EXPLORING THE RELATIONSHIP OF NETWORK CENTRALITY AND ACADEMIC PERFORMANCE OF FEMALE STUDENTS

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Abstract: *This research endeavor aims to investigate the impact of network centrality (degree, closeness and betweenness) on academic performance (CGPA) of female students in an academic advice network. Where degree centrality refers to the number of direct links that an actor has with other actors, betweenness centrality refers to the degree to which an actor lies on the geodesic paths between other actors and closeness centrality focuses on how close a member is to all other members in network. Data was collected from 182 female students enrolled in various programs at a public sector University in Baluchistan through name generators for egocentric network by Burt. Techniques of correlation and standard multiple regression analysis are employed to test the hypotheses. The results of statistical analysis revealed that high degree and betweenness centrality leads to increase academic performance of students whereas higher closeness centrality leads to decrease academic performance. The result of the study has practical implications for students' academic life: it will aid the female students to discover structural pattern of social ties of their advice network and enhance their tendency for forming more ties related with academic advices for the achievement of excellent academic performance.*

Key words: Network centrality, academic performance, advice network

Introduction

According to the "social network approach", the performance of a person is affected by the types of ties, and structural characteristics of network more than by qualities, traits, characteristics that an individual owns (Yang &Tang, 2003).Structural characteristics refer to the complete arrangement of relations among the system's actors (Tichy, Tushman, & Fombrun, 1979), like, clustering, bridge, gatekeeper, density and centrality etc. Structural characteristics (Granovetter, 1985) in social network have the power to impact positively or negatively on performance of entities (Yang & Tang, 2003). Structural characteristics (Granovetter, 1985) served as focal principle in social network studies. The unique characteristic of this stream of investigation lies in how it pleas to the structural properties of social networks in clarifying results (Sparrowe,

Liden, Wayne, & Kraimer, 2001). From this point of view, people enjoy gains or suffer damages by virtue of social structure (their places inside social networks) in any kind of situation. For example, organizational integration (Sparrowe & Liden, 1997), advancement, progress, development or promotion (Burt, 1992), authority, power, control (Brass, 1984), creativity (Ibarra, 1993), learning aftermaths (Baldwin, Bedell, & Johnson, 1997), and job successes (Sparrowe, et al., 2001) all depends on actors position in social network. In addition, individuals embedded in advice networks can benefit from the ties by gaining structurally beneficial positions in the advice network to derive positive outcomes for example enhanced research performance (Badar, Hite, & Ashraf, 2015).

Several studies were conducted to prove impact of structural social capital (Zheng, 2008) on performance but their unit of analysis was comprised of both genders, disregarding (ignoring) individuals- just male or female students and their position in social networks which influence their academic performance. Researchers like, Guldner and Stone-Winestock (1995); Baldwin et al. (1997); Sparrowe et al. (2001) conducted research to find the impact of structural social capital on students' performance and confirmed that student's location in social network enhance their academic performance.

Researchers (particularly in education) have been quite interested in exploring the factors which significantly contribute for performance improvement of students (Shah, Rahman, & Abbas, 2015). Some scholars have conducted research on females' centrality in network but their context were different from education like, Burt (1998) tried to find the impact of structural social capital on women manager's advancement and concluded weaker relationship among these variables. Hence, this research endeavor (unlike others) attempts to encompass the knowledge of advice networks by concentrating on a social structure of female student's network and studying the influence of three traditional dimensions of centrality (degree, closeness and betweenness) on female student's academic performance.

Centrality

Centrality is defined as the level to which a focal actor is linked to other actors within identified network (Wasserman & Faust, 1994). Freeman (1979) suggested three measured of centrality, commonly used to show position of actor in network, that are *degree centrality* which is based on the number of direct links that an actor has with other actors, *betweenness centrality* that is the extent to which an actor lies on the geodesic paths between other actors and *closeness centrality* focuses on how ''close'' a member is to all other members in network. This current research used these dimensions to predict impact of centrality on academic performance of female students in advice network.

Centrality is one of the most significant notions in social network analysis (Domhoff, 2013). Central position of individuals offers them a lot of benefits (Tsai & Ghoshal, 1998) like firm's innovation (Ahuja, 2000) and performance (Tsai 2001; Yang, 2007) and a person's ingenuity (Smith & Shalley, 2003) and knowledge creation (Mcfadyen & Cannella, 2004). Baldwin et al. (1997) indicated that network centrality has positive

effect on MBA team member's success. Similarly, Hopp, Iravani, Liu and Stringer (2011) indicated that individuals having central position in advice network show good job performance. Likewise, Brass (1981) revealed that the flow of the work represented by centrality of one's position indirectly impact performance. Aktamov and Zhao (2014) concluded that firms having higher degree centrality leads in the field of innovation. It is affirmed by researchers e.g. Spillane and Kim (2012) that actor who occupies central position in networks are better linked than others and are more noticeable in the network.

Academic Performance

The utmost critical assets of educational institutes are students. The development of any country depends on number of qualified individuals, larger the number of quality graduates opens up endless ways for country to run on the road of success (Mushtaq & Khan, 2012). The best and easiest way to judge presence of quality graduates with in country is to check the academic performance of students through academic reports. As suggested by Allen (2005) academic performance of students are conversed through academic report that tells about students' progress/ achievement (in terms of CGPA/ GPA) established during course of study in particular discipline. The foremost purpose for allocating CGPA/GPA is to generate a public record of student's academic success that can perfectly and excellently communicate the level of mastery of a subject a student has demonstrated (Airasian, 1991).

Conceptual Framework

This conceptual framework is showing the relationship between centrality measures (degree centrality, degree closeness, betweenness centrality) and academic performance of female student's in advice network.
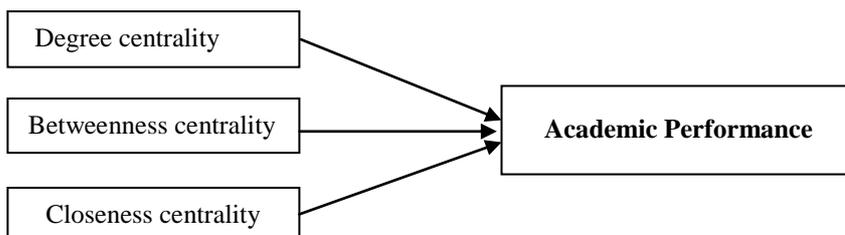

Figure 1 Conceptual Framework

Theory and Hypothesis

Centrality and academic performance

Advice networks means set of ties through which individuals share information, data, knowledge, facts and guidance that assist them in the completion of their assigned task (Webster & Hackley, 1997) in better way. Student's position in advice network plays a dynamic role (Picciano,2002) but if a student resides the central location s/he can get much more academic benefits. Gaining advices from number of contacts, not only develop (Tsai, 2001) intellectual ability of student but can aid him in locating, griping,

diffusing, and blending relevant advices into valuable resources and ultimately enhancing performance (Borgatti, 2005; Tsai, 2001). Student can also get assistance form advice network, if s/he became only source of interaction among other two or more students. Asking for advices from each other they have to depend on him/her (Spillane & Kim, 2012). While helping other students in exchange of advices, s/he gain a lot of advices which can be used by him/her in resolving his own study related problems (Hopp, Iravani, Liu, & Stringer, 2011). Access to timely and dissimilar advice's is also possible for students only if they are at shortest geodesic distance from others in network. By finding position near to others saves his cost and energy too in searching for required academic advices. With the help of timely and dissimilar academic advices he can solve his difficulties which impede his performance instantly and hastily.

Thus, it was proposed that:

H1: Female students with higher degree centrality scores in advice network will have higher academic performance (in terms of CGPA).

H2: Female students with higher betweenness centrality scores in advice network will have higher academic performance (in terms of CGPA).

H3: Female students with higher closeness centrality scores in advice network will have higher academic performance (in terms of CGPA).

Method

Sample

182 female students enrolled in various programs at a public sector university served as sample of this study. Convenience sampling technique was used to collect data.

Measures

Dependent variable: Academic performance. CGPA of each student was used to measure academic performance. Which was taken from university examination record but CGAP can be calculated with the help of grades, grade weights (A=4, B=3, C=2, D=1), credit hours attempted, and number of semesters / classes / subjects attended.

Independent variables: centrality measures. According to Freeman, (1979), the indexes/measures of centrality .i.e. degree, closeness and betweenness are used as a measure of closeness centrality, degree centrality, and betweenness centrality of female student's advice network. Where degree is the total sum of links to other people in the network. Betweenness states the level to which a person lies in the middle of other actors in the network. Closeness is the level to which a person is positioned near all the other individuals in a network (directly or indirectly).

Procedure

Data was collected through network questionnaire based on name generators (these are type of questions that ask central/ focal personal to list the names of those individuals from whom s/he receive or to whom s/he provide resources)for egocentric network. Name generator was adapted from standard method of name generator for egocentric

(personal) network as developed by Burt (1984) that is also used in United States general social surveys (GSS) since 1984 (McPershon, Smith-Lovin, & Brashears, 2006). Name generators asked the respondents to write the names of those learners/students with whom the s/he (respondent) most frequently discuss their study related problems and take academic advices. Reliability of questionnaire was determined by Cronbach's alpha to be 0.69.Participants were given questionnaire along with informed consent form. Participants were requested to read inform consent form carefully and if they agree to take part in this study then sign on form. After that participants were requested to read the guidelines cautiously and sensibly to fill out demographic and name generator sections of the questionnaire.

Ethical guidelines

It was announced that participants are free to withdraw participation. When all questionnaires were returned back participants were praised and let them know that the study was in fact considering for association among social network structure and academic performance of students. It was made sure to participants that data would be used for research purpose only and their names were kept anonymous. Participants were given the right to ask question if they want. The data collection instrument by Burt (1984) is free to use for all researchers so no permission was required.

Analysis

The study was carried out using the statistical techniques of correlation and standard multiple regression. Correlation is used to show the relationship of all dependent and independent variables with each other while, standard multiple regression is used to predict the effect of predictor variables on the dependent variable. Analysis was performed using Statistical Package for the Social Sciences (SPSS) 20.0 to determine potential associations amongst the variables and effect of independent variables on dependent variable.

Performance of students was measured by CGPA that was taken from university examination record. Data about academic advice was collected through questionnaire based on name generator (Burt, 1984) for egocentric network. With the help of data collected through name generator 182 X 182 matrix was constructed in MS Excel, where zero (0) shows absence of advice tie and one (1) shows presence of advice tie. This matrix was later on imported in UCINET VI (Borgatti, Everett, & Freeman, 2002) where three centrality measures were calculated (degree, closeness and betweenness). Data was coded, entered and analyzed through IBM SPSS 20.0 to determine potential relationships among the variables.

Correlation

The means, standard deviation and Spearman's correlation coefficients can be seen in Table 1. Total number of students participated in the study was 182. Table 1 also shows the data about the performance of students in exam as measured by their CGPA. The highest possible CGPA was 3.85. The lowest possible CGPA was 0.24. The mean CGPA score of all students was 2.74 (*S.D*=0.74). The measures of centrality were likely to be correlated with the academic performance but were also expected to be

non-parametric in nature (Yan & Ding, 2009). Therefore, Spearman's correlation was calculated to measure strength and direction of relationship among variables. The correlation table disclosed that degree centrality have positively and significantly correlated with CGPA ($r = .60$, $p < 0.05$), closeness centrality also shows positive and significant correlation with CGPA ($r = .39$, $p < 0.05$) and betweenness centrality positively but non-significantly correlated with CGPA ($r = .33$, $p > 0.05$).

Table 1: *Summary Statistics and spearman's Correlation Matrix*

	Mean	Std. Dev	1	2	3	4
1. CGPA	2.74	.74	___			
2. degree_centra	.01	.01	.60**	___		
3. betweenness_centra	.03	.09	.39**	.63**	___	
4. closness_centra	18.33	79.17	.33**	.57**	.18*	___

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Regression Analysis

Before applying multiple regression some assumptions related with multiple regression must be addresses like normality of residuals, no outliers, independence of residuals, Multicollinearity.

The assumption of normality of residuals and independent variable was checked by using histogram(figure 1), and normal P–P (figure 2) and Q–Q plots (figure 3).The shape of histogram curve nearly approaches a bell-curve, which means that residuals are approximately normally distributed. All data points at normal P-P and Q-Q plot lies near or on the straight line which also give indication of normality of data.

The assumption of no outlier can be checked through histogram. Outlier is an observation that is different from general configuration of distribution. Through graphical examination of histogram we concluded that overall trend of data set is almost same, so there is no significant outlier.
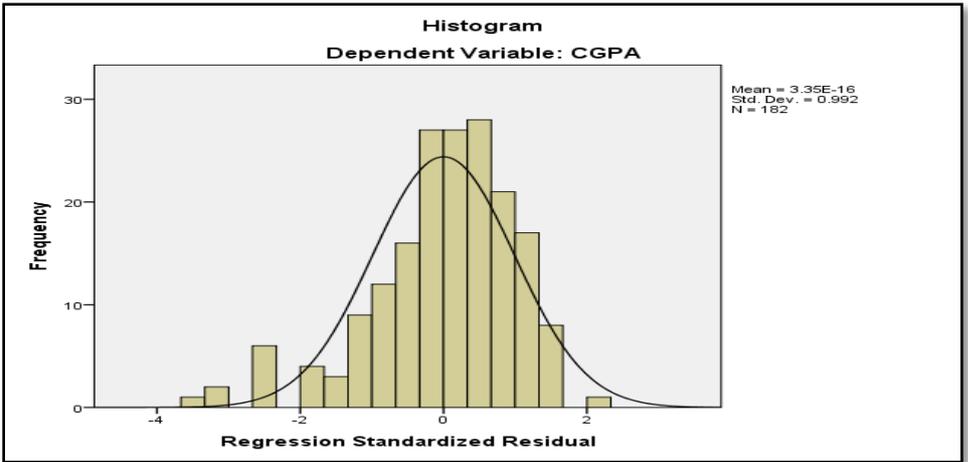
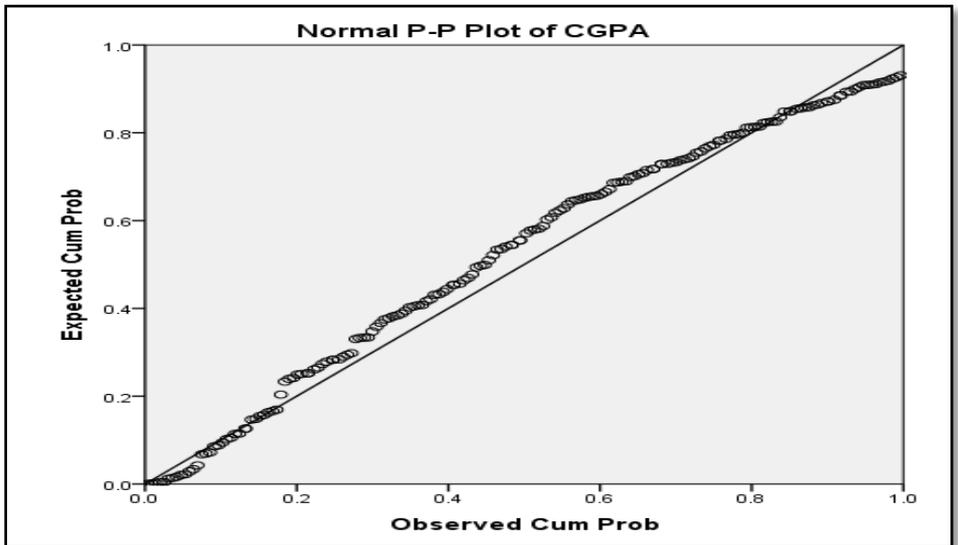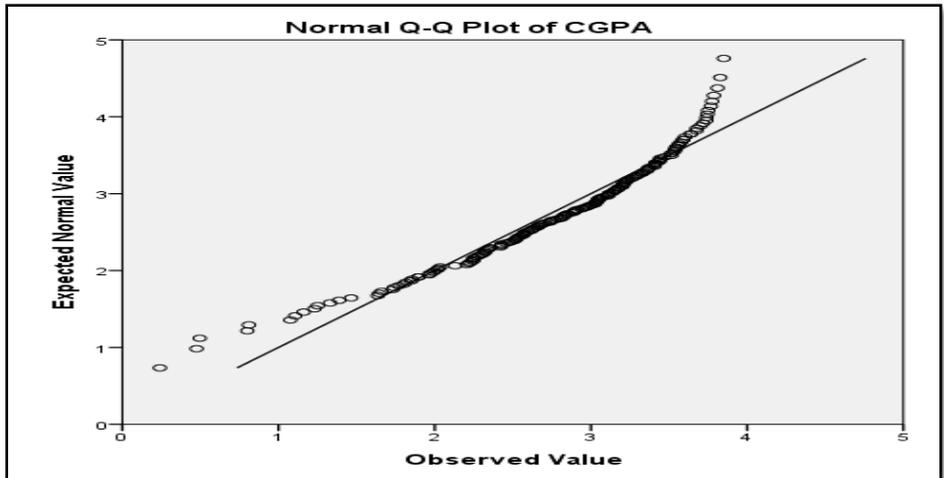*Figure 2* Histogram of standardized residuals

Figure 3 Normal P-P plot of CGPA

Figure 4. Normal Q-Q plot of CGPA

To check that the three measures of centrality(independent variables) can significantly predict the academic performance (dependent variable) of female student's, standard multiple regression analysis was executed. Result of the standard multiple regression is reported in Table 2. This table also shows the value of Durbin-Watson statistic through which we can check the assumption of independence of residuals (autocorrelation). Independence of residuals means that error should not be interconnected to another error. The value of Durbin-Watson statistic is always lies between 0 and 4. Zero (0) mean positive autocorrelation, values near 4 mean direct negative autocorrelation and values near 2 indicates no autocorrelation. In case of current study the value of Durbin-Watson statistic was near 2 (1.63) indicating our data has almost no autocorrelation.

Multicollinearity is another problem associated with regression analysis. Therefore, data should be checked for this problem before to apply regression. Multicollinearity means that independent variables show high or moderate level of association with each other to such an extent that they make it difficult to recognize the contribution of single independent variable in predicting dependent variable. The assumption of no multicollinearity was checked through the values of VIF. Normally, it is believed that the value of VIF below 10 indicates no or low level of multicollinearity (Myers, 1990). Table 2 specifies that there is no problem of multicollinearity as all values of VIF were lowers than 10.

Table 2 shows the result of the multiple regression i.e. positive and significant relationship between degree centrality ($\beta1$=0.74, p<0.05), betweenness centrality ($\beta2$=0.32, p < 0.05) and academic performance.

Table 2: *Summary of Slandered Multiple Regression Analysis*

Model	Unstandardized Coefficients		Standardized Coefficients	VIF
	B	Std Error	β	
Degree_centrality	28.22	3.79	.74*	2.62
Betweenness_centrality	267.1	57.34	.32*	2.6 1
Closness_centrality	0.00	0.00	-0.03	1
R^2		0.32		
F		28.13**		
Durbin Watson		1.63		

Independent variable: Degree_centrality, Betweenness_centrality, Closness_centrality.
Dependent variable: Academic performance.

Discussion and Conclusion

Based on results, we find support for H1 and H2. This means that female students having high degree centrality and betweenness centrality in their advice network are expected to achieve better academic performance. This study findings are supported by prior researchers like, Aktamov and Zhao (2014); Tsai (2001); Cross and Cummings (2004).While closeness centrality and academic performance shows negative and insignificant relationship (β3= -0.03, p>0.05) finding no support for H3, that means academic performance of female students is reduced with every increment in closeness of female students in advice network. This finding challenges the prior studies like, Claro, Neto, and Claro (2013) but conform the finding of some researchers like, Aktamov and Zhao (2014); Perry-Smith and Shalley (2003).

Closeness centrality shows negative relationship with female student's academic performance this may be due to defining our limited network boundary (students were restricted to give answer to questions, just remembering to their ties with class fellows not individuals outside of their class). It is argued that too high or too little network centrality may be restraining. There should be an intermediary degree of network centrality which wins the maximum incentives and/or rewards (Rotolo & Petruzzelli, 2013; Mcfayden & Cannella, 2004; Badar et al., 2015).In case of current research closeness centrality is high (all advisers are from the same class) due to which students can get access to large but conflicting viewpoints (Podolny & Baron, 1997). Which may be the cause of negative relationship between closeness centrality and female student's academic performance.

This study aimed to explore and investigate the effect of structural social capital on female student's academic performance in advice network. Our findings of degree centrality and betweenness centrality are in line with what was found in prior studies, indicating that higher degree centrality and betweenness centrality higher would be academic performance of female student's. While, closeness centrality shows negative relationship with female student's academic performance which means that higher closeness centrality lower would be academic performance of female student's.

Limitations and Recommendations

This study has certain limitations e.g. our study lack generalization as female students of one university may not represent all. More disseminated findings should be created through involvement of other university female students and results of research can be strengthen by increasing sample size.

The result of closeness centrality is different from scholar expectations of current study. Therefore, it is recommended that more future research should be done concerning relationship between closeness centrality and female student's academic performance with an enlarged network boundary.

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