwaite, 2002).

According to Baldwin, Bedell and Johnson (1997), based on the theoretical proposal put forth by Webb (1982), there are two kinds of influences or mechanisms that can lead to a positive relation between interactions with classmates and students' achievements and attitudes. The first is a direct influence on cognitive processes. In this context, several authors have suggested that the interactions among students in situations of assistance and exchange of knowledge make it possible for them to improve their understanding of the different concepts, theories or problems addressed, as well as their cognitive restructuring (Durling & Schick, 1976; Gall & Gall, 1976; Slavin, 1977). This is meaningful for both the students who provide academic assistance and those who receive it. Thus, the fact that a student tries to teach another student may allow the former to cognitively restructure their knowledge, as well as to clarify and identify new relations among the concepts conveyed (Bargh & Schul, 1980). Likewise, the student receiving new knowledge in these processes of academic

assistance and exchange can more easily understand the concepts and make cognitive readjustments (Webb, 1982). Complementary to this line of argumentation, students' changes in opinions on a concept, problem or theory which may arise from their social relations can also be an additional key factor in their learning process. Following the conflict-resolution-learning model (Johnson & Johnson, 1979), a difference of opinions among classmates regarding a theoretical concept or problem generates a sense of mutual uncertainty that can facilitate the joint quest for new information. As a result of processing this information, some students will change their opinions, thus enriching their base of knowledge.

On the other hand, in addition to the improvement in cognitive processes, a second mechanism that can lead to a positive relation between interactions with classmates and students' achievements and attitudes is the generation of an emotional or intellectual climate that is favourable to learning. In this case, the main socio-emotional variables believed by the literature to mediate in the relation between social ties and student performance are anxiety, motivation and satisfaction (Webb, 1982). For example, students who work independently have to think in an isolated fashion, without either social support or group feedback. In the case of complex tasks, this isolation can increase their anxiety and uncertainty and thus diminish their performance (Benbunan-Fich & Hiltz, 1999). In fact, several authors associate isolation and the student's weak social presence with high drop-out rates (Flood, 2002; Johnson, Hornik & Salas, 2008). On the other hand, according to Harasim (1990) and Webb (1982), anxiety and uncertainty are lowered when working with classmates since students find ways to deal with new and complex tasks together. These effects tend to increase motivation and satisfaction with the process and the results. In this sense, the literature has stressed the positive influence that the students' social integration into learning communities may have on their remaining at the university (Thomas, 2000).

Kinds of relations

When relations among students are further explored, it was noticed that not all ties influence performance in the same way. Thus, as Smith and Peterson (2007) suggest, when predicting a student's academic performance and involvement, not only is the size of their network of relations important, but so is the content of these ties.

Therefore, we should distinguish among the different kinds of relations that can occur among classmates, since a purely formal relation will not have the same influence as a bond of friendship, which assumes some kind of social interaction that extends beyond the academic context.

In this sense, the literature identifies two main kinds of networks among students (Ibarra, 1993). The first are *instrumental networks or academic assistance and exchange networks*, which are more closely tied to students' sharing knowledge. These links provide the student with support either to exchange and share materials and notes or to solve problems together in order to successfully complete their learning (Chen et al., 2012). In fact, Thomas (2000) indicates that the structural properties of this kind of academic network could be interpreted as indicators of the degree to which students integrate into life in the faculty, school or university. Likewise, the formation of academic assistance and exchange networks is consistent with the idea of a learning community where the joint understanding of practices and collective learning takes place (Stassen, 2003).

Secondly, *expressive or friendship networks* have been identified, which are more closely associated with affect and emotions. These ties encompass the relations that involve the exchange of friendship and trust, and they are seldom related to academic matters. Through these ties, students tend to share values and habits and create bonds based on the mutual reinforcement of these similarities (Smith & Peterson, 2007). Friendship relations are often regarded as a source of psychosocial support (Ibarra, 1995) and can help students deal with

the stress and tensions that come with studying (Baldwin et al., 1997). However, in other contributions to the literature, expressive bonds are regarded as a factor that can hinder learning, since friends can limit students' development of new relations that may expose them to constructive criticism of their work (Smith & Peterson, 2007).

In short, the presence of both academic assistance and exchange relations and friendship relations among university students has been proven and confirmed in the literature. However, when we further examine the scope and importance of each of these kinds of relations, the contributions to the literature have been very limited and the conclusions have been disparate. Thus, while some studies claim that friendship predominate over academic assistance relations (Chen et al., 2012), others claim the opposite: that instrumental relations predominate over expressive ones (Smith, 2010). In consequence, with the goal of providing new empirical evidence, we have posited our first research question:

Research question 1: Are relations among university students widespread, and to what extent do they develop each kind of bond, expressive and friendship on the one hand and academic assistance and exchange on the other?

Link of the assistance and academic exchange bonds and friendship bonds

There is no doubt that students can be involved in multiple kinds of relations at the same time. For example, two students who begin to do projects together in the classroom can end up becoming friends (Chen et al., 2012). The presence of multiple relations among nodes is called multiplexity (Wasserman & Faust, 1994), and it reflects the nodes' tendency to develop the same relations in different kinds of networks. Multiple dyadic relations are a major indicator of the strength and confidence in the bond given the nodes' possibilities to interact in a variety of contexts (Ibarra, 1993).

The existence of multiple relations among students requires the presence of common elements which lead them to form these kinds of bonds. When two friends meet in the classroom, it is not difficult for academic assistance and exchange relations to also emerge. However, in certain specific situations it is possible for their relations to be limited to the expressive sphere, such as when one of them joins a course later than the other and the latter has consolidated their relations with other members of the course in terms of study or work groups. In this case, the new student may be forced to seek new classmates with whom to form a group and exchange knowledge. On the other hand, when instrumental relations emerge between two students, the subsequent appearance of expressive ties between them is not guaranteed. In this context, the idea of interpersonal closeness may play an important role. Closeness refers to the proximity between two students in a context of analysis. The elements of closeness which play a significant role in these situations include physical aspects, tastes and hobbies and cultural aspects, among others.

Physical closeness refers to the continuous presence of two students in a close physical context, whether this closeness is fortuitous or not. For example, the fact that two students already had instrumental relations and later shared a home, a hall of residence or membership in the same association within the university (such as student council, tutoring or student orientation programmes) may foster the establishment of friendship as well. On the other hand, closeness in tastes and hobbies and cultural/ethnic closeness may also play an important role in the formation of these multiple ties. For example, the fact that two students who share knowledge in a classroom also share the same hobby may lead them to develop expressive bonds. Likewise, belonging to the same race or geographic origin may also foster the additional formation of this kind of bond.

The literature analysing the origin and presence of multiplexity in university students' relations is quite limited (Chen et al., 2012). For this reason, and with the goal of providing new evidence in this area, we suggest a second question to study:

Research question 2: To what extent is students' pattern of friendship bonds and of academic assistance and exchange bonds related, that is, to what extent are students involved with other students in both kinds of relations simultaneously?

Social relations and academic performance

In this twofold scenario of student networks (academic assistance and exchange and friendship), the literature has studied how the centrality of students in these networks, that is, the degree to which the students occupy a strategic position (Freeman, 1979), influences their academic performance and satisfaction.

Several contributions have noted a positive influence of centrality in academic assistance networks on performance (Baldwin et al., 1997; Yang & Tang, 2003; Cho, Gay, Davidson & Ingraffea, 2007; Smith & Peterson 2007; Hommes et al., 2012). Students who occupy a central position in academic assistance and exchange networks are capable of accumulating more information, knowledge and experience related to the functions and job performed. In consequence, they are also likely to have better results than their classmates who are not in these central positions. Contrary to these arguments, other contributions have warned about the difficulties that central actors in a network may have in gaining new knowledge and therefore developing creative results. In this sense, Morrison and Rabellotti (2005) indicate that because of their profound integration, actors who occupy central roles may be more likely to access the same sources of information and in turn exchange redundant information and knowledge. Additionally, these actors may show difficulties abandoning existing ideas

and exploring new ones (Schilling, 2005). In line with these arguments, Baldwin et al. (2007) and Gašević et al. (2013) have stressed that having a more diverse set of instrumental relations may allow students access to a wide range of viewpoints, which can result in more and higher-quality information.

With regard to friendship networks, there is some controversy on the influence that they may have on students' academic performance. Some authors claim that these bonds are more closely connected to students' satisfaction and emotional balance (Baldwin et al., 1997; Yang & Tang, 2003), with no evidence of their association with academic performance. Other authors have revealed a minor positive influence (Hommes et al., 2012), while yet others have even suggested a negative effect (Smith & Peterson 2007).

Based on these arguments, we believe that this study should also contribute to this debate and examine a third question:

Research question 3: Do students' positions in their friendship networks and academic assistance and exchange networks influence their academic performance? If so, what position may be the most beneficial for students' performance?

Design of the empirical study

The Alcoy campus of the UPV is one of the university's external campuses. It had 2,344 students in academic year 2013-2014, and it offers a total of six degrees and four official Master's. Its degree programmes include GIDIDP, which has 346 students divided among the four courses in the programme. This programme aims to scientifically and technically train students to work professionally in a context of directing and managing the entire product lifecycle, from generating the idea (market analysis, creativity, marketing, basic, design, etc.)

to producing, manufacturing and launching the product, and including the environmental impact study at the end of its shelf life.

Participants

The sample analysed focused on students in the fourth year of the GIDIDP on the Alcoy campus of the UPV. These students were in their last year of the degree programme, with consolidated friendship relations and academic assistance and exchange relations, which were presumably at their most intense point. The fieldwork was performed using the roster recall method (Smith & Peterson, 2007), which was applied to all the students during the month of February 2014. At the end of the process, we had a total of 58 valid responses, which encompassed all the students enrolled. Table 1 shows the technical information on the study.

INSERT TABLE 1 HERE

Description of the variables

Academic performance

To make the academic performance variable operative, we used the mean mark of the classes which the students took during the first semester of the fourth course of the GIDIDP.

Variables associated with networks of relations

To make the variables related to the study of the networks and relations among students operative, we applied social network analysis. This enables us to explore the structural properties of a network, and it encompasses theories, models and applications which are expressed in terms of relational concepts or processes (Wasserman & Faust, 1994). The application of this kind of analysis in the field of higher education is a relatively recent

phenomenon (Biancani & McFarland, 2013), although its use is gradually increasing (Gašević et al., 2013).

The application of social network analysis first requires that the networks of bonds be constructed, both academic assistance and exchange bonds and friendship bonds. Therefore, in order to move on to this step, we followed the procedure described in Smith and Peterson (2007). Specifically, each of the students was shown a list of classmates (Erickson, Nosanchuk & Lee, 1981) and was asked to indicate what kind of relation they had with each one. They were asked 2 specific questions: “With which of the classmates on the list have you been friends recently?” and “Which classmates have helped you or provided you with information to help you do projects in the different classes during the last semester?”

This information enabled us to construct the networks and later study them. To analyse the morphology, structure and associations of the networks, we studied different measurements of social network analysis such as the density of the network, the Gini Index, reciprocity and multiplexity. Likewise, to study the association between the networks and academic performance, we used the coreness variable (Borgatti & Everett, 1999), which refers to the proximity of each node in the network with the nucleus of densely interconnected nodes.

Analysis techniques

The data gathered were processed using UCINET v6 software (Borgatti, Everett & Freeman, 2002). Likewise, to graphically depict the networks of relations, we used the NETDRAW application. To study the associations between the students' position in the networks and their academic performance, we used analysis of variance (ANOVA). For this final analysis, we used the SPSS v16 statistics software.

Results

Figures 1 and 2 show the networks of friendship and of academic assistance and exchange in the sample analysed. In each of these networks, one node represents one student, and a line between two nodes indicates the presence of a relation between them. Likewise, the size of the nodes is associated with their degree of relational activity. In this way, the larger the size of the node, the higher their degree of interaction.

INSERT FIGURE 1 HERE

INSERT FIGURE 2 HERE

Visually, the figures reveal several important aspects of the students' relations. First, we can see that the students extensively develop both friendship relations and academic assistance and exchange relations. Furthermore, based on the previous figures, we can see that no student is disconnected from the others in either of the two networks. Likewise, we can detect that there are differences in cohesion between the two networks. Thus, the friendship network is denser than the academic assistance and exchange network. The figures in Table 2 confirm the impressions yielded from this visual inspection.

General characteristics of the networks

Table 2 presents all the measurements calculated based on each of the networks analysed.

INSERT TABLE 2 HERE

Based on the figures from the table above, we can see that both networks show notable levels of interaction, thus confirming that the students significantly develop both friendships and knowledge exchange relations. On the other hand, they also confirm our initial impressions on density, that is, the proportion of bonds in the network compared to the total possible bonds is significantly higher in the friendship network (32.46%) than in the academic

assistance and exchange network (21.75%). This leads us to deduce that the students in the sample have more friendships than academic relations. This may be due to the fact that academic assistance bonds are more specialised than friendship bonds and/or to the fact that friendships are generally relations with a higher degree of multiplicity which show generic bonds that are not associated with getting a specific resource (such as resources with academic value). The higher presence of friendships than exchange of knowledge relations is also corroborated by the number of links in the networks, which is higher in the friendship network. Thus, we can claim that the academic network is also more restrictive than the friendship network. On the other hand, the Gini concentration index shows whether there are students with a higher number of contacts than others. The results indicate a certain degree of homogeneity in the number of bonds per student, and these results are similar for both networks. In turn, reciprocity measures the number of bonds that are reciprocal within a given network. When we have reciprocal exchanges, the bonds are much more stable and reliable. The results show that reciprocity is somewhat higher in the friendship network (44.41%) than in the academic assistance and exchange network (41.81%), although the values are high in both. This entire analysis contains the answer to the first proposed research question.

Strengths of bonds. Multiple relations in the networks studied

In this section, we aim to analyse the second research question, that is, to explore the degree to which the existing pattern of interactions in the friendship network of the students analysed is aligned with the existing pattern of interactions in the academic assistance and exchange network.

In order to perform this analysis, we observed the degree of overlap or multiplexity between the relations in both networks using the QAP (Quadratic Assignment Procedures) in

UCINET. This is a statistical technique that shows the correlations between two square matrixes, and it is commonly used to analyse patterns of association among networks (Krackhardt, 1987).

Below is the information on the QAP correlations, following the procedure outlined in Friendkin (2009) and Ramos and Maya-Jariego (2013). Specifically, we used Pearson and Jaccard correlation coefficients as indicators of overlap. Their values, interpreted as a percentage, ranged between 0 and 1 such that the closer to 1, the higher the degree of overlap between networks. The results show a high degree of overlap between the relations explored, with a level of overlap of 61.8% according to the Pearson coefficient and 54% according to the Jaccard coefficient. These values indicate that sharing a class leads students to develop different kinds of relations with the same people.

Students' position in the networks of relations and their association with academic performance

To conclude the analysis, the third research question sought to study the relation between the students' position in the networks of relations and their academic performance. To do so, we initially divided the students in each of the networks according to their degree of integration within them. We based this on a core/periphery model (Borgatti & Everett, 1999) in UCINET, and later verified whether there were significant differences between the academic performance of the students in each group.

Core/periphery network structures are characterised by the presence of a dense, cohesive nucleus and a dispersed periphery relatively disconnected from the nucleus of core actors. Based on the procedure outlined in Borgatti and Everett (1999), we estimated the degree of coreness of each node by the fit of a continuous model of the core/periphery structure. The degree of coreness refers to the proximity of each node in the network to the nucleus of

densely connected nodes. The UCINET algorithm assigns high values to the members of the nucleus of the network and low values to those on the periphery. In our case, following a procedure similar to the one described in García-Muñiz, Morillas-Raya and Ramos-Carvajal (2011), we chose to classify the nodes into 3 groups in both networks according to the coreness value.

Thus, the first group is made up of the nodes with a high coreness value (higher tercile) which are part of the nucleus or core of the network. A second group made up of the nodes with a low coreness value (lower tercile), was made up of the students that are far from the nucleus of relations, which we call periphery, and finally the third group shows intermediate values of coreness (central tercile), which is located in an intermediate relational position called semi-periphery. Figures 1 and 2 also show the results of the application of this procedure in the students analysed for both the academic assistance and the friendship networks. In both networks, the colours of the nodes represent white for students at the core of the network, grey for students in the semi-periphery and black for students in the periphery.

Once the students were classified into groups according to their relational level, we believed that applying an ANOVA model is appropriate for our analysis. In this case, the design of the experiment for both networks would have an independent variable or factor (location at the core, semi-periphery or periphery), while students' academic performance would be taken as the dependent or response variable.

To perform the ANOVA analysis, we first had to check two basic assumptions, namely the normality of the samples, that is, that they come from normally distributed populations, and

the homoscedasticity or homogeneity of variances, that is, that these populations have the same variance.

The first assumption could be checked via the Shapiro-Wilk statistic, since none of the three groups was larger than a sample size of 50 elements. In all cases, the normality hypothesis was accepted: core (Shapiro-Wilk = .961, Sig. = .583, n = 19), semi-periphery (Shapiro-Wilk = .970, Sig. = .757, n = 19) and periphery (Shapiro-Wilk = .918, Sig. = .102, n = 20), since the critical level is higher than 5%.

Regarding the second assumption, the Levene statistic allows us to check the hypothesis of homogeneity of variances. The contrast value (Levene statistic = .384) and its critical level (sig. = .683) allow us to state that the variance of the academic performance variable is the same for all three populations defined by the Location in the Network variable.

Once the assumptions had been checked, we carried out the ANOVA analysis. The results of this test obtained using the SPSS v. 16 software are shown in Table 3.

INSERT TABLE 3 HERE

Based on the previous results, we only found significant differences in the mean academic performance among the different groups in the case of the academic assistance and exchange network.

In order to pinpoint where the differences among the three groups in this network are, we performed a post-hoc analysis. In this case, we used the Tukey method, an analysis commonly accepted in research. The results are shown in Table 4.

INSERT TABLE 4 HERE

The results show that the mean of the students in the semi-periphery group is higher than and significant different to the others. Thus, the semi-periphery group would comprise a homogeneous group. On the other hand, the scores of the students in the core and periphery groups are lower and do not show statistically significant differences, meaning that they would comprise a second homogeneous group. With the goal of clarifying this result, we included the bar diagram per group obtained using the SPSS v. 16 software (Figure 3).

INSERT FIGURE 3 HERE

Conclusions

This study sought to more thoroughly examine university students' relations. To do so, we analysed the friendship bonds and academic assistance and exchange bonds forged by students at the university and their possible influence on the students' performance.

The results obtained indicate that students extensively develop both friendship and academic assistance networks, although the former are predominant. Even though these results are in line with those obtained in studies like the one by Smith (2010) in Bachelor's students in the United States, they differ in the predominant kinds of relations from the results found by Chen et al. (2012) in Master's degrees programmes in China targeted at working professionals. This divergence reveals that apart from the possible cultural differences that may exist in the tendency to forge social relations in different countries, the kind of university studies and especially the kinds of students in these programmes may play a major role in the formation of the pattern of relations. Thus, students who may be actively working in companies, as often happens with Master's students, require greater academic support and have less time to develop friendships with classmates, while Bachelor's students can establish and develop more bonds of friendship and trust.

On the other hand, the results of our study also reveal the existence of a considerable association between the friendship and academic assistance and exchange networks analysed. Thus, they confirm that students reinforce their interactions by building multiple relations across different networks with the same group of people. These conclusions are indeed similar to those of Chen et al. (2012).

Additionally, in our opinion, the association between the students' location in the network of relations and their academic performance is particularly interesting. On the one hand, the results do not allow us to confirm a relationship between the students' position in the friendship network and their performance, in line with studies like Baldwin et al. (1997) and Yang and Tang (2003). These authors suggest, in contrast, a greater association of this kind of relation with students' satisfaction and balance than with their academic performance.

Despite this, the results do allow us to confirm the association between the position in the academic assistance and exchange network, where students share ideas and knowledge, and the student's academic performance. Curiously, students located in the semi-periphery of the network earn better final marks in their programmes. These results show the possible presence of a saturation effect in this kind of relations developed by students. That is, after a certain level of proximity to coreness, an extra effort to draw closer and establish relations with the goal of getting better academic results implies a higher use of resources, such as time, which would even lead to a drop in the student's academic performance. These results differ from those obtained by previous studies, which indicate the presence of a linear, positive relation between the bonds of knowledge developed by university students and their academic performance (Baldwin et al., 1997; Yang & Tang, 2003; Cho et al., 2007; Smith & Peterson, 2007; Hommes et al., 2012). According to these authors, the students who occupy a central role in the academic assistance and exchange network are capable of accumulating more information, knowledge and experience on the tasks and work done, thus allowing them

to achieve better performance than other classmates who do not occupy these central positions. A comparison of the results with these other studies leads us to establish the following reflection following the theoretical premises mentioned above regarding the problems that might come with excessive centrality in a network of relations. Taking the degree programme analysed as the basis, the Bachelor's in Design, in which students' creativity and capacity for innovation is valued, the results can be explained through contributions that justify the advantages for creativity of being located on the boundaries between a densely related sub-network (core) with high trust and access to information, but that at times can be redundant, and another more disperse network (periphery), with access to new external sources of information but with few exchanges of knowledge (Cattani & Ferriani, 2008). Therefore, being in contact with the core without losing the relation with the periphery provides a way to acquire knowledge without being subjected to the ties that typically join this kind of knowledge to particular or closed worlds (Hargadon, 2006), thus fostering the students' creative and innovative capacity.

We believe that these results may have meaningful implications in both research and university policies and strategies. Regarding research, these results reveal the importance of considering the kind of degree programme analysed, especially its ties to creativity, when studying the influence of students' relations on their academic performance. On the other hand, with regard to university policies, and with the goal of positively influencing students' academic performance, these results should reinforce university institutions' interest in the status of the relations that their students establish inside and outside the classroom and serve as a guide to launch activities aimed at improving their portfolio of relations shaped according to the importance of the creativity needed in their degree programmes.

Finally, this study does have some limitations. Because the sample and degree programme analysed may have influenced the results, it would be interesting to compare this study with

other degree programmes where creativity is not a significant factor. Likewise, we have not considered the influence of the structure and composition of the students' work teams on the academic performance of each of their members. Recent studies indicate that the internal composition of working teams can offset the lack of relational skills of some of their members (Guimerà, Uzzi, Spiro & Amaral, 2005; Cattani & Ferriani, 2008). These questions can serve to inspire future studies.

Table 1. Technical information on the study

Universe	Bachelor's of Industrial Design and Product Development Engineering at the Alcoy campus of the UPV
Geographic area	Alcoy campus of the UPV
Sample framework	Students enrolled in the 4th year of the Bachelor's of Industrial Design and Product Development Engineering at the UPV (Alcoy campus)
Sample unit	Students
Population	58 students
Sample size	58 valid responses. 23 males (39.66%) and 35 females (60.34%). Mean age 22.57.
Confidence level	95.5% ($p = q = 0.5$)
Sample design	Questionnaire design and pre-test
Information gathered	Responses from students on academic assistance and friendship relations

Table 2. General characteristics of the networks

Measurements	Academic assistance and exchange network	Friendship network
Density	21.75%	32.46%
Total number of links	719	1073
Isolated nodes	0	0
Gini index	.22	.22
Reciprocity	41.81%	44.41%

Table 3. Mean scores by comparison group and results of the ANOVA test for both networks.

Network	Mean Core	Dev. Core	Mean Semi- Periphery	Dev. Semi- Periphery	Mean Periphery	Dev. Periphery	F	Degrees of freedom
Academic assistance and exchange network	5.858	1.057	6.927	1.232	5.883	1.266	5.174*	2
Friendship network	6.179	1.155	6.664	1.312	5.864	1.290	1.967	2

Note: $n_{\text{Core}}=19$; $n_{\text{Semi-Periphery}}=19$; $n_{\text{Periphery}}=20$; * $p<.05$

Table 4. Multiple post-hoc comparisons for the academic assistance and exchange network.
Tukey test

Group	Comparison group	Difference in means
<i>Core</i>	<i>Semi-Periphery</i>	-1.069*
	<i>Periphery</i>	-.025
<i>Semi-Periphery</i>	<i>Core</i>	1.069*
	<i>Periphery</i>	1.045*
<i>Periphery</i>	<i>Core</i>	.025
	<i>Semi-Periphery</i>	-1.045*

Note: *p < .05

Figure 1. Structure of the academic assistance and exchange network

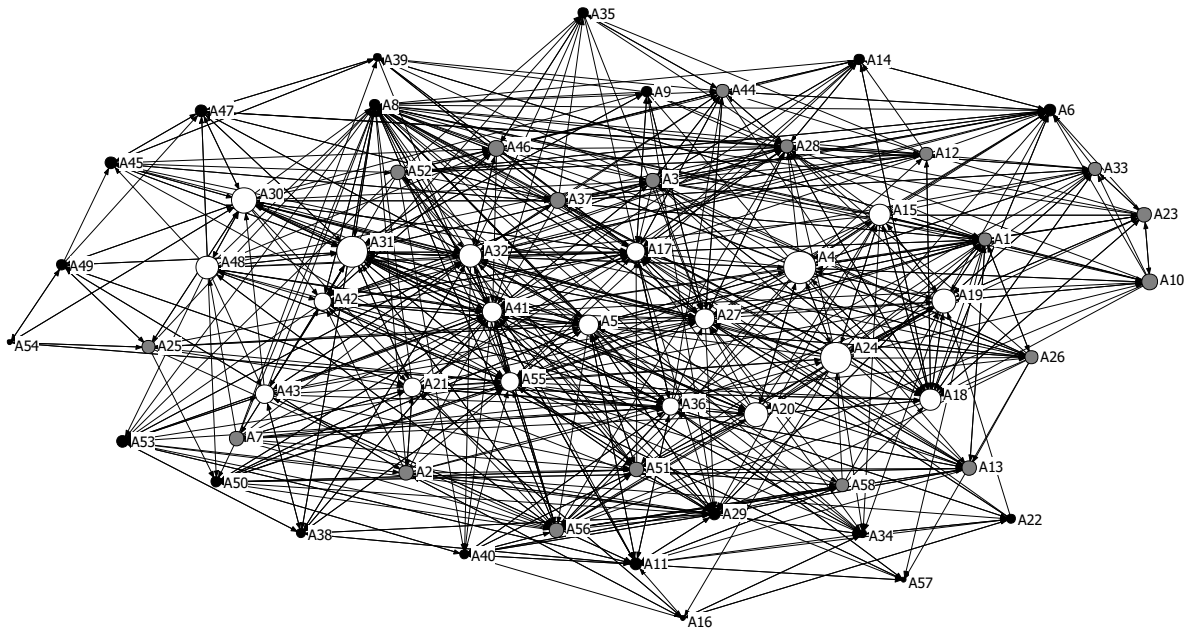


Figure 2. Structure of the friendship network

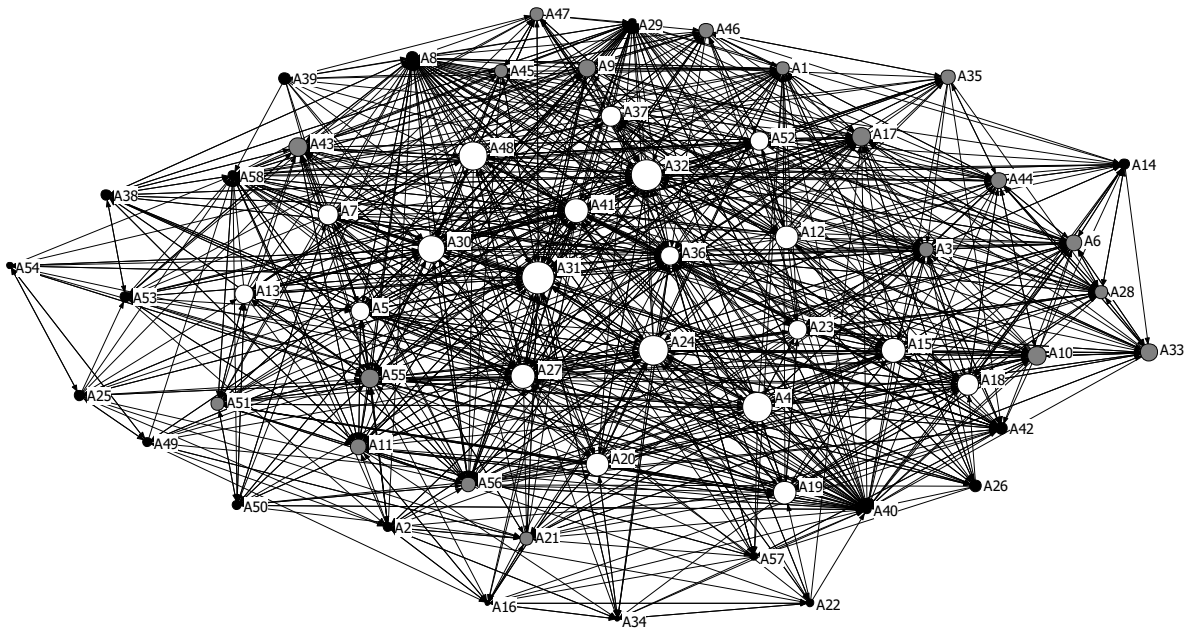


Figure 3. Bar diagram by group for the academic assistance and exchange network

