International Journal of Management, Knowledge and Learning | ISSN 2232-5697

Social Network Analysis of College Student Group Selection: Case Study

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Purpose: This research aims to analyse the social network of college student group selection to understand students' relationships and behaviour for effective teaching planning, group work assignments, and individual student management.

Study design/methodology/approach: The samples are college students who study a master degree program in digital innovation and take course IO-001(business intelligence and data analytics) or IO-002 (cybersecurity). Data were collected using the questionnaire asking the college students for their 1st and 2nd choices of classmates who want to be in the same group. For data analysis, Gephi, open-source software, is used for social network analysis (SNA) and graph visualisation.

Findings: According to the results, the most desirable students to work with and the least desirable students to work with are defined. The instructors can appoint the student who is the most desirable to work with into a position of influence to facilitate learning in the classroom to motivate inspiration during the study. For those students who the least desirable to work with, the instructors might make them gain more attention, including giving them some roles or let them have more identity. According to SNA, the least desirable students to work with have low IT background for both courses IO-001 and IO-002. Therefore, IT background might be one of the factors that influence student group selection. The instructors might provide additional courses to enhance IT skills for those students who have low IT backgrounds. Moreover, the instructors might assign the influent students to work with the least desirable students to make a better relationship.

Originality/value: The results of this study can be used as a guideline in the formulation of teaching and learning courses, including setting the learning style to make each student more connected and to encourage each group of students to interact more with each other. The instructors can promote a learning environment to increase opportunities for innovation.

Introduction

Digital technology had increased and had thoroughly transformed numerous parts of our economic and social life. Different sectors had applied digital technology, including social networks, big data, blockchain, internet of thing (IoT), cloud computing and artificial intelligence (AI), to improve the organisation's performance and to gain a competitive advantage (Y. Chen, 2020; Greco, Percannella, Ritrovato, Tortorella, & Vento, 2020; Mirzaei Abbasabadi & Soleimani, 2021).

Many countries anticipate learning skills that could help it correspond to the development of science and digital technology (Hamidi, Meshkat, Rezaee, & Jafari, 2011). With the application of digital technology, the education industry indicated extraordinary opportunities and challenges. Technology promotes the deep integration of education and teaching (L. Chen & Wang, 2019). Therefore, many courses and curricula are conducted to increase students' potential to enter the digital age confidently (Olszewski & Crompton, 2020).

To support the role of digital technology and prepare the country for economic and social using digital technology and innovation as the driving force, a case study university offers a master degree program in digital innovation to create added value and international competitiveness and to drive all dimensions of economic goals related to finance production and services. The

program provides a lot of courses related to digital technologies. In many courses, group project assignment is conducted to help students develop team-work skills that are significant in the digital era. Group project brings social, psychological, and learning benefits to students (Bojanova, 2012). This paper aims to analyse the social network of college student group selection to understand students' relationships and behaviour for effective teaching planning, group work assignments, and individual student management.

Social Network Analysis

A social network comprises structures made up of actors and their relationships with each other (Can & Alatas, 2019). A social network component is a node that represents a person or thing within a network and the edge or relationship that describes the relationship between the nodes (Radha & Nithia, 2017).

Social network analysis (SNA) analyses networked structure leveraging graph theory to explain relationships between individuals, organisations, groups, or whole societies (Hu, Liu, & Zhang, 2014). The analysis of such networks benefits society, and simultaneously it creates a better understanding of society (Radha & Nithia, 2017). Social networking has been used frequently in various areas such as social science, education and computer technology (Can & Alatas, 2019). Social networks influence a broad range of social processes by accessing finance, society, nature, physical and human capital, and information content relevant to them. In addition, social networks can influence development in policies, plans, strategies, projects and collaborations that builds a solid foundation, including design, implementation, and results (Can & Alatas, 2019).

For the education sector, researchers have increasingly adopted social network analysis (SNAs) to understand better relationships among students in the entire learning community in conference rooms or networked learning settings such as blended learning, MOOCs, blogs, or online forums. Furthermore, it is found that SNA helped enhance understanding with students' participation in networked learning, as shown in a mathematical method of measuring students' participation through their positions in social work (Liu, Chen, & Diana Tai, 2017).

The study in (Liu et al., 2017) showed how elementary school students teamed and collaborated with their peers to create multimedia stories and analysed their participation with SNA. In Moreno (1960), the dining table partner choices of the girls' school dormitory were studied. According to Karimi and Matous (2018), the research applies social network analysis to map students' social activities. Leveraging large-scale data on students' participation in social activities at a major public university demonstrated how to adapt social network analysis to visualise the student's overall social structure and explore a mixed and separate social group at the core and the scope of the student's extracurricular activities.

SNAs have recently been used to study, understand and visualise relationships in social networks (Radha & Nithia, 2017). For instance, a social structure can be represented as a network made up of groups of nodes and a set of links that represent connections between them (Can & Alatas, 2019). To better understand social networks, the visualisation of large graphs has been applied to utilise human perception capabilities to find features in network structures and information (Bastian, Heymann, & Jacomy, 2009).

Analysing social networks encourages people and organisations to make a tremendous opportunity to the advent of constant SNA in the existing state of development. Several SNA toolsets such as UCINET, Pajek, SocialAction, and NodeXL (Hansen et al., 2012), and various programming languages such as R programming language (Maddumage & Dhanushika, 2018).

Gephi is open-source software for graph and network analysis. The software provides modules that can import, filter, visualise, deploy and export all types of networks. It can handle a vast network built on the multi-task model and multi-core processors. Node design can be customised to be a texture, a panel or a photo. The algorithms can be run in real-time with a configurable layout. For example, the Force Atlas algorithm, a specific force-directed algorithm developed by the team, offers speed, gravity, repulsion, auto- stabilise, inertia or size-adjust with real-time settings (Bastian et al., 2009).

Research Methodology

The research process comprises three phases: literature review, data collection and analysis, and conclusion, as illustrated in Figure 1.

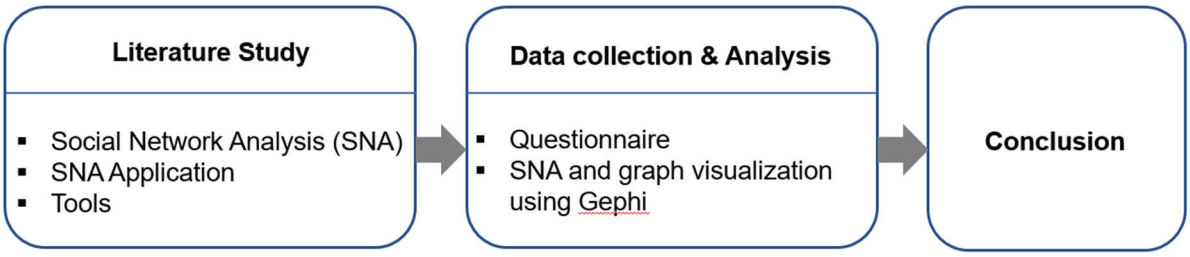

Figure 1: Research Process

Literature review comprises the study of social network analysis (SNA), application, and tools. For data collection, similar to the study of Moreno (1960), the questionnaire was distributed among college students in course IO-001 and IO-002 for their 1st and 2nd choices of classmates who wanted to be in the same group.

Table 1: Attribute Description

Attribute	Type	Description
Student	Nominal	Student name
Batch	Nominal	A group of students who enter the college in the same semester.
Gender	Binary	Male or Female
IT background	Nominal	Students' background in IT which is Low, Medium, and High.
GPA	Ordinal	GPA range which is: 3.00-3.25 3.26-3.50 3.51-3.75 3.76-4.00

Table 1 illustrates some attributes of the collected data: student name, batch, gender, Information technology (IT) background, and GPA. For IT background, the data can be categorised as High, Medium, and Low:

High = student has an education background in computer science, computer engineering, information technology (IT), or has work related to IT technical, computer, or programmer.

Medium = Student has an education background in management information systems (MIS), Computer management, computer graphic, or has work related to IT management, digital marketing, or graphic design.

Low = student has an education background in other fields such as business, management, journalism, or laws.

For data analysis, Gephi, open-source software for graph and network analysis (Bastian et al., 2009), is used for SNA and graph visualisation. Graphs are usually laid out with "Force-based" algorithms, which follow a simple principle: linked nodes attract each other, and non-linked nodes are pushed apart. Furthermore, the "Adjust by Sizes" option is applied to avoid node overlapping, depending on the size of each node (Gephi, 2011). Finally, the conclusion is presented to summarise the results.

Results

The attributes of the collected data are shown in Table 2 and Table 3. Table 2 illustrated students' detail of course IO-001, and Table 3 presented students' detail of course IO-002. IO-001 course is related to business intelligence and data analytics. For IO-002, the course is about cybersecurity, Data Protection, and Cryptography.

Table 2: Students' Details of Course IO-001

Student	Batch	Gender	IT-Background	GPA
A	X	Female	Low	3.00-3.25
B	X	Female	Medium	3.51-3.75
C	X	Male	High	3.51-3.75
D	X	Female	High	3.51-3.75
E	X	Female	Low	3.26-3.50
F	X	Female	Medium	3.26-3.50
G	X	Male	High	3.26-3.50
H	X	Male	Medium	3.00-3.25
I	X	Male	High	3.00-3.25

As shown in Table 2, Students who enrolled in IO-001 are in batch X. The genders are 4 males and 5 females. 4 students have high IT background, 2 students who have medium IT background, and 2 students have low IT background. For GPA, there are 3 students whose GPA is 3.00-3.25, 3 students whose GPA is 3.26-3.50, and 3 students whose GPA is 3.51-3.75.

From Table 3, 18 students enrolled in IO-002, 6 students from batch Y, and 12 students from batch Z. The genders are 7 males and 11 females. 2 students have high IT backgrounds, 4 students who have medium IT background, and 12 students who have low IT background. For GPA, there are 4 students whose GPA is 3.26-3.50, 8 students whose GPA is 3.51-3.75, and 6 students whose GPA is 3.76-4.00.

Table 3: Students' Details of Course IO-002

Student	Batch	Gender	IT-Background	GPA
A	Z	Female	Low	3.51-3.75
B	Z	Male	Low	3.26-3.50
C	Y	Male	Low	3.51-3.75
D	Y	Female	Low	3.51-3.75
E	Z	Male	Low	3.76-4.00
F	Y	Male	Medium	3.26-3.50
G	Z	Male	Medium	3.51-3.75
H	Z	Male	Low	3.26-3.50
I	Z	Female	Low	3.76-4.00
J	Z	Female	High	3.76-4.00
K	Z	Male	Low	3.76-4.00
L	Z	Male	Medium	3.51-3.75
M	Y	Male	Medium	3.51-3.75
N	Z	Female	Low	3.26-3.50
O	Z	Male	Low	3.51-3.75
P	Y	Female	Low	3.76-4.00
Q	Z	Female	Low	3.76-4.00
R	Y	Male	High	3.51-3.75

For the analysis using SNA, the directed graph of students who enrolled in course IO-001 is illustrated in Figure 2, and the graph of students who enrolled in course IO-002 is displayed in Figure 3.

From Figure 2, student D is the most desirable to work with among all the students, followed by student F. On the other hand, Student A is the least desirable to work with. Regarding attributes, student D has high IT background, and GPA is 3.51-3.75, and student F has medium IT background and GPA is 3.26-3.50. On the other hand, student A has low IT background, and GPA is 3.00-3.25.

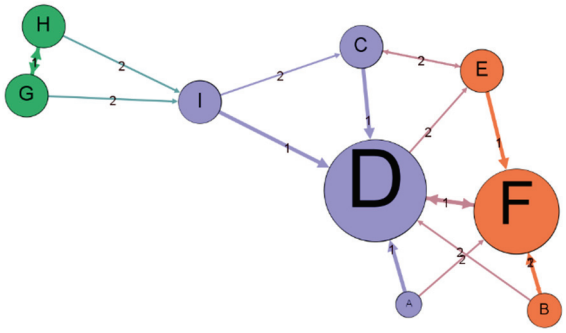

Figure 2: Student Network of course IO-001

From Figure 3, student C is the most desirable to work with among all the students, followed by students A, Q, D, and O. On the other hand, Student H is the least desirable to work with. Regarding attributes, student C has low IT background and GPA is 3.51-3.75, while student H has low IT background and GPA is 3.26-3.50.

Students I, J and L are in the same group as they selected each other's, and this group is isolated from different groups of students. The group is connected by student E, who selected student L as the second choice. Students I, J and L are in the same batch (batch Z), but they had different IT backgrounds.

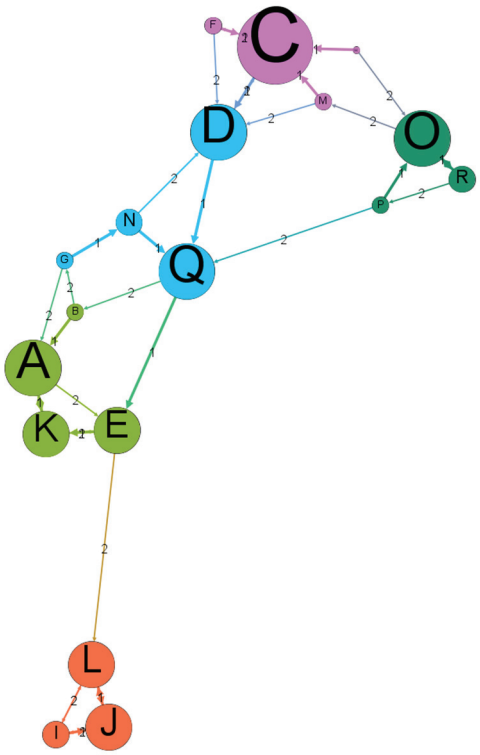

Figure 3: Student Network of course IO-002

From SNA results, the instructors can appoint the student who is the most desirable to work with into a position of influence to facilitate learning in the classroom to motivate inspiration during the study and be a centre for alumni association after graduation.

For those students who the least desirable to work with, the instructors might make them gain more attention, including giving them some roles or let them have more identity. In addition, instructors can ask questions about the cause and observe behaviours to find answers. For example, students whose peers do not want to work with might have some problems, have an introverted personality, or do not help their friends when working in a group. According to SNA, of course, IO-001 and IO-002, the least desirable students to work with have low IT backgrounds for both courses. Therefore, IT background might be one of the factors that influence student group selection. Thus, the instructors might provide additional courses to enhance IT skills for students with low IT backgrounds. Moreover, the instructors might assign the influent students to work with the least desirable students to make a better relationship.

Furthermore, if any student has a problem in case of emergency, instructors can ask for initial information from students in a similar relationship.

The SNA can be used as a guideline in the formulation of teaching and learning courses, including setting the learning style to make each student more connected and encouraging each group of students to interact more with each other. In addition, the instructors can promote a learning environment to increase opportunities for innovation.

Conclusion

This paper presents a social network analysis of college student group selection. The research is conducted by a questionnaire survey of 9 students in course IO-001 (Business intelligence and data analytics) and 18 students in course IO-002 (Cybersecurity). Data is analysed using Gephi, which is open-source software for graph and network analysis.

According to the results, the most desirable students to work with and the least desirable students to work with are defined for both courses IO-001 and IO-002. The results can help instructors understand students' relationships and behaviour to provide effective teaching courses by establishing the learning method to make more connections and persuade each student with more interactions. Moreover, the instructors can apply the results to promote an innovative learning environment of the course. Future research considers this study regarding different attributes, courses, or activities, or other networks such as organisational networks. Furthermore, some network modelling, for example, exponential random graph models (ERGMs), or some properties of actors in the network can be studied to analyse complex social network structures.

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