Collaborative Learning in Virtual Learning Environment using Social Network Analysis: Case study Universitas Terbuka

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Abstract— Distance learning is supposed to provide not only independent learning activities but also two-way interaction and collaborative learning based on inquiry model to control students' learning. E-learning is one of the platform to implement two-way interaction and inquiry model. Universitas Terbuka (UT) is the first open distance education university in Indonesia. This paper will study and visualize participation in discussion and interaction on the virtual learning environment (VLE) UT using Social Network Analysis (SNA). This paper also used a questionnaire to detect knowledge sharing behavior (KSB) in the Collaborative Learning Environment (CLE) based on Social Presence, Perceived Online Attachment Motivation, Perceived Online Relationship Commitment, and Altruism indicators. For the perception of students and evaluation about e-learning UT, we use Yilmaz's Transactional Distance. The results of the measurement network in forum discussion can detect that the tutors are most important, and who are mostly reply to other student's posts or which students' post are mostly commented by others. Personal/Informal network shows that students tend to interact only with students on same location registered region office.

Keywords— *Social Network Analysis, SNA, E-learning, Open Distance Education, Knowledge Sharing Behavior, Collaborative Learning*

I. INTRODUCTION

Universitas Terbuka (UT) is the first open distance education system in Indonesia. UT has 40 regional offices spread across 34 provinces in Indonesia, and one main office in Tangerang Selatan. Implementation of distance education using various communication to expand and open an access to higher education services for people who can't attend regular education based on UU No. 12/2012. Provision of student support services in distance learning are provide independent learning activities [1], two-way interaction between students and institutions [2] and creating inquiry model based collaborative learning in virtual learning environment (VLE) [3] to control and monitor students' independence learning process.

Although distance education offers openness and flexibility, withdrawal become one of challenges [4]. In fact, distance education tends to have higher attrition rates than traditional face-to-face education [5]. Rector UT 2017-2020 [6] said that 30% of UT students who do not complete their study until graduation each year. There are four main categories that have a significant impact on dropout decisions, i.e. student, resources (learning material, human resources, and partnerships), university, and faculty [7]. Based on Rector UT [6], students are feeling isolated and alone because they are far from their tutors and peers and lowering their motivation to continue studying in university. Based on Budiman's research [8] confirm that one of the factors that drives students to drop out is feeling isolated and alone, and added other factors to contribute in student drop out: financial problem, and lack of managing and balancing responsibilities in family, work, and study. Arifin [9] added the reasons to not continuing studies are lack of real cases analysis in course learning material, lack of awareness in proactive intervention support system from faculty, and student support services quality still not meeting students' requirement. Zuhairi, Karthikeyan, and Priyadarshana [7] said that there is a challenge on identification of weak students' strategies to prevent drop out (university).

Based on students' drop out factors, we are focusing on 'feeling isolated and alone' problem. Wieser and Seeler [10] said that interaction through collaborative learning approach will reduce social isolation in distance education. Naidu [4] added that understanding student behavior pattern in interacting and engagement with their tutor, peers, and course material can be an indicator to student persistence and success. Moreover, Arifin [11] states that interactive learning design and productive communication can strengthen students' determination to continue their study in university. Harsasi and Sutawijaya's finding in students' satisfaction on UT e-learning [12] that there is a positive correlation on providing online collaboration, getting feedback, and exchanging knowledge with peers and tutors to perceived learning outcomes and achievements. Students' persistence has a strong influence to attrition rates in university. It is believed that knowledge sharing will improve their knowledge acquisition through forming and maintain relationship and institution must create online learning environment's condition to foster it [13]. Collaborative learning processes in virtual learning community depends on knowledge sharing behaviors (KSB) [14]. Usually, students are working in groups of two or more, mutually searching for understanding, solutions, or meanings, or creating a product and focus on on students' exploration or application of the course material, not just the tutor's presentation or explication of it [15].

E-learning is one of platform which provided by UT as two-way interaction and inquiry model approach. Online and

blended students can participate virtual class, discuss in forum, and post an assignment through e-learning. Their activities in e-learning can contribute to their grade and help to interact with tutors and peers from different and scattered location across region. Cela, Sicilla, and Sánchez [16] states that e-learning provides a rich virtual network which students can create possible interactions with other members (students or tutors) in network to exchange ideas and information. Virtual network can figure students' collaboration and interaction communication pattern to help understanding characteristic of students' learning pattern (active, non-active, isolated), to improve course design, and to foster collaboration and attachment in online learning. In fact, besides using a commonly known learning management system framework (Moodle), instant chat messaging (WhatsApp) and social media (Facebook) can emerge more personally collaborative learning [17].

Therefore, this paper will analyze interaction of master of primary education program students on odd semester term 2019/2020 in Research Methodology on Education course in e-learning and outside e-learning i.e. chat messaging and social media using Social Network Analysis (SNA) techniques from social perspective. We select Research Methodology on Education course because this is a course which explicitly instructed to discuss with peers in class by tutor. Head of the Postgraduate Teacher Education and Managing Master of Primary Education Program (MPDR) added that 16% of 153 first semester's students on even semester term 2018/2019 (almost one full class of online tutorial) did not pass this course than other first semester's courses. Various studies indicated that social network analysis can be particularly effective in studying students' interactions in online collaboration. The aim of this research is to give information to UT's lecturers and top management about the involvement and interaction with students so they could analyze students' behavior in order to improve their involvement for better students' learning performance. The action could be done by sending a message to low engaged students and encourage their participation [18]. We conduct two research question for this paper: (1) What occurs in interaction student with each other and with tutor on "Research Methodology on Education" course MPDR UT using social network analysis, and (2) What are strategies to improve collaborative learning between students and tutors in UT to increase not only their retention, but their knowledge too.

This research paper is organized into 6 sections: 1) Introduction, to explain why the study is conducted; 2) Literature Review, to explain about relevant theory used in this research; 3) Methodology, to describe methodology adopted to this research; 4) Result and Analysis, to show result of SNA and KSB in UT E-Learning; 5) Conclusion; and 6) References.

II. LITERATURE REVIEW

A. Social Network Analysis

Social network analysis (SNA) aims to study relationships among actors that interact with one another in social networks [19]. SNA is a method for studying the structure of relationships and the effect this social structure has on the attitudes, behavior, and performance of the individual actors or groups [20]. A social network has two fundamental elements: nodes (participants) and edges (relations) connecting them [20] to examines the roles and behavior of nodes on other nodes in the network, and on the network as a whole. Social networks can be visualized, and measures potentially related to aspects of community can be calculated [21].

Filvà, García-Peñalvo, and Forment [22] explained SNA in learning process to identify interaction or friendship patterns among students, identify or improve characteristic of students, and optimize social learning environment.

SNA method is a tool that considers actors interactions making it easier to understand the influence of each actor in the network. SNA provides both a visual and a mathematical analysis of human relationships. Using SNA indexes can provide conclusions about unprecedented implications which could not be revealed by using a simple count of meaningful posts because of SNA indexes demonstrating interactive relations between actors.

Several researchers have proposed using SNA as a method for identifying community. Ferguson and Shurn [23] used social network analysis approach to identify interaction in learning process (disconnected student, key information brokers within class, and learning community) and analyses students' contribution on formal and informal (personal) education environment. This study also visualize how behavior of student is in multiple learning environment. Gottardo and Noronha [18] use SNA to obtain useful information to help monitoring students in distance learning courses based on interaction patterns from discussion forums.

Adraoui et.al [24] try to classify the students' level and to help the instructor to find new strategies for help learners who are classify at-risk by using SNA to see interactions between learners in an online discussion forum in Moodle using the Pajek. They found that SNA can help to the reason why learners do not interact with each other, so at the end there could be improvement should be done.

In this paper, SNA will be used to study and visualize about participation in discussion and interactions on VLE in UT. Furthermore, based on these visualizations, this paper aim to give strategy to improve knowledge sharing process between students and tutors on UT's virtual learning.

B. Knowledge Sharing Behaviour

Ma and Yuen [13] describe knowledge sharing behavior as two social perspectives to understanding students' motivation i.e. perceived online attachment motivation (POAM) and perceived online relationship commitment (PORC). POAM describe as the ability of students to improve their interaction to feel as part of community in VLE. PORC describe as commitment to maintain relationship which has been formed in VLE. Ma and Chan [25] added one social perspective i.e. altruism which key factor to triggering online KSB. Altruism is explained as unconditional kindness to providing help other students without expectation of return, just achieving their satisfaction to helpful.

Yilmaz [14] describe two characteristics on knowledge sharing in online learning collaboration, social presence (SP) and transactional distance (TD). SP is explained as student's experience in VLE and feeling belonging to community that could change according to interaction in learning environment as activities to develop relationship and ensure continuity, students' ownership to environment as a sense of belonging, and existence of affective statements and

emotional expression used in environment. TD is explained as communication gap or potential misunderstanding in interaction of between students themselves (S-S), student-teacher (S-T), student-content (S-C), student-interface (S-I), and student-environment (S-E).

III. METHOD

First, we collected data of master of primary education program students on odd semester term 2019/2020 in first semester from academic information system database to understanding their profile background such as age, gender, education history, marital status, registered regional services' location. We list group of students based on Research Methodology on Education class in e-learning UT. This research will focus on interaction of students in the same online class only. Interaction and participation in VLE are collected from two sources, forum discussion e-learning UT as formal VLE, and questionnaire survey to detect personal interaction outside e-learning UT using name generator approach from list of students for each online class. We will ask about "To whom you will ask questions through media other than e-learning when you have difficulty doing assignments or understanding lessons?" to representing an incoming communication and to "Do you respond to their answers and submit opinions to create mutual discussion (if you just answer "thank you" or "okay" without give an opinion, please choose 'never')?" representing an outcoming communication. We made a KSB questionnaire using a 5-Likert scale. We use SP, POAM, PORC, and altruism as questionnaire indicators to detect KSB in CLE. For perception of students and evaluation about e-learning UT, we use Yilmaz's TD perspective.

After collecting data, we separately transform for each interaction in e-learning and outside e-learning into network graph using Gephi and Socnetv to visualize interaction network and calculate measurement: centrality (in-degree, out-degree, betweenness, and closeness), density, and size of network from node. This research will present network visualization in form of directed graph where the flows for both in- and out- degrees to be defined. Closeness centrality is used to investigate how quickly information flow in students' interaction. Betweenness centrality is used to investigate link that control interaction to be connected. Density of network is used to give insights about interconnected between member.

The result of SNA in e-learning and outside e-learning through questionnaire are used to answer research question (1) What occurs in interaction student with each other and with tutor on "Research Methodology on Education" course MPDR UT using social network analysis. We hypothesize based on collaboration learning theory that student can actively build an interactive discussion in e-learning through reply other students' post and outside e-learning through other communication media regardless of their location difference.

To answer research question (2) about strategies to improve online collaborative learning, we use gap analysis [26] with Head of the MPDR. First, we analyze and identify current interaction and collaborative learning behavior based on SNA in e-learning, SNA questionnaire to analyze interaction outside e-learning, and KSB questionnaire, and how current learning design. Then, we will identify target on collaborative learning that should occur. Based on current and target situation towards collaborative learning implementation, we will conduct gap analysis to formulate strategy that will improve collaborative learning implementation in Research Methodology on Education course MPDR UT.

IV. RESULT AND DISCUSSION

We collected 222 name in master of primary education first semester students odd term 2019/2020 data set with their personal information such as location of registered regional services (Jakarta, Denpasar, Serang), age which we calculated from birth of date, gender, and marital status in SIA database. These information will give us more about background of students. For example, older student may having difficulties to use e-learning than younger student, or married student will not having much time to response their peer than single student. But, SIA database does not provide information about which online class they entered. We collected it from Research Methodology on Education course in e-learning UT and download list of student from each classroom. Data merging process from SIA database and e-learning online classroom using excel. There are nine students who are not on list of e-learning online classroom member. So, we exclude nine students and the remaining of total 212 student will be included in our research. There are 8 Research Methodology on Education course online classroom. Classroom name consist of course id (eight first character alphanumeric), next two numeric character of no. classroom, and one alphabet character (B for new, and U as a class for students who retaking a course). Total student for each class are 30 students in MPDR5103.01B, 29 students in MPDR5103.02B, 28 students in MPDR5103.03B, 26 students in MPDR5103.04B, 25 students in MPDR5103.05B, 25 students in MPDR5103.06B, 25 students in MPDR5103.07B, and 24 students in MPDR5103.08B. The average student based on gender is dominated by women (71%), average student based on age is dominated by 31-40 years old (54%), average student based on marital status is dominated by married status (86%), and the regional office location (considered as the closest student's residence) consist of Jakarta (22%), Yogyakarta (13%), Medan (11%), Denpasar (11%), Jayapura (9%), Surakarta (9%), Serang (8%), Bogor (8%), and Bandar Lampung (8%) (See Fig. 1.)
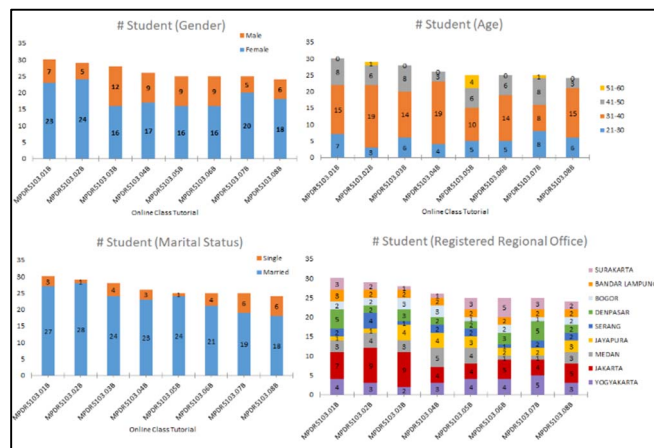

Fig. 1. Distribution of Master of Primary Education Program Student in Research Methodology on Education class E-learning UT

A. Social Network Between Students and Tutor

An interaction between member of online classroom on forum discussion thread from each classroom are collected using web scraper python beautifulsoup4. In order not to

make e-learning server down because making too many requests when executing web scraper code, we execute code which work for download it first as HTML file for all session in each classroom. Forum discussion session that we collected are from first session to eleventh session on 22 November 2019. Twelfth session will not include in this research because it still on progress. Each HTML file will be extracted to csv file with columns: classroom name, session, post id, subject or title post, author of post, content of post, and reply to which id post they referred. To simplify data processing, we store our dataset: student's personal information which has been merged with list of students in e-learning online classroom, and post in forum discussion into database. Then, we make a relationship between post for every session on online classroom and transform it to become binary adjacency matrix with name alias label as an input to SNA visualization and analysis tools.

The results of measurement network of interaction between member of classroom can be seen in Table I. Nodes in this network are member of classroom, whereas directed edge indicated interaction to other member through replying post in VLE. The results showed that class MPDR5103.01B has the largest size of node network with 31 nodes, though there is one node (S 1) who doesn't participate in forum discussion. However, class MPDR5103.04B has the largest density showing that more interaction and participation overall in this class forum discussion, and the lowest density in class MPDR5103.02B and MPDR5103.03B. The class that has the best betweenness value is MPDR5103.01B. Although MPDR5103.02B and MPDR5103.03B have the same number of edges, MPDR5103.03B density and betweenness is higher because of the initiative of students to interact with other students besides their tutor e.g. comment their peer post on forum discussion even though only one person. GDC indicating the number of interaction participants or degree centrality. Class MPDR5103.01B has the largest degree centrality value, SNA results show that the tutor has the highest out degree measure (28). This indication that tutor give a response or feedback to 28 participants' post. We concluded that tutor's response and feedback affect the value of degree centrality for each class.

We use online survey questionnaire and spread using SMS broadcasting to 213 student phone number contact. There are only 28 completed response on questionnaire from total 84 response on 1 December 2019 (See Fig. 2.). 56 incomplete response will not be included in result. There are two respondent, IGN and IGA 3, that choose wrong classroom for questions about SNA. So, we excluded them from our result in personal interaction SNA, but we included them in KSB questionnaire because there is no dependency with which member of classroom they are.

TABLE I. MEASUREMENT OF NETWORK INTERACTION BETWEEN MEMBER OF EACH ONLINE CLASSROOM

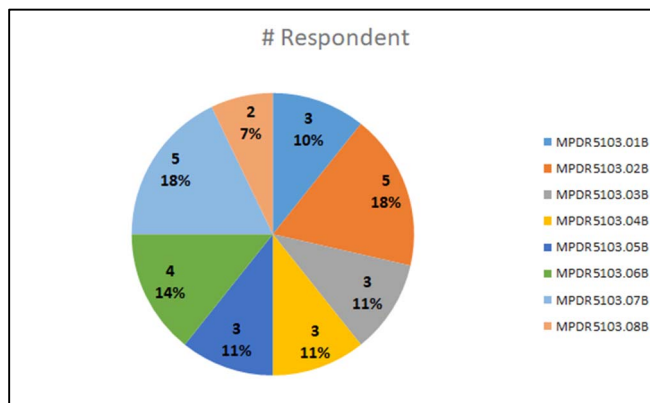| Class	Node	Edge	Density	GDC	GBC
MPDR5103.01B	31	75	0.08	0.88	0.87
MPDR5103.02B	30	52	0.06	0.12	0.16
MPDR5103.03B	29	52	0.06	0.41	0.51
MPDR5103.04B	27	89	0.13	0.35	0.50
MPDR5103.05B	26	54	0.08	0.33	0.44
MPDR5103.06B	26	60	0.09	0.28	0.56
MPDR5103.07B	26	77	0.12	0.29	0.45
MPDR5103.08B	25	47	0.08	0.44	0.52

Fig. 2. # of respondent on questionnaire

We display SNA result of class MPDPR5103.04B which has the most interactions in forum discussion with the measurement of closeness centrality and betweenness centrality are shown in Fig. 3. and Table II. The result shows that EATutor has the highest betweenness centrality value, which means the tutor has a key responsibility and the most important person in the network because all information flow is passed through him. This could also be seen by the number of in and out degree of EATutor which is higher compared to other participants. On the matter of closeness centrality, EATutor also has the highest value with 0.71 indicates that EATutor is the closest one to the other nodes, which means EATutor has highest influence to other participant in the network and the information flow faster through EATutor. This is due to that tutor initiated the discussion first. So, we are not focusing on EATutor. The first student who has the most influential based on in-degree and out-degree in Table II is VQ. VQ often comment his/her peer's post and his/her post often commented by others. In-degree and-out degree could be used to know who is active student and student who post something that makes the peer want to give a comment. VQ's betweenness is also indicated that VQ's post become bridge for other students to express their opinions and build discussions other than only to post their answer to tutor. In-degree provide an insight to know who is member's post is replied by other members, and out degree to know who is member has an initiative to comment other members' post. For example, TM's post is replied by seven members in class, but TM's reply post to other members is still low than LR.
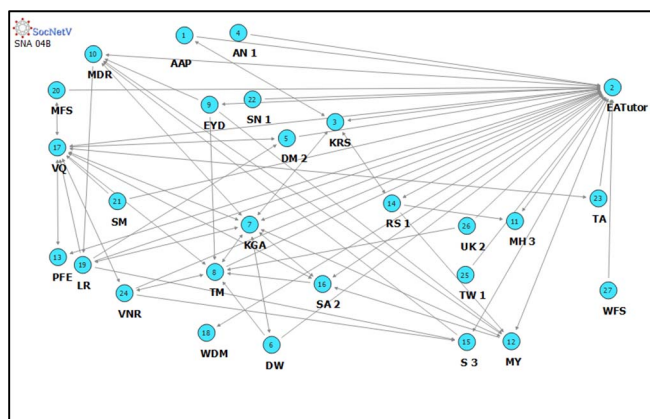

Fig. 3. SNA of MPDR5103.04B class

TABLE II. MEASUREMENT OF FORUM DISCUSSION IN MPDR5103.04B

Node	Closeness Centrality	Betweenness Centrality	In Degree	Out Degree
EATutor	0.71	333.7	26	12
VQ	0.63	108.78	9	9
KGA	0.65	71.23	9	9
KRS	0.5	28.54	4	4
MDR	0.49	12.2	5	3
TM	0.49	7.68	7	3
LR	0.56	6.07	2	5
SA 2	0.54	4.79	4	4
MY	0.49	3.35	4	4
EYD	0.49	2.54	1	4
VNR	0.51	2.25	2	4
S 3	0.44	1.03	3	2
RS 1	0.47	0.83	2	4
AAP	0.44	0	1	2
AN 1	0.43	0	0	1
DM 2	0.43	0	2	1
DW	0.49	0	1	3
MH 3	0.43	0	2	1
PFE	0.49	0	2	2
WDM	0.43	0	1	1
MFS	0.49	0	1	2
SM	0.49	0	0	2
SN 1	0.43	0	0	1
TA	0.49	0	1	2
TW 1	0.43	0	0	1
UK 2	0.46	0	0	2
WFS	0.43	0	0	1

A survey on personal interaction between students is also conducted into egocentric network. Due to small sizes sample in each online classroom, we're only summarize the results on paragraph and give one classroom, i.e. MPDR5103.04B to represent the results of SNA personal interaction. The result shows that student AAP has the highest value of closeness centrality (0.63), betweenness centrality (107.5), in degree (8), and also out degree (7). This could also mean that AAP is most active to informally interact with other students in same online classroom. However, AAP has the strongest and most frequent interaction with KGA who is same location with AAP. Meanwhile the tutor interaction with student outside discussion forum is not really intense, which is showed by low in-degree and out-degree. It can be concluded that respondents in MPDR5103.04B aren't too often communicate personally with tutors. The result shows students tend to communicate more personally with students in same location. For example, Denpasar student tend to often interact only with student from Denpasar too, as well as Jayapura's student and Medan's student. The reason is that students in one location are formed and assigned into the same face-to-face tutorial class by their respective regional offices.

The result about preference of informal interaction (outside UT's discussion forum) between students on left side of Fig 4 shows that most of them, with 67.9%, preferred to communicate and discuss using Instant/Chat Messaging (Whatsapp). The other most used medias to conduct discussion are Email (25.0%), SMS & Skype (each 3.6%). On tutor-student interaction on right side of Fig 4, Instant/Chat Messaging (Whatsapp) with 50% is still the most used media, slightly higher than Email (42.9%), followed by SMS & Skype (each 3.6%). One respondent from Denpasar mentioned that students have Whatsapp chat group, but only member of face-to-face tutorial on the same class. This result

shows that most preferences media to interact with other students or tutor outside UT's discussion forum, is Whatsapp because it's faster to connect with others.
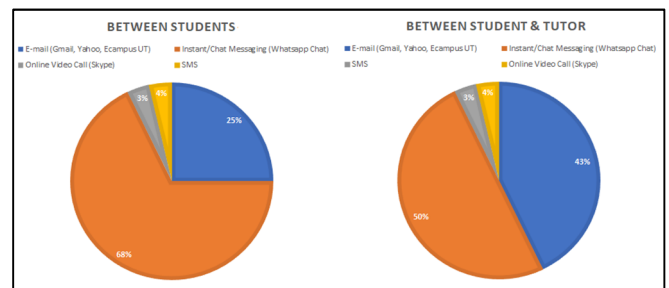

Fig. 4. The preferences media outside e-learning UT to interacting between students and between student and tutor

We have classified networks based on media used for discussion, which are e-learning UT and outside e-learning UT. Relationships between students and tutor in each network have been identified by measuring some SNA metrics. To answer RQ: "What occurs in interaction student with each other and with tutor on Research Methodology on Education course MPDR UT using social network analysis", we make conclusions from two results of SNA. On e-learning UT environment, the SNA result shows that tutors still have the highest values of in-out degree, betweenness centrality, and closeness centrality. Tutors hold important roles and as key information brokers in the classroom, mostly initiate discussion, response most of posts, become the bridge between students and become centre of information flow. So, tutor-dependency in forum discussion is still high because there is a policy which only tutors who can initiate the creation of discussion forums for each session. Students rarely take the initiatives to reply other students' post and build an interactive discussion. this can be seen from the lower number of in-degrees and out-degrees (< 10 edge). Outside e-learning UT, SNA result shows the opposite result. Students tend to interact and initiate discussion actively without tutor initiation but the interactions mostly happen between students on the same location using Whatsapp chat group.

B. Knowledge Sharing Behavior of Students

1) TD Perspective Results

The TD perspective used as evaluation on collaborative learning and interaction in VLE especially on e-learning UT. Respondents perception about "Tutors are very helpful in e-learning" result is "quite agree" and "agree" with both percentages are respectively 39.29%. Respondents who choose "agree" commented that tutor give help and response their question, but respondent who choose "quite agree" commented that tutor still not give a mark on participation discussion and need a feedback to maximize their learning. But, some of respondent who choose "quite agree" give a positive comment about good response from tutor. Majority of respondents' perception on "Tutors answer student questions on e-learning" is "agree" (35.71%). They give a positive comment about tutor's response for them such as detailed explanation to them, and answer their questions. Some of them who choose "quite agree" (25%), "disagree" (10.71%), and "strongly disagree" (7.14%) give neutral

comment about their passive actions (not asking a question) in the class so they cannot give a judgement about it, and negative comment about tutors rarely answer their questions (but they understand maybe tutor still busy with his/her own activities), and positive comment about good response from tutor.

Respondents give a positive response about "The contents of material in the e-learning class are interesting" with 53.57% "agree", 28.57% "strongly agree", and 17.86% "quite agree". They are commented about interesting discussion, diversity of material types (text, video), and the material is aligned with the problems in learning process. Their response about "I have difficulty understanding the material given by tutors on e-learning" is "disagree" (67.86%). They have a many positive comments about comprehensiveness material to their learning process, various material type i.e. video, and tutor gave another reference to enrich knowledge. Yet, some students commented about their knowledge to understand terms is still not enough or to understand words written in material will be different compared to directly explained through communication.

Their response on "The technology used in e-learning is easy to use" also positive that is 60.71% "agree", 28.57% "strongly agree", 7.14% "quite agree" and 3.57% (only one person) "disagree". Some of positive comments contains the flexibility of student learning, and easy to use. Few negative comments are from two student from Jakarta, even though they choose "agree", their confusion about system failure when checklist attendance in e-learning or their frustration about instability internet network to access e-learning. Question about "I do not like using e-learning" are "disagree" (46.43%) and "strongly disagree" (42.86%), because they feel the benefits of e-learning like flexibility, and gathering platform with other students outside their residential area. Their response about "I am more comfortable using e-learning using a computer than using a smartphone" is "strongly agree" (39.29%) and "agree" (32.14%). Some of positive comments about better computer screen resolution, ease of reading, easy to typing in keyboard, and comfortable. There are comment about ease of both devices. In fact, there is comment that doesn't agree because the habit of using iPad. Majority of student choose "agree" (57.14%) on "I have access to the information sources that I need" because they have contact number, e-mail, and internet to access e-learning or asking question to tutor or other students.

2) OKSB, SP, POAM, PORC, and Altruism Perspective Results

SP, POAM, PORC, and altruism perspective used to measure experiences students in online environment. On SP indicator, there are 71.43% students "agree" about "share the opinions of agree or disagree in the e-learning discussion forum", and 75% explained their ideas clearly to other members. But 32.14% choose "quite agree", 10.71% choose "agree" and 3.57% choose "strongly agree" that they still doubtful when they want to ask in e-learning discussion forums. And there are 25% choose "quite agree" and 7.14% choose "agree" that they have no response to e-learning discussion forum. Compared to discussions on social media the number of students who share the opinions of agree or disagree and explained their ideas clearly to other members is higher than the e-learning discussion forum. 28.57% choose "quite agree", 50% choose "agree" and 3.57% choose

"strongly agree" to share the opinions of agree or disagree in social media discussion. While students explained their ideas clearly to other 21.43% choose "quite agree", 50% choose "agree" and 10.71% choose "strongly agree". This shows students still prefer on social media discussion than e-learning discussion forum.

On POAM indicator, response to motivation of attachment to an environment in e-learning discussion forum, 25% choose "quite agree", 50% choose "agree" and 21.43% choose "strongly agree" use e-learning to communicate and discuss when have difficulty in learning. Respondents also motivated to use e-learning when someone asks and likes the topic that they give, and when they were noticed and valued in the discussion. Based on the results on POAM indicator, when they have difficulty in learning, majority of respondents use social media (78.57% "agree" and "very agree") than e-learning discussion forum (71.42% "agree" and "very agree"), even though if we include number of "quite agree" response, student will likely to use both (social media and e-learning). Respondents give a positive response about committed to maintaining friendships in classrooms that are formed now that use e-learning. Majority of respondents also feel connected with peers in same online classroom, though only 7.14% student choose "disagree" because they feel not connected with online classmates in social media.

On altruism behavior indicator, only one respondent (3.57%) choose "disagree" on willingness to sharing knowledge if other student need help. Other students give positive response on altruism behavior. They will help other who need help to use e-learning or have difficulty understanding the knowledge provided through e-learning. They also help by answering questions or participating in e-learning discussions.

The results of student response on OKSB, they agree that the information from e-learning users increases their understanding and knowledge of the material provided. They also use the material in e-learning as a source of information they refer to when discussing and when they need information. Member's behaviour in e-learning discuss also politely without hurting or offending others, respect each other, and avoid using annoying expressions or words. Students also responding to other questions that they can help by sharing information in the e-learning community. However, there is still 3.57% students choose "strongly disagree" that the information from e-learning helps to complete the task on the same topic and helps improve the quality of assignments on the same topic. They do not feel the benefits of e-learning in helping their assignments.

C. Strategies to Increase Collaborative Learning

We have presented and explained the results from SNA in e-learning, SNA from questionnaire, and KSB questionnaire as current situation of behavior interaction and collaborative learning in Research Methodology on Education course. We found that implementation of collaborative learning using e-learning in Research Methodology on Education course hasn't yet made interactive discussions between students of different locations. Students tend to actively interact with other student on same location because they have personally met each other when attend to face-to-face tutorial classes and use Whatsapp chat group for online informal interaction.

We are conducted gap analysis while discussing with Head of MPDR to identify achievement targets for each result to formulate strategies that will improve collaborative learning in Research Methodology on Education course (See Table III.).

Based on gap analysis, there are some improvement to achieve targets in implementing collaborative learning and interaction to minimize student who feel isolated and alone which will have an impact on reducing drop out:

- Collaborative learning has not yet been formed as should have formed. This is due to assignment design which has not include group assignment. Naidu [4] said that not only assuming that learning community will be form because student as participant of learning are connected with each other, but better design in group-based learning experience in assignment will drive to minimize attrition and promote persistence.
- Students from different locations still don't interact personally with each other. Even though they may interact with other classmates on same online classroom, some of them probably won't build deepen relationship to achieve collaborative learning with other student from different locations, between regions and even between islands.

To improve perceptions of the students in order to increase their interaction on collaborative learning by creating a comfortable learning environment that promote appreciation and support to build trust and promote open communication. Tutors positive feedback as soon as possible also contribute to increase participation and interaction in e-learning discussion. Isolation still occurs between students because many students will only interact with other students who are in the same location only. Online collaborative learning between students from different location is still can't be formed. To improve online collaborative learning within students on different location, MPDR can use social media like Facebook or Whatsapp group to gather MPDR student, tutor, and administrative officer to 'break an ice' and MPDR will give an initiation to open bridge between students and help students interact with each other. Beside using social media, MPDR also has to create a course design to increase collaborative learning such as from assignment's design. Research Methodology on Education course has three assignment. The first assignment will provide good paper/thesis for review by students and other students will ask or give comment about it, second assignment will have student to review paper/thesis, and last assignment about group assignment. Group assignment can be formed from Facebook or Whatsapps group for all students who take course or using e-learning to formed group in same online

class. If there are students experiencing difficulties, they can ask in social media group to share their experiences and to give an opportunity to other students to help them. This difficulties and solution to answer will be posted publicly so that other students can learn from it.

V. CONCLUSION

Based on analysis and discussion of online collaboration learning in Research Methodology on E-Learning UT environment, the SNA result shows that tutors mostly initiate discussion, response most of posts, get the most of replies. Tutor-dependency in forum discussion is still high because there is a policy which only tutors who can initiate the creation of discussion forums for each session. Students rarely take the initiatives to reply other students' post and build an interactive discussion. Outside e-learning, SNA result shows the opposite result, students tend to interact and initiate discussion actively without tutor initiation but the interactions mostly happen between students with the same location.

Most of respondents only interacts with fellow students who are located in the same place with him/her, while UT implements distance education that encourage collaborative learning among students scattered in various locations. Therefore, online collaboration learning in Research Methodology on Education still need to be improved. Using gap analysis, the results of strategies formulation to improve collaborative learning are enhancement in assignment design and providing social media group to help student close to other students from various regions and to become knowledge sharing environment, if they meet difficulties or want to other know about their experience. But, respondents' evaluation about e-learning is overall good and can helps students in their learning. They also have good intention to share their knowledge and discuss with other students. It is expected that the strategy that has been formulated can increase student persistence. Students are also not frustrated because they feel isolated and alone during the learning period.

VI. FUTURE RESEARCH

The strategies formulated in this paper have not yet been tested whether they can really reduce drop out which is the main problem, although it might help students not feel frustrated by being isolated and alone. However, these strategies can still be implemented and tried out to see their effectiveness in building collaborative learning. For further research in SNA, can be more focused on personal interaction and communication of all students on course because this study is still limited to only social networks per each online class only to assess student.

TABLE III. GAP ANALYSIS IN CURRENT AND TARGET OF COLLABORATIVE LEARNING AND INTERACTION IN UT

Current	Target	Gap
Based on SNA in forum discussion e-learning, tutors are mostly initiate discussion, response most of posts, and get most post replies. tutor-dependency in forum discussion is still high because there is a policy which only tutors who can initiate the creation of discussion forums for each session. Students rarely take the initiatives to reply other students' post and build an interactive discussion because the participation score mark in online class is only from answering tutor's questions in discussion, and there is no assessment that affects to participation score mark when interacting with other students. There are also no assignments that are required to be done in group of study from three assignments.	Students are also taking the initiative to reply other students' post and build an interactive discussion and sharing their knowledge to create collaborative learning based on inquiry model through group-based learning experience in assignment.	Collaborative learning has not yet been formed as should have formed. This is due to assignment design which has not been include group assignment.

TABLE III.   Gap Analysis in Current and Target of Collaborative Learning and Interaction in UT

Current	Target	Gap
Based on SNA questionnaire, majority of respondents interact and communicate more personally with other online classroom member in same location. There is a 'student group' policy where student on same location are gathered into 20 people per group to make face-to-face tutorial class. Due to this policy, students tend to be closer to other students whom are in the same location, even different from online classes.	Collaborative learning that formed in distance learning, should into a seamless interaction with other students that crossing different location boundary to reduce the loneliness and isolation.	Students from different locations still don't interact personally with each other. Even though they may interact with other classmates on same online classroom, some of them probably won't build deepen relationship to achieve collaborative learning.

REFERENCES

[1] G. M. Moore, "Autonomy and independence," *The American Journal of Distance Education,* vol. 8, no. 2, pp. 1-5, 1994.

[2] B. Holmberg, Theory and practice of distance education, London: Routledge, 1995.

[3] R. Garrison, T. Anderson and W. and Archer, "Critical inquiry in a text-based environment: Computer conferencing in higher education," *The Internet and Higher Education,* vol. 2, no. 2, pp. 87-105, 2000.

[4] S. Naidu, "Openness and flexibility are the norm, but what are the challenges?," *Distance Education,* vol. 38, no. 1, pp. 1-4, 2017.

[5] S. Carr, "As distance education comes of age, the challenge is keeping the students," *Chronicle of higher education,* vol. 46, no. 23, pp. A39-A41, 2000.

[6] M. F. Bona, "Rektor Baru UT Janji Tingkatkan Kualitas Layanan Akademik," 3 August 2017. [Online]. Available: https://www.beritasatu.com/nasional/445575/rektor-baru-ut-janji-tingkatkan-kualitas-layanan-akademik. [Accessed 2019 November 16].

[7] A. Zuhairi, N. Karthikeyan and S. T. Priyadarshana, "Supporting students to succeed in open and distance learning in the Open University of Sri Lanka and Universitas Terbuka Indonesia," *Asian Association of Open Universities Journal,* 2019.

[8] R. Budiman, "Factors Related to Students' Drop out of a Distance Language Learning Programme," *Journal of Curriculum and Teaching,* vol. 7, no. 2, pp. 12-19, 2018.

[9] M. H. Arifin, "Role of Student Support Services in Enhancing Student Persistence in the Open University Context: Lesson from Indonesia Open University," *Turkish Online Journal of Distance Education,* vol. 19, no. 3, pp. 156-168, 2018.

[10] D. Wieser and J. M. Seeler, "Online, Not Distance Education: The Merits of Collaborative Learning in Online Education," in *Disruptive Power of Online Education: Challenges, Opportunities, Responses*, 2018.

[11] M. H. Arifin, "Exploring Self-Motivation in Contributing Student Persistence in the Indonesia Open University," in *09th Annual International Conference of Education, Research and Innovation (ICERI)*, 2016.

[12] M. &. S. A. Harsasi, "Determinants of student satisfaction in online tutorial: A study of a distance education institution," *Turkish Online Journal of Distance Education,* vol. 19, no. 1, pp. 89-99, 2018.

[13] W. W. K. Ma and A. H. K. Yuen, "Understanding online knowledge sharing: An exploratory theoretical framework," in *International Conference on Hybrid Learning*, Berlin, Heidelberg, 2010.

[14] F. G. Karaoglan Yilmaz, "Social presence and transactional distance as an antecedent to knowledge sharing in virtual learning communities," *Journal of Educational Computing Research,* vol. 55, no. 6, pp. 844-864, 2017.

[15] B. L. Smith and J. T. MacGregor, "What is Collaborative Learning?," 1992.

[16] K. L. Cela, M. Á. Sicilia and S. Sánchez, "Social network analysis in e-learning environments: A preliminary systematic review," *Educational Psychology Review,* vol. 27, no. 1, pp. 219-246, 2015.

[17] M. T. García-Álvarez, I. Novo-Corti and L. Varela-Candamio, "The effects of social networks on the assessment of virtual learning environments: A study for social sciences degrees," *IEEE,* 2017.

[18] E. &. N. R. V. Gottardo, "Social Networks Applied to Distance Education Courses: Analysis of Interaction in Discussion Forums," in *18th Brazilian Symposium on Multimedia and the Web*, 2012.

[19] S. Wasserman and K. Faust, "Social network analysis: Methods and applications," in *Social network analysis: Methods and applications*, Cambridge, England, Cambridge University Press, 1994.

[20] S. P. Borgatti, A. Mehra, D. J. Brass and G. Labianca, "Network Analysis in the Social Sciences," *American Association for the Advancement of Science,* 2009.

[21] A. Chin and M. Chignell, "Identifying Communities In Blogs: Roles for Social Network Analysis and Survey Instruments," *Int. J. Web Based Communities,* vol. 3, no. 3, pp. 345-363, 2007.

[22] D. A. Filvà, F. J. García-Peñalvo and M. A. Forment, "Social network analysis approaches for social learning support," in *Proceedings of the Second International Conference on Technological Ecosystems for Enhancing Multiculturality*, 2014.

[23] R. Ferguson and S. B. Shum, "Social learning analytics: five approaches," in *Proceedings of the 2nd international conference on learning analytics and knowledge*, 2012.

[24] M. Adraoui, A. Retbi, M. K. Idrissi and S. Bennani, "Social learning analytics to describe the learners' interaction in online discussion forum in Moodle," in *16th International Conference on Information Technology Based Higher Education and Training (ITHET)*, Ohrid, Macedonia, 2017.

[25] W. W. Ma and A. Chan, "Knowledge sharing and social media: Altruism, perceived online attachment motivation, and perceived online relationship commitment," *Computers in Human Behavior,* vol. 39, pp. 51-58, 2014.

[26] I. Mukherjee, "The complexity paradigm: Implications for information systems and their strategic planning," *Journal of Computer Science,* vol. 4, no. 5, p. 382, 2008.