Title	Beyond research: Classroom interaction analysis techniques for classroom teachers
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Source	*4h Redesigning Pedagogy International Conference, Singapore, 30 May to 1 June 2011*

BEYOND RESEARCH: CLASSROOM INTERACTION ANALYSIS TECHNIQUES FOR CLASSROOM TEACHERS

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This research was supported by CRPP project OER08/ZSH.

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Paper presented at the 4th Redesigning Pedagogy International Conference

May/June 2011, Singapore

Abstract

This paper explores how research methodologies employed in a large-scale research project can benefit classroom teachers in helping them self-evaluate and reflect the instructional efficacy of teaching practices. Flanders Interaction Analysis System (FIAS) and Social Network Analysis (SNA) are introduced as alternative methods of research on classroom observation as well as the approaches of helping teachers conduct self-evaluation and self-improvement.

Keywords: Interaction analysis, Flanders Interaction Analysis System (FIAS), Social Network Analysis (SNA).

Beyond Research: Classroom Interaction Analysis Techniques for Classroom Teachers

Introduction

This paper explores how research methodologies employed in a large-scale research project can benefit classroom teachers in helping them self-evaluate and reflect the instructional efficacy of teaching practices. Specifically, we will introduce two data analysis techniques of classroom pedagogical interaction applying to the case studies in a publically funded research project entitled "Effectiveness of the Chinese Modular Curriculum in Singapore Primary Schools – A Holistic Evaluation". These two analysis techniques are Flanders Interaction Analysis System (FIAS) and Social Network Analysis (SNA), both coming along with recommended analysis methods that can be conveniently applied by teachers to assist in their performing the techniques. Before proceeding to elaborate on in which way these two techniques can be tapped by classroom teachers in improving their instructional practices, a brief introduction is provided in what follows.

Flanders Interaction Analysis System (FIAS)

Interaction analysis has been used to study spontaneous teaching behaviour and it was also been used in projects which attempt to help teachers modify their behaviour. Interaction analysis in this paper, among other category systems, mainly focuses on teacher influence in the classroom (Amidon, 1966). We introduce one of the earliest classroom interactions analysing systems which inspired many classroom analysing systems, especially in the field of interactions in language classes (e.g. Spada & Frolich, 1995). Verbal interaction between teacher and students in the classroom was recorded and analyzed by researchers through FIAS. The assumption is made that teaching behaviour and pupil response are expressed primarily through the spoken words as a series of verbal events which occur one after another (Flanders, 1970). These events are identified, coded,

so as to preserve sequence, and tabulated systematically in order to represent a sample of the spontaneous teacher influence. In using the FIAS, we tried to provide an answer to the question of how a teacher can obtain objective information about his classroom behaviour, which is rich enough and clear enough to guide his steps towards self-directed improvement. Teachers may benefit from the chance of examining whether the observed information is consistent or inconsistent with their own intentions, and make proper decisions of change afterwards.

Categories

FIAS provides ten categories to classify classroom verbal behaviours, as shown in table T1[*]. These ten categories classify verbal events in class into three groups, namely, teacher's talk, student response and the silent moments. The categories of teacher's talk can also be clustered into two groups, indirect influence and direct influence, which would partially depict the teaching style of a teacher.

Teacher's talk: indirect influence

1. Accept Feeling

   Teacher accepts and clarifies the feeling tone of the students in a non-threatening manner. Feelings may be positive or negative also includes predicting or recalling feelings.

2. Praises or Encourages

   Teacher praises or encourages student action or behaviour. Jokes that release tension but not at the expense of another individual, nodding head, or approval are included.

3. Accepts or Use Ideas of Students

   Teacher clarifies, builds or develops ideas suggested by a student. As teacher states more of his ideas, the category shifts to lecturing.

Teacher's talk: direct influence

4. Asks questions

   Teacher asks a question about content or procedure with the intent that a student answers.

[*] The number in front of a category is nominal in nature, which represents a classification of event happened during the observation but not the position on a scale.

5. Lecturing

   Teacher gives facts or opinions about content or procedures; expresses his ideas, asks rhetorical questions.

6. Giving Directions

   Teacher gives directions, commands, or orders to which a student is expect to comply.

7. Criticizing or Justifying Authority

   Teacher gives statements which intended to change student behaviour from non –acceptable to acceptable pattern, states teacher authority and so forth.

Student response:

8. Student Talk – Response

   Students talk in response to teacher. Teacher initiates the contact or solicits student statement.

9. Student Talk – Initiation

   Students initiate the talk, including the response to teacher's statements which indicates the student is willing to talk.

Silent moments:

10. Silence or Confusion

    Pauses, short periods of silence and periods of confusion in which communication cannot be understood by the observer.

Table T1. Categories for FIAS

Teacher Talk	Indirect Influence	1. Accept Feeling
		2. Praises or Encourages
		3. Accepts or Use Ideas of Students
		4. Asks questions
	Direct Influence	5. Lecturing
		6. Giving Directions
		7. Criticizing or Justifying Authority
Student Talk		8. Student talk—Response
		9. Student talk –Initiation
		10.Silence or Confusion

During the class time, trained observer identifies and records the events in class into the above ten categories. In the original design (Flanders, 1970), the observer should records the verbal event occurred into category numbers every three seconds. However, it was reported less applicable to train a suitable observer. Therefore, in classroom practices, the interval may vary according to the experience of the observer.

Matrix Analysis

After classroom observation, a series of numbers are produced as the written record which preserves the original sequence of events. The number sequence of FIAS is arranged into pairs and tabulated into a matrix format to facilitate calculation, whereas the outcomes can also be visualized to explain the results more directly. By highlighting the sequence of verbal behaviours in class, FIAS also provides teachers their unique teaching styles from analyzing their verbal reactions to students' speech. It is teacher's indirect or direct influence which may encourage the interaction in class or, on the contrary, reduce students' involvements in class.

We explain the matrix analysis of FIAS through simulated data of classroom observation which lasts 350 seconds of teaching time. The simulated matrix is showed in table T2. In the table, rows are previous events (categories), while columns are following events. Areas of the matrix indicate different aspects of a teaching procedure.

- [Total] The cells in the total row show the percent time the teacher talk, the student talk and the time in silence. They showed the extent of teacher-student interaction and the efficiency of a class.
- [Row 6-7, Column 6-7] indicates the continued use of directions and criticism, which implies discipline problems in the class.
- [Row 1-3, Column1-3] indicates the continued use of acceptance and praise, which shows an encouraging teaching style.
- [Row 8-9, Column8-9] indicates sustained students participation, which is supposed to be a frequently event in a class with more interactions.

- [Row 1-7, Column 8-9] indicates the types of teacher statements that trigger student participation, which shows the possibility of gaining students' attention and involvement. Particularly, [Row4-5, Column 8-9] indicates the response of students towards the instructions; [Row1-3, Column8-9] shows the frequency of teacher encouraging and students responding.
- [Row 8-9, Column 1-7] shows the immediate response of the teacher toward the students' talks, which also indicates the teaching style of a teacher.

Table T2. Simulated Matrix Analysis

Interaction Matrix		Category (later event)									
		1	2	3	4	5	6	7	8	9	10
Category (Former event)	1	1	0	0	1	1	0	0	0	0	0
	2	0	1	1	0	1	0	0	1	0	0
	3	0	2	5	1	3	0	0	0	1	1
	4	0	0	0	7	0	0	0	6	0	2
	5	1	1	0	2	32	0	1	0	3	1
	6	0	0	0	0	1	0	0	0	0	1
	7	0	0	0	0	0	0	0	0	0	1
	8	1	0	2	2	2	0	0	8	1	0
	9	0	0	4	0	0	0	0	1	3	0
	10	0	0	1	2	1	2	0	0	0	0
	Total	3	4	13	15	41	2	1	16	8	6

Graphic analysis

Graphic analysis is another way to examine the teaching procedure. Since the numbers preserve the original sequence of events, an event map can be produced according to the timeline, which gives a visual impression of teaching procedure. A graph is also convenient to familiarize the percentage variation of teacher's talk and students' talk as the class proceeds, which also describes the interaction activities more directly. Figure Fig.1 shows a scatter chart of the simulated events in the teaching timeline. According to the density of spots on the fifth category, we have the information that Lecturing is the major verbal event during the recorded time slot. The first 60 seconds show that the teacher starts the class with asking questions and appraising or encouraging

the students' answers. Spots on Line (category) 4, 5, 8 and 9, the teacher asks questions every once awhile during lecturing and the students always provides short answers, sometimes the students also initiate talks when teacher gives statements.

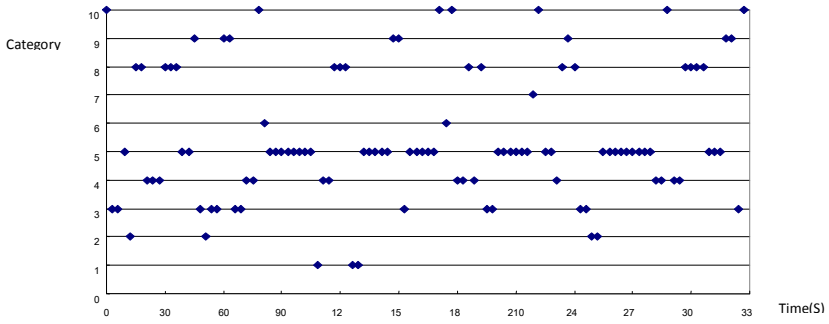

Fig. 1 Simulated scatter chart of teaching event on the timeline

Besides the scatter chart, the comparison of students' talk with teacher's talk during the class can also be visualized with curve chart. The chart tells us when, and then what event, trigger more (or less) verbal participation of students which represents more (or less) student involvement in class. For instance, Figure Fig.2 shows the accumulation percentage of teacher's talk and students' talk during the class. The curvature of both curves in the chart shows the increasing pattern of teacher's talk and students' talk. When the students' talk increases greatly in a very short time span, the teaching events happened before the time span can be viewed as the inspiring stimulation. While the teacher's talk increases greatly, the chances for students' expressions are reduced accordingly, which predicts a pattern of less interactions between the teacher and the students.

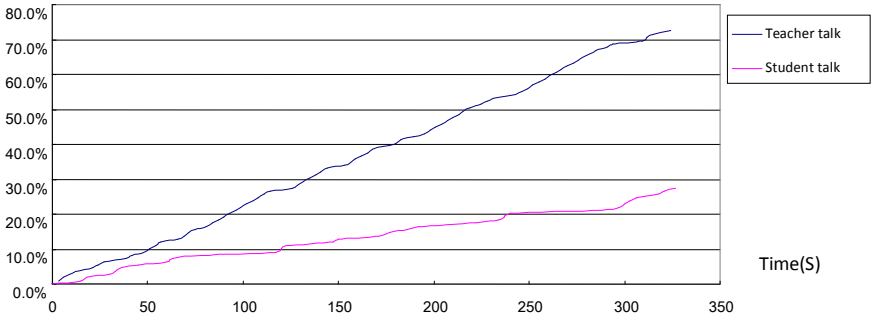

Fig. 2 Simulated curve chart of teacher talk and student talk percentage

Social Network Analysis（SNA）

SNA is defined as the mapping and measuring of relationships and flows between people, groups, organizations, computers, and other connected information/knowledge entities. The nodes in the network are the people and groups while the links show information relationships or flows between the nodes. SNA provides both a visual and a mathematical analysis of human relationships.

The Rationale of SNA Application as a Case Study

SNA is becoming increasingly popular as a general methodology for understanding controllable structures and patterns of interaction among actors (i.e., individuals, groups, or organizations). It describes structures and patterns of relationships between people or social entities, seeks to understand both their causes and consequences. From the network perspective, teacher-student interactions in the classroom can be examined as a verbal communication network, in which speeches are viewed as connections (or *ties*) between individual student and the teacher, which are viewed as nodes or *vertices* in the network. Some underlying characters of the in-class interactions can be acquired through analysing the basic attributes of the network. For example, the *degree* of a certain *vertex* (an actor) may indicate the involvement of a certain student. The mathematical root of network analysis permits powerful and well defined manipulations, calculations, as well as visualizations of social network. SNA technique can be easily applied to analyzing the classroom environment with the data acquired from classroom observation system. Some of the software which could perform visualized SNA is also easy to access and master for both researchers and teachers.

NSA approach has been widely used as an effective tool in many research areas. It has been used in Chinese language studies over recent years (e.g. Liu, 2009) and its potential application in language classroom have been recently explored (e.g. Larsen-Freeman & Cameron, 2008, among others), but no actual attempts of applying it to Chinese language classroom are found in the literature. Coming to the lesson study carried out by Chinese language researchers at CRPP, in the

past, a Specific Focus project of a comparative study by using classroom observation coding scheme has been completed and the general picture of pedagogical interaction in Chinese language classroom has been detailed (in form of tabulation and percentage counting) in the findings reported in both preliminary and final technical reports. Now, policy makers hope to see this kind of pedagogical interaction (both IRF and oral/aural exercise among the learners) in a more detailed and individual dimension. SNA method provides not only a graphical and intuitive network picture showing oral/aural communication patterns and effectiveness occurred in classes, but also a comparative basis to find out the differences and similarities between different modules under the new modular curriculum launched since 2006 across Singaporean primary education system, as well as the modular classes (as experimental groups) and the old classes (as control group, through utilizing the existing CRPP data collected since 2003). Initial literature scan finds that the major metrics used in SNA are applicable in looking at features of pedagogical interaction in language classroom. It can be a powerful research approach to visualize classroom discourse, thus a good answer to key concerns revolving around the effectiveness and efficiency of efforts committed in improving students' oral communicative skills. Given the difficulties and time consuming to capture the individual speech in a normal classroom, the use of SNA approach in classroom data analysis in current project will be limited to case study.

SNA Metrics Applicable in Language Interaction Analysis

As mentioned earlier, a social network is a social structure made of individuals (or organizations) called "nodes," which are tied (connected) by one or more specific types of interdependency, such as friendship, kinship, financial exchange, dislike, sexual relationships, or relationships of beliefs, knowledge or even prestige. To understand networks and their participants, researchers evaluate the location of actors in the network. Measuring the network location is finding the centrality of a node. These measures give us insight into the various roles and groupings in a network – who are the connectors, leaders, bridges, isolates, where are the clusters and who is in them, who is in the core of the network, and who is on the periphery?

We believe that most of metrics (or measures) used in SNA have implications in analyzing language interaction and can be generally fit into analysis of efficacy of pedagogical dialogues in occurring in language classrooms. In what follows, to showcase how they can be used for analysing communicative effectiveness, through using the well known sample (see below) developed by Professor David Krackhardt (http://www.orgnet.com/sna.html), we attempt to show how some of major SNA metrics can be employed to examine the features and efficacy of language class in light of oral communicative skills.

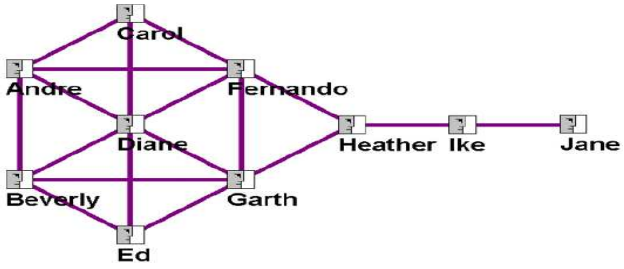

Fig. 3 Sample of Simulated Network – the"Kite Network"

Social network researchers measure network activity for a node by using the concept of degrees – the number of direct connections a node has (Freeman, 2006). In the above figure, two nodes are connected if they regularly talk to each other, or interact in some ways. Andre regularly interacts with Carol, but not with Ike. Therefore Andre and Carol are connected, but there is no link drawn between Andre and Ike. In measure the intensity of language communication, the higher degree of the link, the more frequent the speakers converse.

Degree Centrality. In the network above, Diane has the most direct connections in the network, making hers the most active node in the network. She is a 'connector' or 'hub' in this network. Common wisdom in personal networks is "the more connections, the better." What significant, this is not always so. What really matters is where those connections lead to – and how they connect the otherwise unconnected! Here Diane has connections only to others in her immediate cluster, known as clique in network analysis. She connects only those who are already connected to each other. In an oral or written communicative environment, she communicates with only those close to her, so that she can hardly learn anything new linguistically. Suppose Diane is

the teacher, then the pedagogy is a teacher centred class; but if she is a student, the high degree indicates that the class might not be dynamic enough, in another words, it is too centralized in terms of opportunity distribution.

Betweenness Centrality. While Diane has many direct ties, Heather has few direct connections (3) – fewer than the average in the network. Yet, in many ways, she has one of the best locations in the network. She is *between* two important constituencies. She plays a 'broker' role in the network, signifying that she plays a powerful role in the network (but she is a single point of failure). Without her, Ike and Jane would be cut off from information and knowledge in Diane's cluster. A node with high betweenness has great influence over what flows in the network. A node like Heather holds a lot power over the outcomes in a network. In language classroom, Heather' language habit should be encouraged, she is not very talkative with the same person, but tries to talk to different persons with the language patterns she has learned from each other, so she is the 'transmitter' of the new language knowledge.

Closeness Centrality. Fernando and Garth have fewer connections than Diane, yet the pattern of their direct and indirect ties allow them to access all the nodes in the network more quickly than anyone else. They have the shortest paths to all others, in other words, they are close to everyone else. They are in an excellent position to monitor the information flow in the network, i.e., they have the best visibility into what is happening in the network. Therefore, Fernando and Garth's behaviours are also ideal in terms of language learning, they learn most from others, and vice versa. For instance, their vocabulary is rich and they intend to be exposed to wide variety of structural patterns of the target language.

Network Centralization. Individual network centralities provide insight into the individual's location in the network. The relationship between the centralities of all nodes can reveal much about the overall network structure. A very centralized network is dominated by one or a few very central

nodes. In language classroom, this kind of classes is dominated by fewer students, or more likely, is a teacher-centred class, and students have few opportunities to communicate with other freely.

Boundary Spanners. Nodes that connect their group to others usually end up with high network metrics. Boundary spanners such as Fernando, Garth, and Heather are more central in the overall network than their immediate neighbours whose connections are only local, within their immediate cluster. One can be a boundary spanner via one's bridging connections to other clusters or via one's concurrent membership in overlapping groups. Boundary spanners are well-positioned to be innovators, since they have access to ideas and information flowing in other clusters. They are normally active in the language learning environment and spread the new words and expressions. They are good language learners and also play a positive role in oral communication.

Peripheral Players. Most people would view the nodes on the periphery of a network as not being very important. In fact, Ike and Jane receive very low centrality scores for this network. Since individuals' networks overlap, peripheral nodes are connected to networks that are not currently mapped. Ike and Jane may be students that have their own small group of friends outside of the bigger language classroom or community, thus making them very important resources for fresh language usages not available inside the bigger unit.

The resulting graph-based structures are often very complex. There can be many kinds of ties between the nodes. Research in a number of academic fields has shown that social networks operate on many levels, from families up to the level of nations, and play a critical role in determining the way problems are solved. Rather than what described above, some other measures that are often mentioned in SNA and relevant to language acquisition are: average degree, path length, eigenvector centrality, hierarchical organization, radiality, weak/strong link (see, e.g. Scott, 1991; Wasserman & Faust, 1994).

Tentative Summary

Constrained by the space limits, what described here provides only a brief description about the major SNA measures and the way how they can be applied in examining language interaction in term of acquisition efficacy. We admit that a number of technical issues need further elaboration before teacher can make better use of them to evaluate their classroom practices. Obviously, like any initiative in educational innovation, new technology introduction invariably requires extra commitment from teachers. There are cases where teachers are not always be able to generate an actual network graph, the SNA may after all be adopted as alternative perspective for classroom practitioners to gauge their teaching results. If teachers and students are regarded as the node, and speech action measured by either dialogue duration or turns (e.g. Initiate-Respond-Feedback, e.g., IRF) as the link value, taking into account other influential factors such as family language background, four network graphs can be generated as shown in the Appendix.

Conclusion

People involved in educational research are discontent about the separateness of the research and practice communities, the limited relevance of educational research, the failure to articulate manageable research-validated interventions, and the weak opportunities for professional development. These are also among the primary reasons that explain the current gap between research and practice in Singaporean context. To avoid the disengagement characterized by done-and-run away that seen in most research projects, the possibilities of making the research more relevant that can have actual impacts on teachers' classroom practises waw keenly explored in course of project implementation. A major research methodology of the project is classroom observation, which examines what happens in the classroom for the analysis of teacher-student interaction. The techniques in our case studies enable us to analyze the same class from other angles, which may also enlighten the teachers to their teaching with alternative methods.

The teaching-learning situation in the classroom involves interaction between the teacher and the student. The success of a teacher may be judged through the degree of effectiveness of his teaching which may be objectively assessed through his classroom behavior or interaction. Thus a

systematic or objective analysis of the teacher's classroom interaction may provide a reliable assessment of what goes on inside the classroom in terms of teaching and learning. Given the intensive human power and time consumption to conduct data processing and annotation which are required in order to generate the graphic illustration, it might be unrealistic to expect a classroom teacher to use the complex classroom interaction analysis techniques without external input. However, it is worth arguing that to have a good understanding of some basic concepts will undoubtedly enable the teachers to have an alternative dimension to look at their teaching practices. The two approaches introduced in this paper are advantageous because that, on the one hand, it is straightforward and intuitive, more significantly, they reveal the covered pitfall that otherwise may not be realized by classroom teachers, namely, being contrastive to traditional stereotype, to remind teachers to give more attention to the marginalized silent students who are normally not the centre of the classroom, but may have special contribution in terms of new vocabulary or expression introduction.

We believe that there are two forms of research on practice: formal research and practical inquiry. Formal research is undertaken by researchers and practitioners to contribute to an established and general knowledge base. Practical inquiry is undertaken by practitioners to improve their practice. It is suggested that practical inquiry is more likely than formal research to lead to immediate classroom change; that these two forms of research are fundamentally different; and that both are useful to practice, but in different ways. Therefore, in carrying out the formal research, beyond formal discoveries and new knowledge that can inform research community and policy-makers, the research team has endeavoured to transform the aforementioned research methodologies into a part of routine practices enabling teachers to improve instruction on individual basis. It is our hope that the intention of bridging the gap between the formal research and practical inquiry will be one of the focuses in project implementation agenda, a unique offer that prevailing research practices have not provided, or cannot provide for education community.

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Appendix

Simulated Network of Classroom Interaction

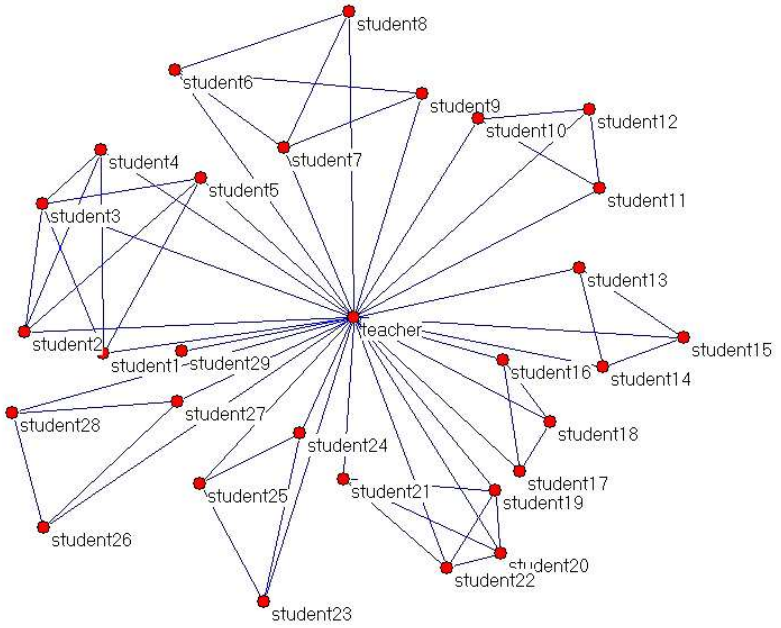

Fig. 1: Simple Network-Imagined Network of Classroom Interaction without Direction

(Node = teacher + student; Line = interaction between teacher and students and among students)

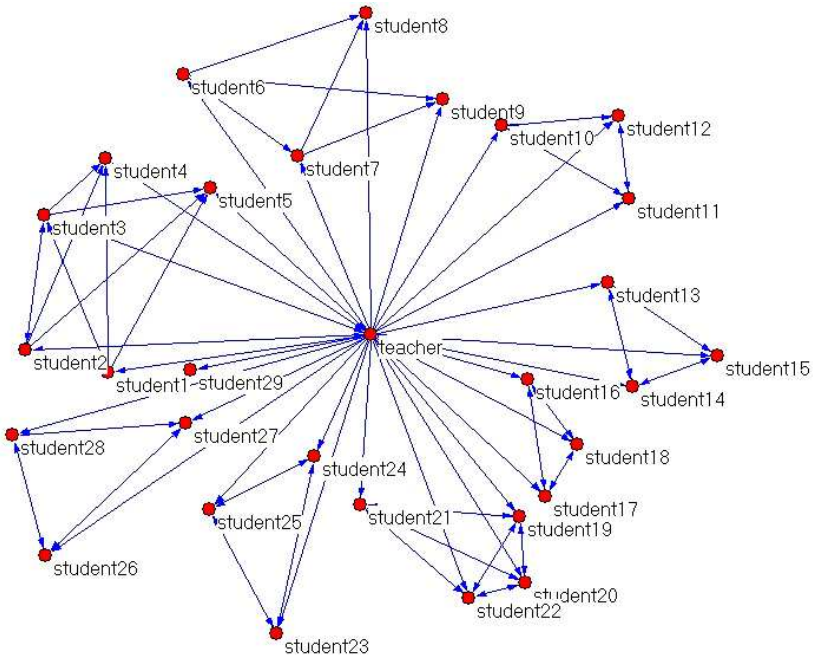

Fig. 1: Network Showing Dialogue Initiation Direction

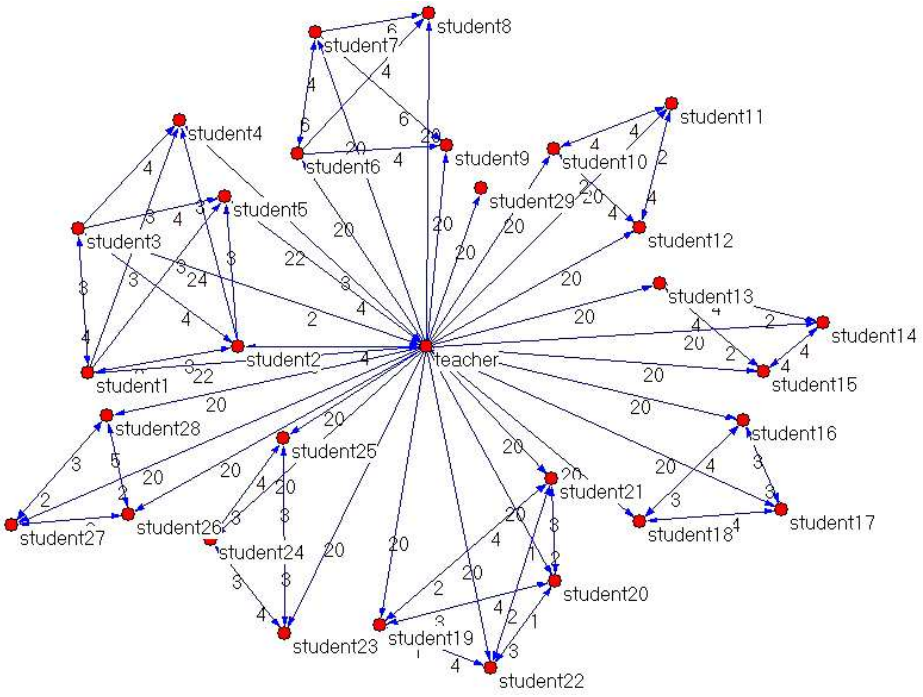

Fig. 2: Network with Directions and Link Value (Unit: minute) Showing Interaction Duration

(The entire class activities last for 20 minutes; the value between the students indicates the total interaction time)

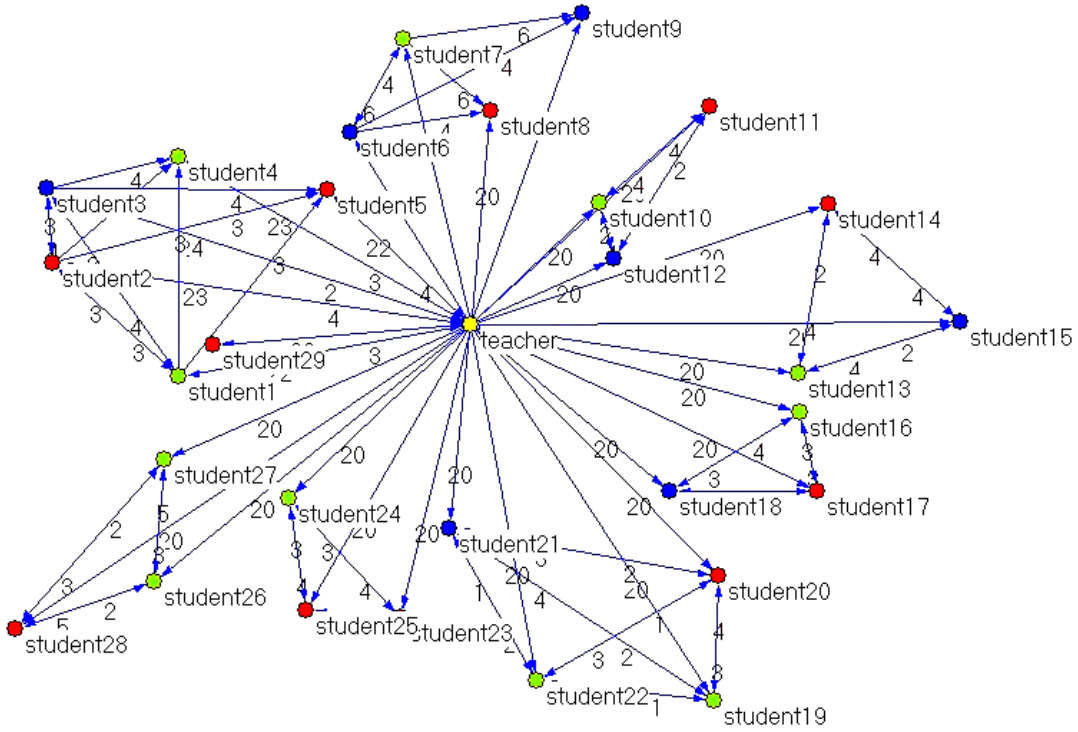

Fig. 3: Network with Differentiation of Family Language Background

(Yellow = Teacher, Red = Students from Chinese predominant family, Green = Students from English predominant Family; Blue = Students from bilingual family)