

# Impact of Social Network Analysis On E-Learning

<sup>1</sup>Anshul Garg, <sup>2</sup>Heena Girdhar

<sup>1,2</sup>Department of Computer Applications

<sup>1,2</sup>Chandigarh College of Colleges, Landran, 140307, Mohali, Punjab, India

<sup>1</sup>anshul.1106@cgc.edu.in, <sup>2</sup>heena.1120@cgc.edu.in

**Abstract:** In contemporary years, the social network plays a significant role in human life as they can interact with other people, share data and knowledge by creating communities and forums. Teaching and learning are becoming more societal as these forms promote informal and collaborative learning. Various social websites like Facebook, Twitter provide user-friendly interface about the content of e-Learning. Social Network Analysis (SNA) gives an influential mathematical approach to support collaborative learning process from a theoretical point of view. This paper aims to discuss various SNA measures like centrality, the density that plays an effective role in improving the performance of students on account of e-learning.

**Keywords:** Social network Analysis, E-Learning, Centrality, Page Rank, Density

## I. INTRODUCTION

The progression of the Internet has changed human associations and shows new administrations in the zone of interchanges. Individuals are utilizing the web in different points of view like in medicinal, social, government, business, and training. [2][10] Social Networks are online stages that empower clients to associate with one another and trade thoughts, advanced photographs and recordings, posts, and so forth.[3] Informal communities have turned out to be a standout amongst the most significant specialized devices among individuals these days. Given that individuals spend in any case a great deal of their extra time on SNs, their appropriation in training ends up easy, expanding learning background past the limits of homeroom. Social Network gives a community-oriented learning condition without time and spot choking influences and advance casual realizing where information is built through companions' communication. [4] SNs encourage understudies to speak with each other, form a feeling of network and create content, consequently supporting dynamic learning through partaking, considering, and contributing. Subsequently, learning through SNs turns out to be progressively intelligent, understudy focused, community-oriented and on interest. Social Network Analysis is giving very fruitful results in various fields like digital marketing, politics, social awareness, and educations, etc. by examining the relationships between actors and the importance of actors.[5] E-learning involves an inexorably conspicuous spot in training. It ace vides the student with a rich virtual system where the person in question can trade thoughts and data and make cooperative energies through communications with different individuals from the system, regardless of whether individual students or instructors. This paper is giving a systematic review of how SNA can enhance e-learning in today's scenario. This paper is mainly concentrating on the education field. There is a lot of research already done on this field and more can be done.

## II. RELATED WORK

The main objective of SNA is to find out how strongly the different actors in the network are connected and who friends with each other are. [6] The social network can be represented both by graphically and mathematically. In the graphical method, different actors interact with each other through a path.[7][9]

The idea of Social Network Analysis came into existence in

1930 when the researchers were discovering the various patterns of interpersonal relationship. Till 1960 no proper methodology was developed for social network analysis[1]After that the SNA was developed as an interdisciplinary field between psychology, anthropology, and sociology.[8]

Table 1. Comparative study

Sr. No.	Year	Author	Analyzing Techniques	Sample	Finding
1.	2019	Qi et al. [5]	SNA	Under Graduate Students	Agreed on the potential of structural metrics as predictors of learning achievement
2.	2019	Cela et al. [9]	SNA+ Description Analysis + Content Analysis	52 Master Students	Teacher role is more important on how the student experience on Social sites like Twitter
3.	2019	Santovena-Casal & Bernal-Bravo[10]	Content Analysis	525 master Degree Students	Teacher Role as a fascinator excreted a more Positive impact on how the student assessed their permission and participation on Twitter than the role as a guide
4.	2018	Martinez-Cerda, Torrent-Sellens, & Gonzalez-Gonzalez [11]	SNA	930 Online Students	Explores new approaches to design a framework for learning team effectiveness in computer-supported collaborative learning
5.	2018	Samanta, & Pal[12]	Review	Review	Study on Centrality Measures in network

6.	2018	Vilkas, Lalic, & Marjanovic[13]	SNA	University of Novi Sad, Serbia	Explores the Employment of Digital technology to bring the earners together
7.	2017	Balakrishnan[14]	Online Survey	300 students	Student's intention was very high to use online media for learning but they are not using so much
8.	2017	Krouska, Troussas, & Virvou[15]	Comparative study	Higher Education Students	Analyze Social network in Higher education
9.	2017	V. Balakrishnan[8]	Comparative study	524 students(214 Australia,310 Malashia)	Investigates the factors which motivate the use of social media in higher education between two countries
10.	2016	Feshchenko [7]	SNA	375 Students, Russia	Finds that 95% of students use social sites for education purpose
11.	2016	Duluta & Mocanu[3]	Content Analysis	Online students	Effect of E-Learning on students
12.	2016	Pervaiz [16]	Survey	Online More than 150 students	Concentrating on the positive and negative factors associated with the use of social networking in Higher Education in Pakistan
13.	2015	Cela et al. [1]	Review	Review	SNA in e-learning is just in the starting phase. SNA and content analysis provides a strong interaction between nodes
14.	2015	Kolokytha et al.[4]	SNA	Not Mentioned	Relationship between SNA and E-Learning using Chi-square and Factor Analysis
15.	2015	Shokri Dafoulas[17]	Content Analysis	Not Mentioned	Guideline for improved integration for SN an E-Learning
16.	2015	Panus & Jonasova[18]	Questionnaire Survey	Students of Economics and Administration at the University of Pardubice	SN can be used as a base for the study of University-based students
17.	2014	Bhatia & Wadhwa[19]	Review	Review	Review about challenges and methods about SNA
18.	2013	Palazuelos, Garcia-Saiz, & Zorrilla[20]	Analysis of E-Learning Course For 3 Years	Students of the University of Cantabria	Explores how SNs can be used in E-Learning Context
19.	2012	Moe & Naing[2]	Review	Review	Use of ICT in the form of internet or individual e-learning
20.	2012	Rosen, Miagkikh, & Suthers[21]	SNA	62 participants	SNA and semantic investigation together are successful techniques for examining the association in the multiuser virtual condition
21.	2012	Piazzo et al. [6]	SNA	Comparind network parameters of two countries	This paper studies the Tourism destination's web space between two countries Austria and Italy.
22.	2011	Rodríguez, Sicilia, Sánchez-Alonso, Lezcano, & García-Barriocanal[22]	SNA	47 Students	Exploratory systems of SNA can be utilized to channel collective understudy exercises in online discussions
23.	2010	Spadavecchia & Giovannella[23]	SNA	Not Mentioned	Two programming instruments are portrayed for assessing and observing learning forms dependent on SNA and programmed content investigation
24.	2010	Dawson[24]	SNA	207 University Students	Size & Privacy vary between systems of high-and low-performance

### III. INCLUSION CRITERIA

The inclusion criteria for this review is

1. The publication year should be between 2010-2019.
2. The papers should include Social network methods to scrutinize the e-learning environment and using electronic formats are included for this review.

### IV. STUDY SELECTION

Total primary studies founded from Google Scholar and Web of Science on the topic Social network analysis in E-Learning from the year 2010 to 2019 are 217. In which 175 are excluded after reading the title and abstract .18 excluded after reading the full text. The total number of papers included in this study is 24.

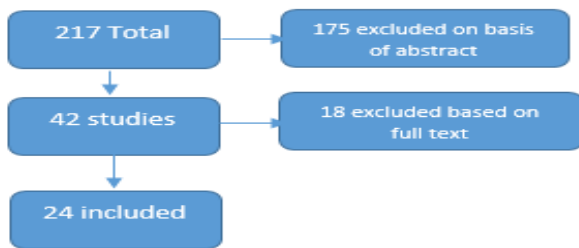


Fig. 1. Study Selection Process

#### A.No. of Publications/Year

Table 2. Number Of Publications in Related Area from 2010-2019 (Source: Web of Science)

Year of Publication	No. of Publication
2010	17
2011	23
2012	23
2013	22
2014	37
2015	25
2016	20
2017	23
2018	12
2019	15

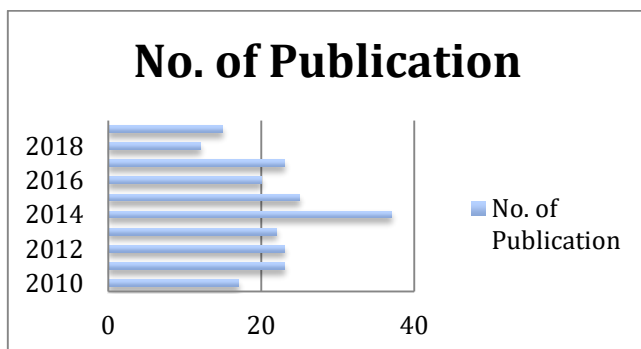


Fig. 2. No. of Publications between 2010-2019

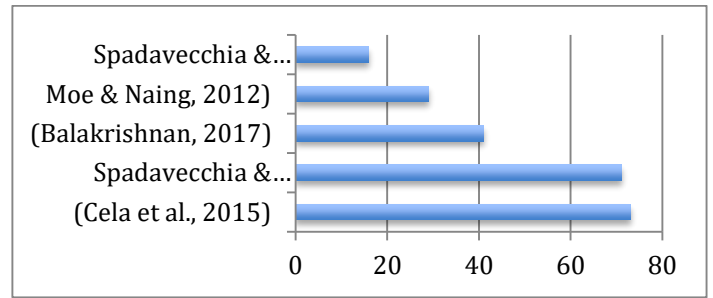


Fig. 3. Top 5 Cited Paper in this study

### V SOCIAL NETWORK ANALYSIS AND ITS MEASURES

When two or more actors are connected through a tie i.e. called social network. To use network the knowledge about the most influential node, who is a friend to others, how one node is reachable to others, what is the shortest path all these questions are important to answer.[13][22] For this analysis of the complete network is required. There are many measures are used to do such type of analysis. A social network can be shown graphically. Some Basic terms are:-

A. The node additionally called an actor can be in any way similar to a website, a web record and so on. In a system, when nodes are legitimately associated with a single edge, they are entitled as neighbors [6][9]. Neighbors are named as firmly associated, if there is a guided way from every node to each other. If there is a way from one node to other yet the direction of an edge isn't in thought then they pitifully associated with each other. A node is named as pendant node on the off chance that it is tied just in one gathering with one association.[6][24] If just a single actor gets consideration for examination, at that point it is considered a sense of self and gathering of on-screen characters those are ties with this personality called adjusts. A gathering of actors wherein every actor picks each other is called responded group. [14] The degree deg (x) of a node x in the directed graph is the entirety of in-joins and out-connections of that node. The average degree can be determined by taking the average of the considerable number of degrees of all nodes present in that network[6][11][18]

B. Tie also called link, edge, connection or relation between the two actors. [6] It can be directed, bounded, dichotomous (present and absent) and weighted. The path between two nodes X and Y is the arrangement of nodes coming in the middle. [17]The length or shortest path d (X, Y) is determined as the absolute least number of edges that are required to reach from node X to node Y. The average length in the web system is the arithmetic mean of the path between every node of the social network. The distance across the web system is the longest conceivable path in the social network.

#### A. Network Density

It is the existing ratio edges in the web network to the maximum possible no of edges when the graph is complete.[6][12] It can be calculated as

$$\Delta = 2 \times n/k(k - 1)[6]$$

Here  $n$  = no of existing edges

$k$  = no. of possible edges when the graph is fully connected

**B. Centrality Of Network**

This is the most important measure to analysis the web network. This measure is used to identify the most essential node in the network. Random process, current flow rehabilitees are some basic criteria to measure the centrality. [12] There are many centrality measures. Description of some are mentioned in the table

Table 3. Some Standard Centrality[12]

Centrality	Time Complexity	Application Area in Web Networking
Degree	$O(m)$	To find out the actor who influence others
Closeness	$O(n^3)$	To find out the actor who can spread information quickly
Stress	$O(mn)$	To calculate the shortest path
Information	$O(n^3)$	In Many situation in which information plays an important role as path
Eccentricity	$O(mn)$	To find out the actor who can spread information quickly
Betweenness	$O(n^3)$ & $O(mn)$	To find out the actor that can be used as to control the flow of information between other nodes
Eigen Vector	$O(n^3)$	To count important links.

**VI. DISCUSSION**

The primary goal of this review is to give a view of how SNA has added to the field of e-learning. [22][23]This paper accepts that SNA-based ways to deal with e-learning will keep on creating. SNA has officially demonstrated to be a powerful strategy for dissecting e-learning. SNA typically used to recognize factors that impact the achievement or productivity of the instructive procedure. [2].SNA has officially ended up being a powerful procedure for breaking down e-learning since it is appropriate to understanding innovation subordinate procedures [1]When connected to learning exercises, SNA intends to recognize factors that impact the productivity of the instructive procedure. Huge numbers of these components are social, reliable with the way that numerous e-learning conditions are structured dependent on social learning hypothesis, which accentuates that learning is socially intervened.

A. Some studies show that SNA strategy has developed to incorporate a few proportions of system availability. Proportions of centrality, for instance, can recognize focal and detached students, just as students with the most friendly and approaching associations. Centrality measures can likewise survey the degree and quality of gathering availability. [12].Network Density demonstrates the extent of conceivable ties that are available in the system.

B. Some papers say that structuring e-learning courses is an unpredictable procedure, the achievement of which relies upon various components, including the coach, educator, LMS, communicational devices, advanced proficiency of the student and the measure of time that students can devote to

the errands [21]

C. In SNA, Pattern analysis can result in improvement in e-learning practices with the help of monitoring patterns regularly and determining the learner’s preferences. [1]

D. The studies in this paper prove that SNA can be beneficial for finding out interactions in the number of networks n e-learning environments.[5]

E. Designing e-learning courses is a complex process, the success of which depends on numerous factors, including the tutor, instructor, LMS, communicational tools, digital literacy of the learner and the amount of time that learners can dedicate to the tasks[1] [21]

F. by applying a blend of SNA and CA, found that students with high inborn inspiration contributed talk at a higher subjective dimension in e-learning correspondence channels.

At long last, the investigations in this methodical survey overwhelmingly bolster the possibility that joint effort among students can fundamentally improve the probability of effective learning in an online domain, Social hypotheses are critical to comprehension and optimizing such coordinated effort and SNA is in a perfect world appropriate for breaking down co-operation among students in e-learning conditions.

**VII CONCLUSION AND FUTURE SCOPE**

The target of this survey was to give a review of how SNA is useful in e-learning. The discoveries demonstrate that SNA has been utilized regularly to break down 'interactions'. [1][13] The paper found that SNA has been utilized frequently to look at examples of student correspondence and joint effort in different circumstances, for example, while talking about, blogging and messaging. These examinations show that SNA can give quantitative bits of knowledge into student co-operations that can support educators and course planners Indeed, a few investigations in our survey have looked to create SNA results that can help avoid student drop-out, improve the structure of class dialogs and recognize the qualities of dynamic students and well-associated 'stars' in the gathering.[13][15] The SNA estimates frequently inspected in e-learning examines are centrality and thickness, which are significant yet at the same time neglect to catch a few factors known to influence student results, for example, subgroup qualities and auxiliary equality. Future examinations should join a more extensive scope of system factors.

Albeit the vast majority of the examinations in our survey depended on SNA alone to dissect student co-operations, a few supplemented the quantitative methodology of SNA with subjective CA to acquire total bits of knowledge. Such consolidated methodologies ought to turn out to progressively visit later on. Undoubtedly, studies ought to consider joining a scope of SNA and non-arrange student factors including identity, ability to convey, social dimension, instructive dimension, and scholarly execution. [13] Concentrates accessible so far on SNA in e-learning bolster the thought that distinguishing collaboration designs in systems of understudies and instructors can give important experiences into the variables that influence learning achievement [16]. Future examinations should keep on inserting SNA reasoning and techniques all the more profoundly into e-learning activity look into by applying it, together with integral substance and semantic strategies, to an

even more extensive scope of system sizes and types [9]. This future research would do well to concentrate on exact inquiries amiable to quantitative examination to abuse the full illustrative intensity of SNA.

#### REFERENCES

- [1] K. L. Cela, M. Angel Sicilia, and S. Sanchez, "Social Network Analysis in E-Learning Environments: A Preliminary Systematic Review," *Educ. Psychol. Rev.*, vol. 27, no. 1, pp. 219–246, Mar. 2015.
- [2] S. Moe and D. K. S. Naing, "ROLE OF E-LEARNING FACILITIES ON STUDENT'S LEARNING: A LITERATURE REVIEW," in *5TH INTERNATIONAL CONFERENCE OF EDUCATION, RESEARCH AND INNOVATION (ICERI 2012)*, 2012, pp. 3941–3948.
- [3] A. Duluta and S. Mocanu, "E-LEARNING: WHO, WHY, WHERE?," in *ELEARNING VISION 2020!, VOL III*, 2016, pp. 286–293.
- [4] E. Kolokytha, S. Loutrouki, S. Valsamidis, and G. Florou, "Social Media Networks As A Learning Tool," in *ECONOMIES OF BALKAN AND EASTERN EUROPE COUNTRIES IN THE CHANGED WORLD (EBEEC 2014)*, 2015, vol. 19, pp. 287–295.
- [5] C. Qi, "Social Media Usage of Students, Role of Tie Strength, and Perceived Task Performance," *J. Educ. Comput. Res.*, vol. 57, no. 2, pp. 385–416, Apr. 2019.
- [6] R. Piazzzi, R. Baggio, J. Neidhardt, and H. Werthner, "Destinations and the Web: A Network Analysis View," *Inf. Technol. Tour.*, vol. 13, no. 3, pp. 215–228, 2012.
- [7] A. Feshchenko, "How students use social networks in education?," in *ERPA INTERNATIONAL CONGRESSES ON EDUCATION 2015 (ERPA 2015)*, 2016, vol. 26.
- [8] V. Balakrishnan, K. K. Teoh, T. Pourshafie, and T. K. Liew, "Social media and their use in learning: A comparative analysis between Australia and Malaysia from the learners' perspectives," *Australas. J. Educ. Technol.*, vol. 33, no. 1, pp. 81–97, 2017.
- [9] K. L. Cela *et al.*, "Exploring the influence of the teacher: Social participation on Twitter and academic perception," *J. Educ. Comput. Res.*, vol. 27, no. 1, pp. 312–321, Jan. 2019.
- [10] S. Santovena-Casal and C. Bernal-Bravo, "Exploring the influence of the teacher: Social participation on Twitter and academic perception," *COMUNICAR*, no. 58, pp. 75–84, Jan. 2019.
- [11] J.-F. Martinez-Cerda, J. Torrent-Sellens, and I. Gonzalez-Gonzalez, "Promoting collaborative skills in online university: comparing effects of games, mixed reality, social media, and other tools for ICT-supported pedagogical practices," *Behav. Inf. Technol.*, vol. 37, no. 10–11, SI, pp. 1055–1071, Nov. 2018.
- [12] K. Das, S. Samanta, and M. Pal, "Study on centrality measures in social networks: a survey," *Soc. Netw. Anal. Min.*, 2018.
- [13] S. Rakic, S. Softic, M. Vilkas, B. Lalic, and U. Marjanovic, "KEY INDICATORS FOR STUDENT PERFORMANCE AT THE E-LEARNING PLATFORM: AN SNA APPROACH," in *2018 16TH INTERNATIONAL CONFERENCE ON EMERGING ELEARNING TECHNOLOGIES AND APPLICATIONS (ICETA)*, 2018, pp. 463–468.
- [14] V. Balakrishnan, "Key determinants for intention to use social media for learning in higher education institutions," *Univers. ACCESS Inf. Soc.*, vol. 16, no. 2, pp. 289–301, Jun. 2017.
- [15] A. Krouska, C. Troussas, and M. Virvou, "Social Networks as a Learning Environment: Developed Applications and Comparative Analysis," in *2017 8TH INTERNATIONAL CONFERENCE ON INFORMATION, INTELLIGENCE, SYSTEMS & APPLICATIONS (IISA)*, 2017, pp. 283–288.
- [16] S. Pervaiz, "The Advantages and Risks of Using Social Networking in Higher Education in Pakistan," in *SOCIAL NETWORKING AND EDUCATION: GLOBAL PERSPECTIVES*, Issa, T and Isaias, P and Kommers, P, Ed. 2016, pp. 83–97.
- [17] A. Shokri and G. Dafoulas, "GUIDELINES FOR DETERMINING AN EFFECTIVE ROLE FOR SOCIAL MEDIA IN E-LEARNING ENHANCEMENT," in *ICERI2015: 8TH INTERNATIONAL CONFERENCE OF EDUCATION, RESEARCH, AND INNOVATION*, 2015, pp. 4654–4663.
- [18] J. Panus and H. Jonasova, "Students' behavior on internets social networks as a base for e-learning tools," in *2015 INTERNATIONAL CONFERENCE ON INFORMATION AND DIGITAL TECHNOLOGIES (IDT)*, 2015, pp. 286–290.
- [19] M. P. S. Bhatia and P. Wadhwa, "Social networks analysis: trends, techniques, and future prospects," pp. 1–6, 2014.
- [20] C. Palazuelos, D. Garcia-Saiz, and M. Zorrilla, "Social Network Analysis and Data Mining: An Application to the E-Learning Context," in *COMPUTATIONAL COLLECTIVE INTELLIGENCE: TECHNOLOGIES AND APPLICATIONS*, 2013, vol. 8083, pp. 651–660.
- [21] D. Rosen, V. Miagkikh, and D. Suthers, "Social and semantic network analysis of chat logs," p. 134, 2012.
- [22] D. Rodríguez, M. Á. Sicilia, S. Sánchez-Alonso, L. Lezcano, and E. García-Barriocanal, "Exploring affiliation network models as a collaborative filtering mechanism in e-learning," *Interact. Learn. Environ.*, vol. 19, no. 4, pp. 317–331, 2011.
- [23] C. Spadavecchia and C. Giovannella, "Monitoring learning experiences and styles: The socio-emotional level," *Proc. - 10th IEEE Int. Conf. Adv. Learn. Technol. ICALT 2010*, pp. 445–449, 2010.
- [24] S. Dawson, "'Seeing' the learning community: An exploration of the development of a resource for monitoring online student networking," *Br. J. Educ. Technol.*, vol. 41, no. 5, pp. 736–752, 2010.