Assessing the Evolution of Social Networks in e-Learning

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Contents

List of Tables

List of Figures

List of Appendices

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Declaration

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Abstract

This research provides a new approach to analysing the evolutionary nature of social networks that are formed around computer-mediated-communication (CMC) in e-Learning courses. Aspects that have been studied include Online Communities and student communication in e-Learning environments.

The literature review performed identified weaknesses in the current methods of analyzing CMC activity. A proposed unfied analysis framework (FESNeL) was developed which enables us to explore students' interactions and to test a number of hypotheses. The creation of the framework is discussed in detail along with its major components (e.g. Social Network Analysis and Human Computer Interaction techniques). Furthermore this framework was tested on a case study of an online Language Learning Course.

The novelty of this study lies in the investigation of the evolution of online social networks, filling a gap in current research which focuses on specific time stamps (usually the end of the course) when analysing CMC. In addition, the framework uses both qualitative and quantitative methods allowing for a complete assessment of such social networks.

Results indicate that FESNeL is a useful methodological framework that can be used to assess student communication and interaction in web-based courses. In addition through the use of this framework several characteristic hypotheses were tested which provided useful insights about the nature of learning and communicating online.

Chapter 1: Introduction

1.1 Introduction

Computer-Mediated-Communication (CMC) has become a big part of our daily lives. More and more people are increasingly using computers to communicate and interact with each other. The internet and its advantages of connectivity, enable CMC to be used from a plethora of applications. Most common uses of CMC include email communication, discussion forums as well as real time chat rooms and audio/video conferencing. By communicating through computers and over the internet, online communities emerge. The use of CMC applications in e-learning courses fosters the development of online communities. Discussion boards and other CMC applications offer large amounts of data the analysis of which can help us understand communities and the social networks that form around them.

E-Learning has been gaining public interest very quickly as universities and businesses see it as an opportunity for cost savings and higher productivity. During the next few years we expect to see further development and refinements in the relevant technologies, improved usability of the systems being developed, a much broader array of applications, and a stronger focus on financially viable applications.

There have been various frameworks by different researchers aimed at analyzing CMC (Bales, 1950; Cooper, 1999; Fahy, 2003; Mason, 1991; McCreary, 1990; McMillan, 2002; Archer, Garrison, Anderson & Rourke, 2001). The methodology presented here studies and compares the existing models. Advantages and disadvantages of each of the CMC analysis methods are presented and suggestions for future research directions are made. Findings from the literature review showed limitations of the existing methods in analyzing the evolution of social networks in e-Learning and the need for the development of a new method is addressed.

Thus, the project's main objective was to develop a methodological framework for the study of the evolution of CMC social networks in e-Learning courses. Social networks are networks of people in online communities and they continually evolve and change over time. I have proposed to develop a unified framework compiled of three types of analysis: Content Analysis, Interaction Analysis, and HCI Analysis. My framework has been developed using existing CMC analysis methods, adaptations of existing methods and developing new methods. The main thing to note is that this framework assesses the social networks of the e-Learning courses lesson by lesson, thus mapping out their changes and evolution over the duration of the online courses. Chapter 3 details the methodology of the development of the research framework used in this study.

1.2 Aims and Objectives

The proposed framework incorporates the CMC analysis tools of Social Network Analysis (SNA), content analysis (TRA), and also uses HCI techniques (the COLLES and ATTLS questionnaires). The main research aim was to provide insights into e-Learning social networks. The final deliverable was the development of **FESNeL**: A **F**ramework for assessing the **E**volution of **S**ocial **N**etworks in **e-L**earning.

Furthermore a number of hypotheses were tested. These are listed below:

Hypothesis 1: *Students consider CMC tools to be important when learning online.*

This hypothesis was tested by evaluating the current state of Computer Aided Language Learning (CALL) websites and by using an online

questionnaire whereby students gave their views and feedback on which features and tools they thought are important to be included in e-Learning websites.

Hypothesis 2: *We cannot predict how students will communicate based on their views about online learning.*

Hypothesis 2 was tested by carrying out a correlation analysis between the students 'Constructivist On-Line Learning Environment Survey' (COLLES) scores and 'Social Network Analysis' (SNA) results to see if their actions reflect their opinions.

Hypothesis 3: *The students' 'way of knowing' and learning styles cannot predict their online CMC participation.*

A correlation analysis was carried out between the students 'Attitudes Towards Thinking and Learning' (ATTLS) scores and SNA results to investigate whether their participation is related to their individual learning style.

Hypothesis 4: *The students' opinions of online learning do not suggest what topics they will talk about during their online course studies.*

A correlation analysis was carried out between the students COLLES scores and their 'Topic Relation Analysis' (TRA) results to determine if what they think actually determines what topics they will be talking about.

Hypothesis 5: *The students' learning style does not suggest what they will talk about in the e-Learning discussion boards.*

A correlation analysis was carried out between the students' ATTLS scores with their TRA results to investigate if their learning styles determine what they will talk about.

The hypotheses listed above were tested by applying FESNeL on a case study (an online computer aided language learning course). Furthermore, during the analysis I have come across several other important findings that can also be considered valuable research contributions. For a complete review of these findings please see chapter 8 (discussion & conclusions).

1.3 Research Contributions

It is apparent from the literature review findings (Chapter 2) that most existing frameworks make either a qualitative or quantitative analysis of CMC, but rarely do we see a mixture of these techniques. As new teaching methods and different learning activities emerge, new methods for evaluating interactions are necessary.

My proposed framework synthesized a number of analysis frameworks with the aim of filling in some gaps identified from research, and answering hypotheses that could not be tested through the use of the individual models.

Other studies in this domain (Aviv, 2004; Aviv, Erlich & Ravid, 2003; Cho, Stefanone & Gay, 2002; Martinez, Dimitriades, Rubia, Gomez & de la Feuente, 2003; Rajasekara & Zaphiris, 2003) focus on particular time stamps of the community of e-Learning courses (usually the end of the course). This project has studied the evolution of these communities throughout the duration of a course. The framework was applied at various stages (per lesson) from the beginning of the course until the end, thus documenting and chronologically mapping the changes of the structure of the social network over time throughout the duration of the course.

Students engage in CMC when they are stuck, confused, excited, have questions, or just want to meet other peer students and have off topic discussions with them (December, 1997; Herring, 2001; Scotcit, 2003; Sumner & Dewar, 2002). The FESNeL approach combines qualitative and quantitative methods, thus allowing for a more in-depth analysis of the communication that takes place between the students (Laghos, 2005; Laghos & Zaphiris, 2006a). Unlike other frameworks, my framework uses several Human-Computer Interaction (HCI) techniques as well. Finally, my framework assesses the social networks over the duration of the courses and the main gain from this is that it will be useful for keeping track of the network changes, while investigating how specific conversation topics, or course amendments positively or negatively influence the dynamics of its online community. This will enable people - who use my framework to assess their e-Learning community - to predict how certain actions will affect their network, and to incorporate various methodologies to alter their state.

In general the process of enrolling and taking part in an online course takes place in the following order:

- Students enroll in online course
- They make use of CMC applications
- Online Communities Emerge
- Various Social Networks and cliques are formed
- Social Network Structure evolves through time (either becoming stronger or weaker)

A visual example of the evolution of a social network over 3 months is illustrated in Figure 1.1. In June 2004 we can see 4 students (A, B, C, D) connected. Also note that (C and D) and (C and B) are not connected directly as there is no direct communication between them and thus is a weaker relationship.

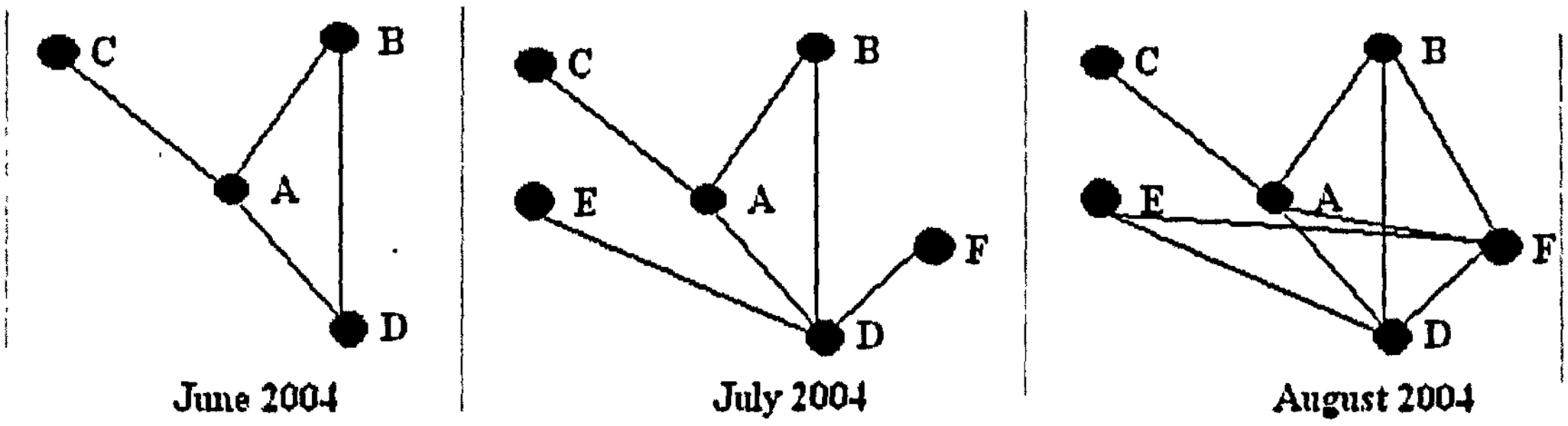


Figure 1.1: The evolution of a social network over 3 months

In July 2004 there are 2 new students in the communication network (E, F) who initially interact only with student D.

Finally, in August 2004, we see how the network has changed. The new students E and F have made connections with each other, and student F also with E and B. This leaves student C as the only student who only interacts with one other student (and in this case with student A). This is just a simple example to illustrate how a social network can evolve over time.

1.4 Thesis Outline

This project includes 7 chapters. The next chapter (Chapter 2) discusses the literature of e-Learning and Computer Aided Language Learning along with their technologies and tools, historical changes and future directions. In addition, the concepts of CMC and Online Communities are introduced and I discuss the research of the importance of Social Interaction in e-Learning and CALL. Furthermore, I provide a review of the currently available CMC analysis methods, their benefits and drawbacks, and the need for the creation of a new methodological framework.

Chapter 3 presents the development of the FESNeL framework, and its four attributes (SNA, TRA, COLLES, ATTLS) are described in more detail.

In Chapter 4, hypothesis 1 is tested showing the importance of CMC in CALL. This is followed by chapters 5 and 6 where FESNeL is applied to a representative case study:

Chapter 5 (Analysis of the Social Network): Partial use of the framework to investigate the environment/context of the case study and the dynamics of the Social Network that lives within this environment. All the results from the SNA are presented and discussed including network properties, connection, centrality, cohesion and equivalence.

Chapter 6 (Hypotheses Testing): Here the whole framework is used and the results of the TRA are presented. The four identified role groups are then discussed and compared in more detail. Furthermore, the two questionnaire results (COLLES and ATTLS) are discussed. The chapter ends with a number of correlations used to test the hypotheses stated in Chapter 1.

Finally Chapter 7 is comprised of a summary of this thesis, along with the reasearch contributions, limitations, future research directions, and conclusions. The thesis ends with the appendices, a glossary for quick reference and a list of my publications.

Chapter 2: Literature Review

2.1 Introduction

This main focus of this chapter is to discuss the concepts of e-Learning and Computer-Mediated Communication (CMC) and relevant research in these areas. This is an important part of this thesis since an understanding of how students communicate, and the characteristics of online learning communities, are necessary in order to be able to accurately analyze them.

The chapter begins with a discussion of e-Learning vs. traditional education issues, a presentation of the e-Learning tools and technologies, and an identification of the key players involved in e-Learning. Following this, the historical development of Computer Aided Language Learning (CALL) is presented along with a CALL methodology with the purpose of providing the reader with an overview of the characteristics of these areas as well as discussing their importance in our society and their advances and future directions.

Furthermore, the characteristics and types of CMC and Online Communities are explained. The chapter continues with Social Interaction research in e-Learning and CALL concentrating on such important areas as factors that influence social interaction, peer support, student centered learning, collaboration and the effect of interaction on learning.

2.2 E-Learning

e-Learning can be defined as "learning that is supported by information and communications technologies" (Ward, 2003). Characteristics of e-Learning are that there is a physical distance between the students and teachers, and usually electronic technologies are used for the delivery of the material. The difference between distance learning and e-learning is the method of delivery. Distance

learning can occur by mailing lecture materials to students in different countries, whereas e-learning is delivered using electronic means like the World Wide Web (WWW) although the terms are often used interchangeably. Traditional education however requires that the students and teachers be together in the same classroom where face-to-face teaching sessions are carried out.

Lately e-Learning has been gaining public interest very quickly as universities and businesses see it as an opportunity for cost savings and higher productivity. A study by the International Data Corporation (IDC, 2004) predicts that the e-Learning market will grow at a compound average growth rate of 27% annually from 2004 to 2008 (Figure 2.1).

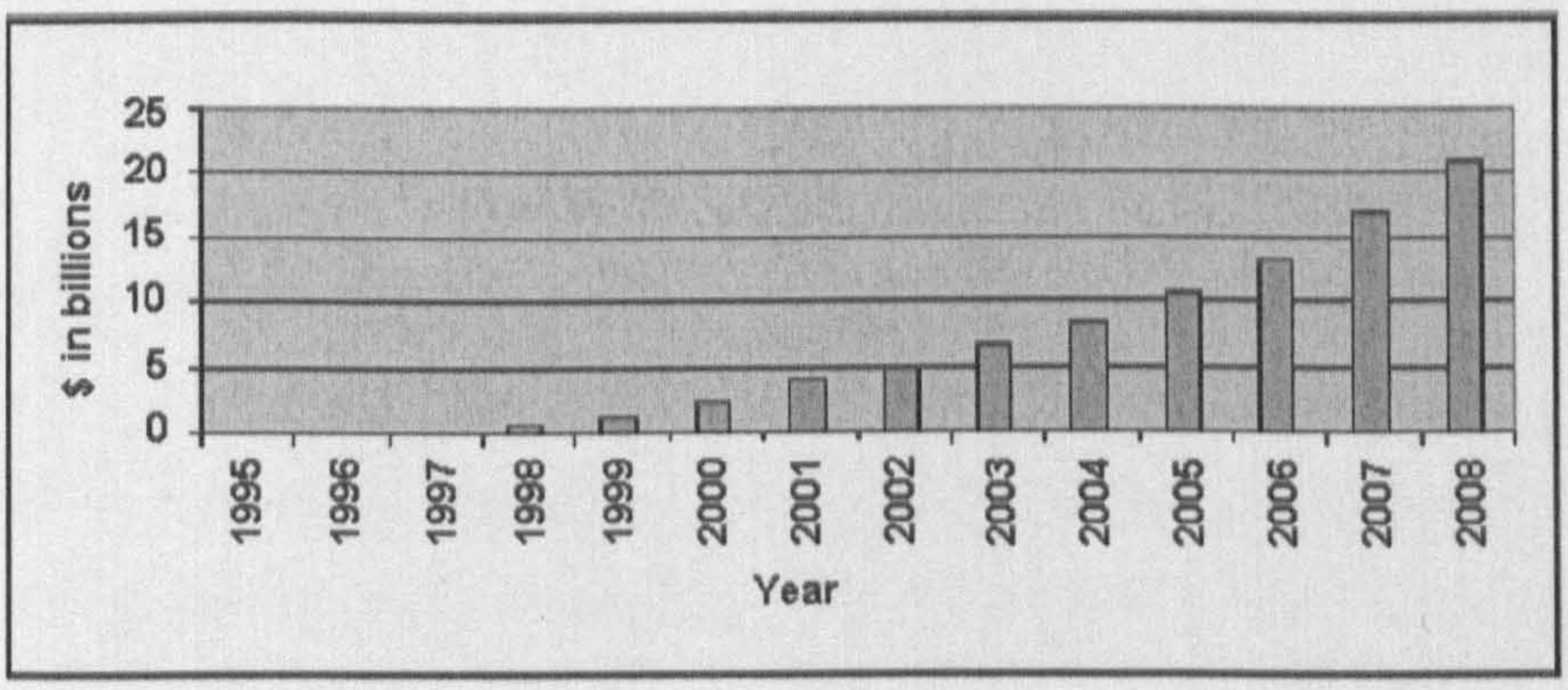


Figure 2.1: Growth of global e-learning market (IDC, 2004)

The e-Learning market was about $6.5 billion in 2003, and it is forecasted to increase to more than $21 billion by 2008 (IDC, 2004).

The Stanford Research Institute Consulting Business Intelligence Group (SRI-BIG) suggests that this growth of the e-Learning marketplace is a direct result of expanding the technology platform installed base (PCs, CD-ROM and Internet) and the enhanced capabilities provided by that platform over time (SRIC-BIG, 2002). As shown in Figure 2.2, SRI sees that the growth of the future e-Learning market will be driven by wireless connectivity, simulation tools, learning object design and peer-to-peer collaboration.

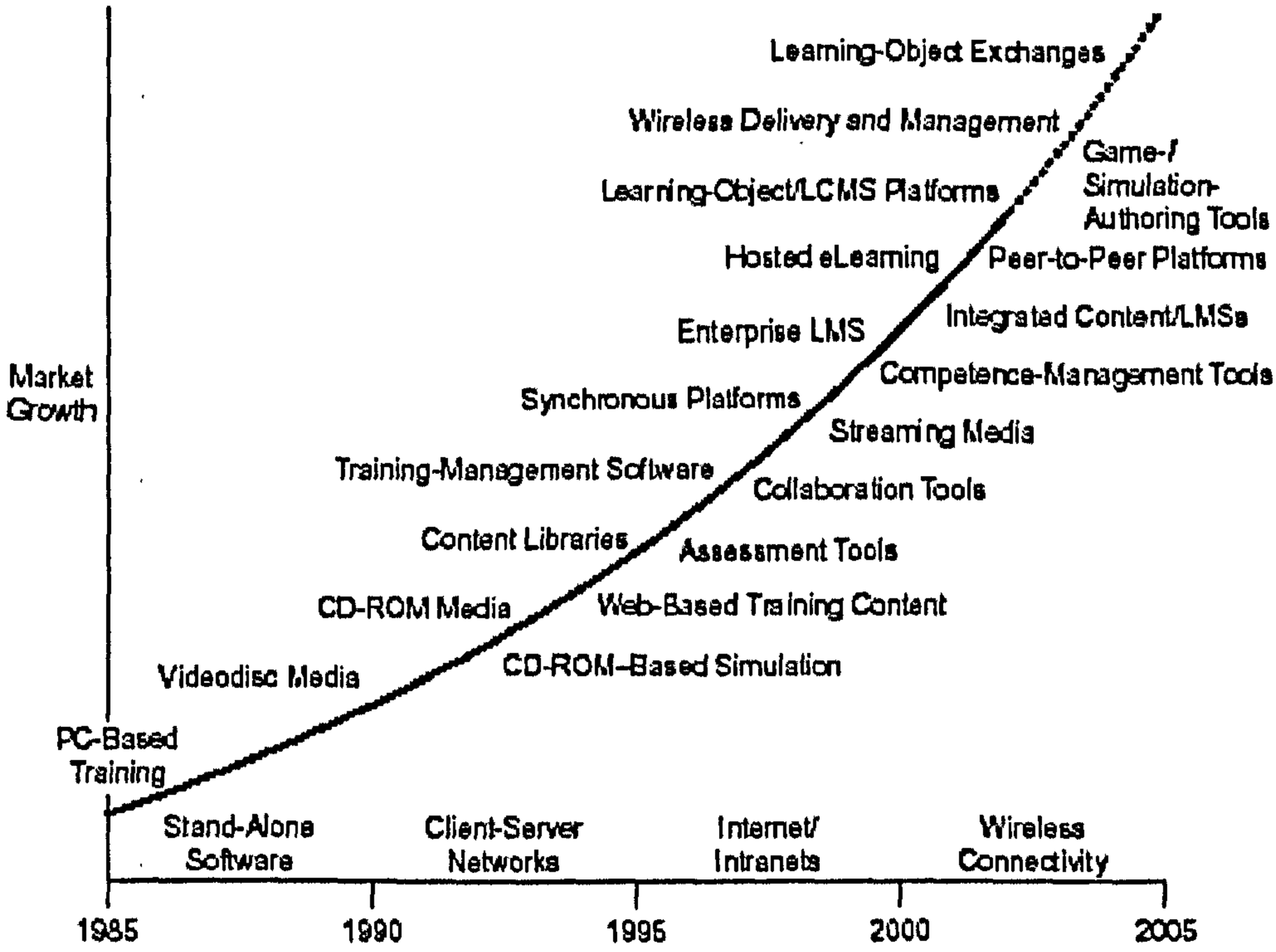


Figure 2.2: Technology Evolution in e-Learning (SRIC-BIG, 2002)

2.2.1 e-Learning vs. Traditional Education

There is no doubt that distance education is an exciting new innovation. The idea of being able to work at your own pace from home sounds very appealing. Student may enrol at universities from around the world and study courses that their local universities do not offer without all the expenses and hassle of travelling overseas. But is distance education going to completely replace traditional education?

Soudes (1993) argues that achievement on various tests administered by course instructors tends to be higher for distant as opposed to traditional students,

whereas Egan (1991) points out that conventional instruction is perceived to be better organized and more clearly presented than distance education.

As for the near future it does not look like e-Learning will completely replace traditional education. Videoconferencing helps to make lectures more like a classroom, where all the students can interact with each other and the tutor. However, videoconferencing and the other e-Learning techniques cannot replace actual face-to-face contact. E-Learning should be seen as a complement to traditional education rather than a replacement.

DLBOIS (2002) states that by using distance learning as an add-on to traditional classroom education or as a replacement for some courses, institutions can develop a richer overall learning environment available to a greater population base.

2.2.2 e-Learning Technologies and Tools

Various technologies and tools are used to deliver online education. Each of these has different uses, along with advantages and disadvantages. Which tool to pick usually depends on needs, budget and what equipment the students will have and be able to use. The following are the main types of technologies and tools used in distance education (DLBOIS, 2002):

- **Instructional television**

  Instructional television is a delivery system whereby programs are delivered using television broadcasting. It can be a one-way process where the programs have been prepared in advance, or a two-way process in which there is live interactivity between the instructor and the students (Oliver, 1994). The pros of instructional television are that most people are already

familiar with the medium, and that video and audio can be represented. The cons are that the programs cannot be easily edited and that video production can be quite costly and time consuming. An example of an instructional television program could be a biology one that teaches students about the feeding habits of a specific animal in its natural habitat.

- **Print**

Print is one of the oldest methods used in distance education (DLBOIS, 2002). The reasons being that print was simply the oldest technology available and the material is relatively easy to prepare, duplicate and revise, while at the same time is easy to use and does not require any special kind of technologies to be viewed. The disadvantages of print are that audio and video cannot be represented while at the same time there is no interaction or feedback since print material is passive and self-directed. Examples of print include textbooks, handouts and syllabi.

- **Computers**

Computers are very useful tools in distance education. They have the ability to integrate print, audio, video and interactivity (Maier, 1998). Using computers has many advantages. As mentioned before, computers can integrate audio, video and print. They are interactive and can increase national or local access by the use of networks. Another advantage is that the users can set their own learning-pace when using computers for learning.

Constantly advancing and changing technologies promise many innovations but on the other hand could also be a disadvantage when trying to stay current. Other limitations include high software and network costs. Table 2.1 shows the four types of computer applications used in distance education with examples of their uses.

Table 2.1: Distance learning applications and examples (Maier, 1998)

Computer Applications	Examples
Computer Managed Instruction (CMI)	Grading tests, monitoring student progress
Computer Assisted Instruction (CAI)	Tutorials, games, simulations
Computer-Based Multimedia	PowerPoint Presentations, Flash and Shockwave productions, video clips
Computer Mediated Communication (CMC)	Email, bulletin boards, fax, online chatting, audio-conferencing, video-conferencing

- **The Internet**

The Internet is currently a widely used medium for distance education (Taylor, 2002). It automatically integrates all the previously mentioned computer features into a 24/7 globally accessed medium. Email, bulletin boards, chatting, dialogues, newsgroups, research, and interactive conferencing are all easily available with the Internet. Many courses are now offered online through a website. WWW is very important because it enables the teacher to include content like course information, assignments, tests, and lecture notes, and allows communication with the students either by email or live conferencing. Online materials also include journals, articles, databases, software libraries, past examination papers, FAQs and notice boards.

- **Interactive video-conferencing**

Interactive video-conferencing uses multimedia elements, digital cameras and microphones to capture video and sound and transmit it live real time to other users who will receive it using their display units and speakers (Maier, 1998). . When both sides have the necessary equipment two-way communication can occur making the video-conferencing an interactive

process (Oliver, 1994). Wider uses of this technology can have multiple users and facilitate meetings or classrooms where the teacher and students are all connected from their homes. The main benefit of interactive video-conferencing is that being at the same location is no longer a restraint for having real time visual communication. Other benefits include access to people in different geographical parts of the world, and the ability to include multimedia aspects during the conferencing. The biggest drawback of interactive video conferencing is the high prices for the equipment and connections. At the moment not many people have both the correct equipment and connection speeds to be able to carry out interactive video-conferencing.

2.2.3 Key Players in e-Learning

There are four key players in distance education. These are:

- the **instructor** whose role is to provide the content while at the same time take into consideration the diverse audiences (DLBOIS, 2002). The instructor should have a good knowledge and understanding of the technologies and delivery methods and should provide feedback to the students.

- the **students** whose role is to learn (Behnke, 2003). Since the students will not have face-to-face interactions with the instructors and other students, they must learn to use the technologies which try to bridge this gap.

- the **facilitator** whose role is to link the instructor with the students. The facilitator must understand the students and the instructor's expectations

and "follow the directive established by the teacher" (Distance Education: An overview, 2002).

- **support staff and administrators.** Support staff handle tasks such as student registration and grading, distribution of the material and copyright issues, while the administrators make sure that the technology is used efficiently to meet the students' and academic institutions' needs (DLBOIS, 2002).

2.3 Computer Aided Language Learning (CALL)

This section's main objective is to provide a thorough introduction to Computer Assisted/Aided Language Learning (CALL) and talk about the evolution of CALL and its future directions. The reason I have chosen to focus on CALL is because communication is vital for language learning and it plays a positive role in the language learning process (Blake, 2005; Harrison et. Al, 2002; van Lier, 1998). The section starts by providing the definitions of CALL and associated relevant terms. Then, an existing CALL methodological framework is presented and discussed. This is followed by an overview of the history of CALL and its current state by citing some representative examples of its uses and discussing advantages and disadvantages of current CALL systems.

Computer Assisted Language Learning (CALL) was the expression agreed upon at the 1983 TESOL (Teachers of English to Speakers of Other Languages) convention in Toronto (Chapelle, 2001), although many academics and researchers very often refer to it as Computer Aided Language Learning.

CALL can be thought of as the use of computers to help learn languages (Laghos and Zaphiris, 2005b). Gamper and Knapp (2002, pp. 329), further define CALL as "a research field which explores the use of computational methods and

techniques as well as new media for language learning and teaching" and Levy (1997) as "the search for and study of applications of the computer in language teaching and learning" (pp. 1). CALL falls under the broader category of Computer Aided Learning (CAL). More specifically CALL is the type of CAL that deals exclusively with Learning Languages.

There are a few other acronyms and terms that are either related to CALL or are specific applications of it. Examples include Network-based language teaching (NBLT), Computer Applications in Second Language Acquisition (CASLA) and Computer-Assisted Second Language Research (CASLR). Specific examples of CALL tools and utilities include games, tests, exercises and word processing and their use in a CALL session is determined by the syllabus, software, teacher or learner.

The popularity of CALL is constantly increasing as multimedia developments and technology are advancing. In the last few years CALL systems are becoming fully integrated with audio and video support creating interesting and attractive presentations. With the internet emerging, a new platform for CALL systems has evolved. Thus, there has been a move from CD-ROM based CALL to online CALL enabling more connectivity and interactivity with other students or teachers. Important examples of why CALL has moved to web-based mediums include the ability to carry out audio and videoconferencing, use chat-rooms and email and communicate with native speakers of the language.

2.3.1 CALL Methodology

As Hubbard (1996) points out, the question for many language teachers now seems to be not whether but how computers can aid in the language learning

process. The use of computers in language acquisition is becoming common practice, a challenge for research and a business opportunity.

In 1987 Hubbard stated that 'courseware reviews commonly focus on technical considerations, sometimes at the expense of language teaching and learning considerations'. He proposed a design/development Framework for CALL (Figure 2.3) which synthesizes the previously developed frameworks of Philips (1985) and Richards and Rodgers (1982). Key players in Hubbard's (1987) framework are the learner, the developer, the evaluator and the teacher. Hubbard's methodology consists of three modules: Development, Evaluation and Implementation, in which 'development necessarily precedes evaluation while both development and evaluation precede implementation'. Furthermore in this framework, an integral approach to evaluation, development and implementation is followed where 'evaluation can inform development and implementation experiences can inform both development and evaluation' (Hubbard, 1996, pp 20).

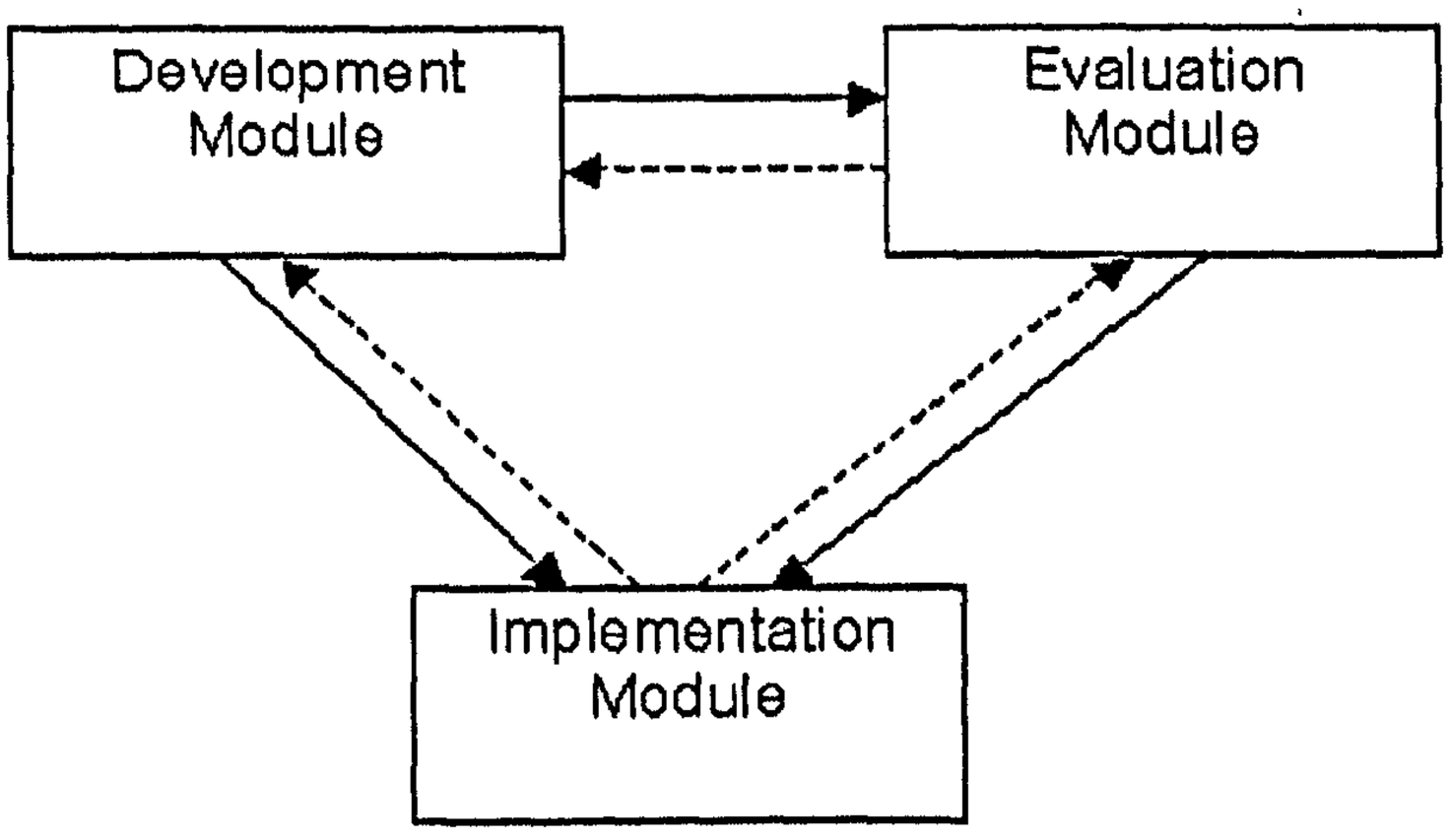


Figure 2.3: CALL design/development Framework (Hubbard, 1996)

Development Module

Figure 2.4 shows Hubbard's Development Module which consists of three sections: Approach, Design and Procedure. In the approach section 'linguistic

assumptions' and 'learning assumptions' are the two principal determining elements. The two fundamental components of the design section are the 'learner profiles' and the 'syllabus'. Finally, the Procedure section of the development model contains the elements to be considered in the actual layout of the program that presents the materials (Hubbard, 1996).

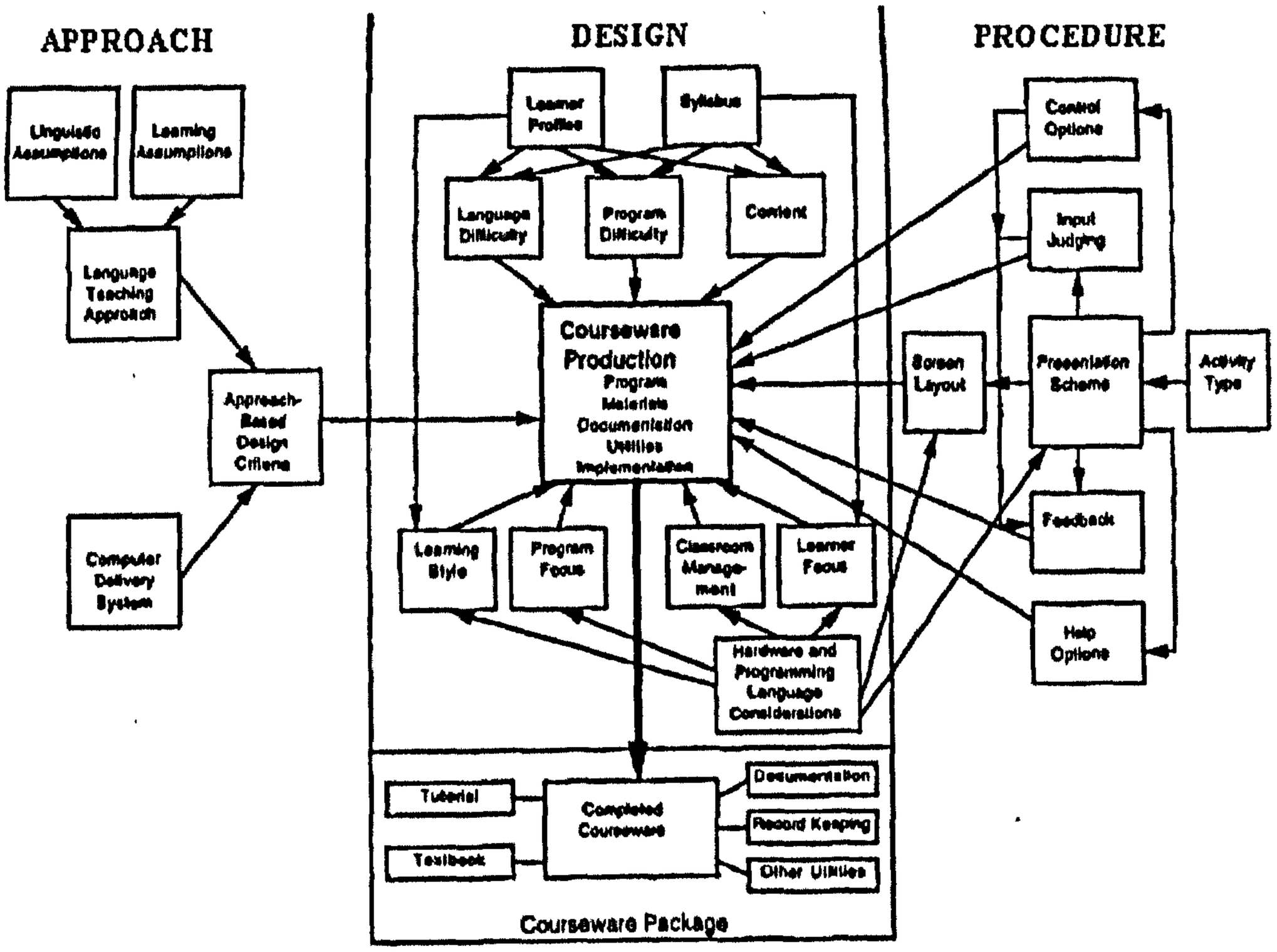


Figure 2.4: Development Module (Hubbard, 1996)

Evaluation Module

The evaluation module (Figure 2.5) is made up of three sections: Teacher fit (approach), learner fit (design) and operational description (procedure). This module focuses on pedagogical issues like learning style, teaching approach and linguistic assumptions (Hubbard, 1996). Although not addressed by Hubbard, one can assume that the evaluation module can also contain elements of usability evaluation of the CALL system.

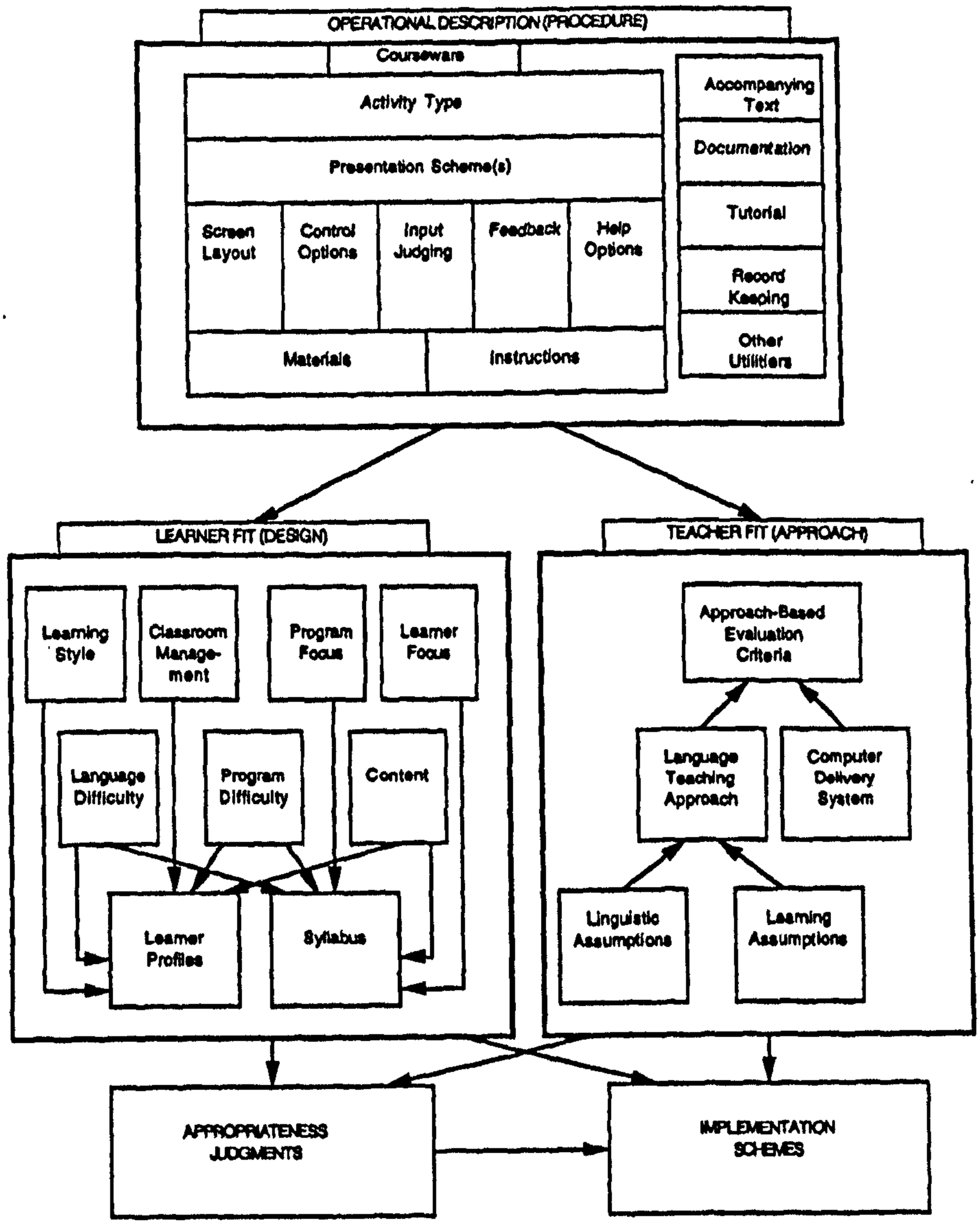


Figure 2.5: Evaluation Module (Hubbard, 1996)

Implementation Module

The implementation module (figure 2.6) is constituted by the areas to be considered for the implementation such as accessibility, the flow of a CALL lesson, learner use of courseware and teacher control. Hubbard (1996) states that "The two aspects of particular note are the central role of teacher control in learner use and the importance of supporting preparatory and follow-up activities."

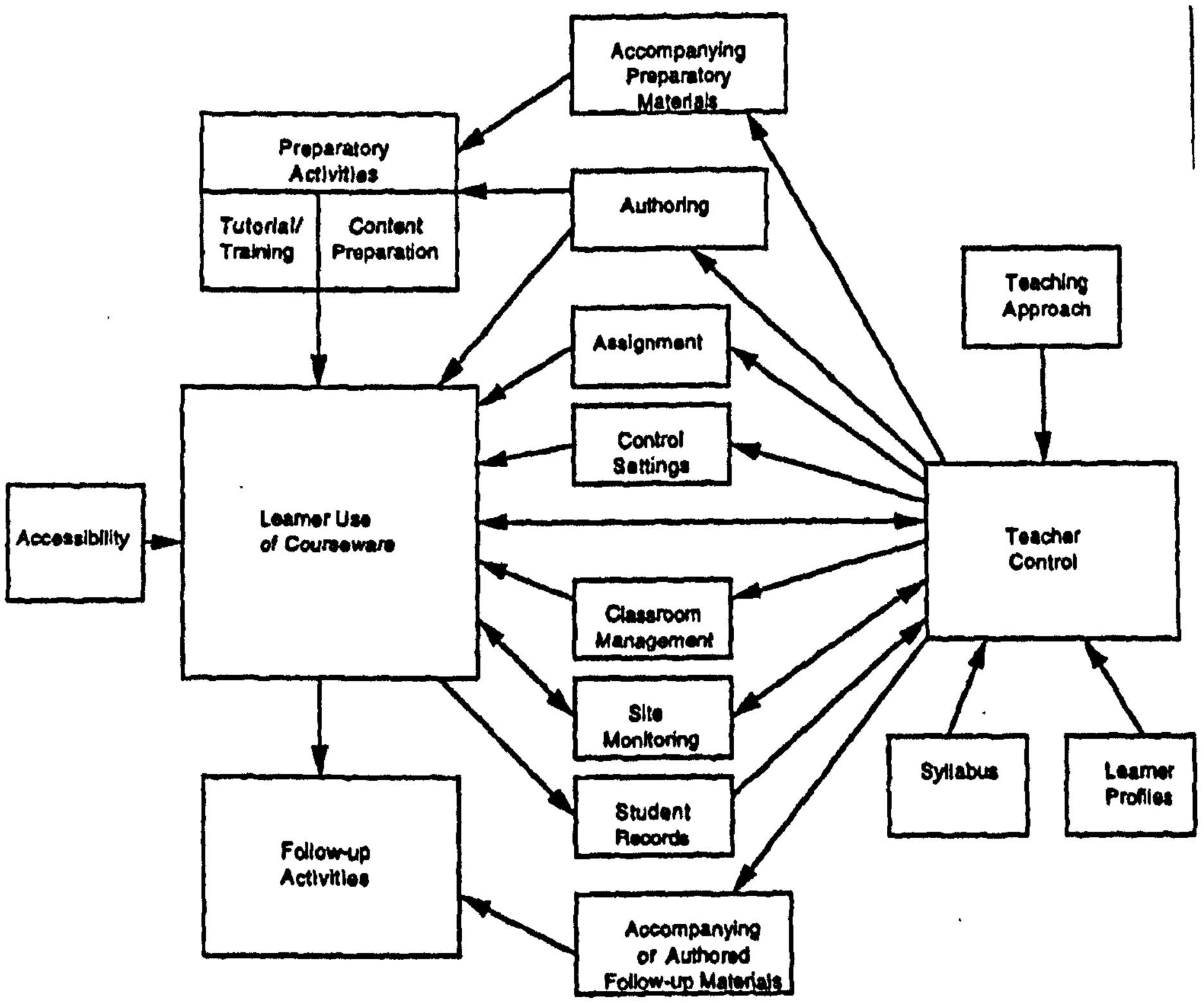


Figure 2.6: Implementation Module (Hubbard, 1996)

2.3.2 History of CALL

This section provides a historical perspective of Computer Assisted Language Learning. The current applications and future directions of CALL research are discussed. It is my belief that as new technologies are created, CALL will also continue to evolve creating new and intelligent interfaces that will make the language learning process more enjoyable and efficient. The earliest applications of CALL date back to the 60's. Warschauer and Healey (1998) divide the history of CALL into three stages:

Behaviorist CALL – was implemented in the 60's and 70's and could be considered a sub-component of the broader field of computer-assisted instruction. Informed by the behaviorist learning model (Kern & Warschauer, 2000), this mode of CALL featured repetitive language drills, referred to as drill-and-practice.

Communicative CALL – emerged in the late 70's and early 80's. It was also during this time that behaviorist approaches to language teaching were being rejected at both the theoretical and pedagogical level, and new personal computers were creating greater possibilities for individual work. "Proponents of communicative CALL stressed that computer-based activities should focus more on using forms than on the forms themselves, teach grammar implicitly, allow and encourage students to generate original utterances rather than just manipulate prefabricated language, and use the target language predominately or even exclusively (Jones & Fortescue, 1987; Phillips, 1987; Underwood, 1984; Warschauer & Healey, 1998, pp. 57)

Integrative CALL – emerged in the late 80's and early 90's while critics pointed out that the computer was still being used in an 'ad hoc and disconnected fashion'. Warschauer (1996), terms integrative CALL as a perspective which seeks both to integrate various skills (e.g. listening, speaking, reading and writing) and also integrate technology more fully into the language learning process.

2.3.3 CALL Today

Today CALL is more popular than it has ever been. Multimedia developments and technological advancements have given CALL systems the opportunity to be fully integrated with graphics, videos and sounds. The Internet provides a new delivery medium and connects people from all around the world in virtual learning environments. Currently there are three main applications of CALL systems available (Laghos & Zaphiris, 2005d): Multimedia CALL, Web-based CALL and Online CALL.

Multimedia CALL

Multimedia CALL systems have emerged as multimedia elements like audio became more readily available. Sound support is extremely important for language learning. The delivery medium for multimedia CALL is usually a standalone CD-ROM disk. The pros of multimedia CALL lie in the attractive presentation of the material (sound, video etc) and the users' increased interactivity with the computer in the learning process. This main disadvantage of CD-ROM based CALL systems is the lack of connectivity and interactivity with other students or teachers.

Web-based CALL

Web-based CALL systems take advantage of Web Browsers. They are usually written using HTML code or other hypertext authoring programs. Like multimedia CALL, Web-based call systems are usually delivered on CD-ROM, corporate intranets, or can be downloaded from the Internet. The advantages of web-based CALL systems - when they can be run online - are vast and are discussed in the next section "Online CALL". The disadvantage is that some web-based CALL systems are designed to be run offline which once again isolate the learner from other people who speak the language.

Due to the increasing popularity of the Internet and the use of multimedia, there has been a recent move of CALL systems from CD-ROM to online ones, creating new innovative ways where people can learn and practice online.

Online CALL

Online education has been gaining public interest very quickly as universities, education centers and businesses see it as an opportunity for cost savings and higher productivity. With the continuously growing community on the Internet, a new medium for Computer Aided Language Learning (CALL) systems has evolved. This medium provides new opportunities as well as gaps for learning foreign languages.

Online CALL is today's most successful example of CALL applications. By being online the learners not only take advantage of the common CALL services that a computer offers (e.g. word processors, spell checkers etc) but also of what the world wide web can contribute (e.g. chatrooms, email, access to journals, online research, search for and communicate with native speakers). Online CALL is also a form of distance learning, since learning the language can be done away from classrooms (for instance at home). It is also a form of e-learning since it can be delivered electronically from the internet.

The Internet has also brought us virtual classrooms. Audioconferencing and videoconferencing can connect people from any part of the world with a 'fast' internet account, a microphone, speakers and webcam. The idea of virtual classrooms is an online representation of a normal class room, where the students and teachers can see each other and talk to and hear each other. Videoconferencing eliminates the need for all the people to be in the same place. People currently use videoconferencing and virtual classrooms as a means of interacting verbally with native speakers of the language. Online CALL is also

very important for teachers since they can use videoconferencing to conduct a class from a distance.

The main disadvantage of online CALL however is that of network congestions since some of the aspects of CALL (like audioconferencing, videoconferencing, streaming content) are bandwidth demanding and although broadband prices have gone down, not that many people have these connections.

2.3.4 Future of CALL

The future of CALL looks promising. There are examples of CALL systems today that we could not even think of years ago. In the same way, and due to the largely increased interest in CALL research and applications, in the future there will probably be CALL systems available with functionality that at the present either seem unattainable or unrealistic. In the next sections I discuss two elements related to the present and the immediate future of CALL.

2.3.5 Computer-Assisted Language Testing

Computer-assisted language testing (CALT) can be defined as "an integrated procedure in which language performance is elicited and assessed with the help of a computer" (Niojons, 1994). Like CALL, CALT is a relatively new field, but interest in this area has increased significantly in the past few years. A very common example of the use of CALT is for multiple-choice questions. If the testing system is designed and implemented correctly, then the results of the computer testing will be immediate and without errors, whereas if multiple-choice questions are corrected by people, there is always the possibility of human

error, and the process is a lot lengthier and time consuming. CALT systems can be used for reading tests, listening tests, and writing tests. Games can also be used as CALT systems. For example, hangman is a great word game and is fun and engaging. It is important, however, for CALT programs to provide the learners with clear and accurate feedback results. One of the most successful CALT systems is the one used for the TOEFL (Test of English as a Foreign Language) exams. The TOEFL is taken worldwide by nearly a million people each year. It is an important test since the results determine whether students are to be accepted into many U.S. universities. TOEFL used to be a "pen-and-pencil" exam, but since 1998 it has become, and still is, a computer based exam taking advantage of CALT. CALT will continue to play a vital role in the future of computer-assisted language learning.

2.3.6 Intelligent CALL

Intelligent computer-assisted language learning (ICALL) has already started to be implemented. ICALL explores the use of artificial-intelligence (AI) methods and techniques for language learning (Gamper & Knapp, 2002). The following is a brief description of a few AI techniques that are starting to be used in CALL systems.

Speech Recognition

Speech-recognition technologies have reached the stage where CALL learners can talk into a microphone and have their pronunciation and fluency tested, giving them results on their progress. One such CALL software that takes advantage of speech recognition technologies is the Tell Me More Education ® packages (http://www.auralog.com). In the future, speech recognition will reach the stage where a conversational

mode can exist between the learner and the computer, just like the learner would have in a conversation with a living person.

Expert Systems

Expert systems work by storing large amounts of knowledge about language learning. This knowledge includes questions and answers, typical mistakes, and learning strategies. It is then used to analyze the learners' interaction with the computer and produce detailed feedback. Other AI techniques for CALL include machine translation (e.g., Babel Fish Translation®; http://babelfish.altavista.com) and intelligent tutoring systems (e.g., personalized learning environments).

2.3.7 Section summary

In this section CALL was introduced. I discussed a CALL methodology and also provided a historical perspective of CALL. As Ahmad et al. (1985) pointed out CALL arose from the combination of two separate factors: educational needs and technological means. The constant advances in technology are creating new and exciting opportunities for the delivery of CALL systems. However, one must not focus solely on the technology side of CALL. Pedagogical issues are also extremely important for a successful language learning process. With both pedagogy and technology together as the focus of CALL research, the final systems implemented will more accurately meet the language-learning educational needs by providing a plethora of language-learning activities.

Today CALL is more popular than it has ever been. The Internet and the World Wide Web have provided us with delivery methods that have created language-learning opportunities that were unimaginable a few decades ago. Videoconferencing has given us virtual classrooms. The future of CALL is very

bright and the field is continually gaining interest. Intelligent CALL includes techniques like speech recognition to test the learner's pronunciation and accent.

2.4 Computer Mediated Communication

One of the most important characteristics of the Internet is the opportunities it offers for human-human communication through computers and networks. As Metcalfe (1992) points out, communication is the internet's most important asset and e-mail is the most influential aspect. E-mail is just one of the many modes of communication that can occur through the use of computers. Jones (1995) points out that through communication services like the Internet, Usenet and bulletin board services that are electronically-distributed, almost instantaneous, written communication has for many people supplanted the postal service, telephone, even fax machine. All these applications where the computer is used to mediate communication are called Computer-Mediated Communication (CMC). Metz (1994) states that CMC has been in existence since 1969, and provides a general definition of CMC as "any communication patterns mediated through the computer." (pp. 32). December (1997, pp.1) defines CMC as "a process of human communication via computers, involving people, situated in particular contexts, engaging in processes to shape media for a variety of purposes."

CMC is a broad area and it is more accurately defined by its specific applications. In my study I am focusing on Internet-based CMC and December (2004) has provided a definition of CMC that is oriented to this particular context:

"Computer-Mediated Communication (CMC) is the process by which people create, exchange, and perceive information using networked telecommunications systems (or non-networked computers) that facilitate encoding, transmitting, and

decoding messages. Studies of CMC can view this process from a variety of interdisciplinary theoretical perspectives by focusing on some combination of people, technology, processes, or effects. Some of these perspectives include the social, cognitive/psychological, linguistic, cultural, technical, or political aspects; and/or draw on fields such as human communication, rhetoric and composition, media studies, human-computer interaction, journalism, telecommunications, computer science, technical communication or information studies" (December, 2004, pp.1).

Figure 2.7 shows the historical development of CMC from the research and development stage in the 1960's through to the Commercialization of CMC in the mid-1990's.

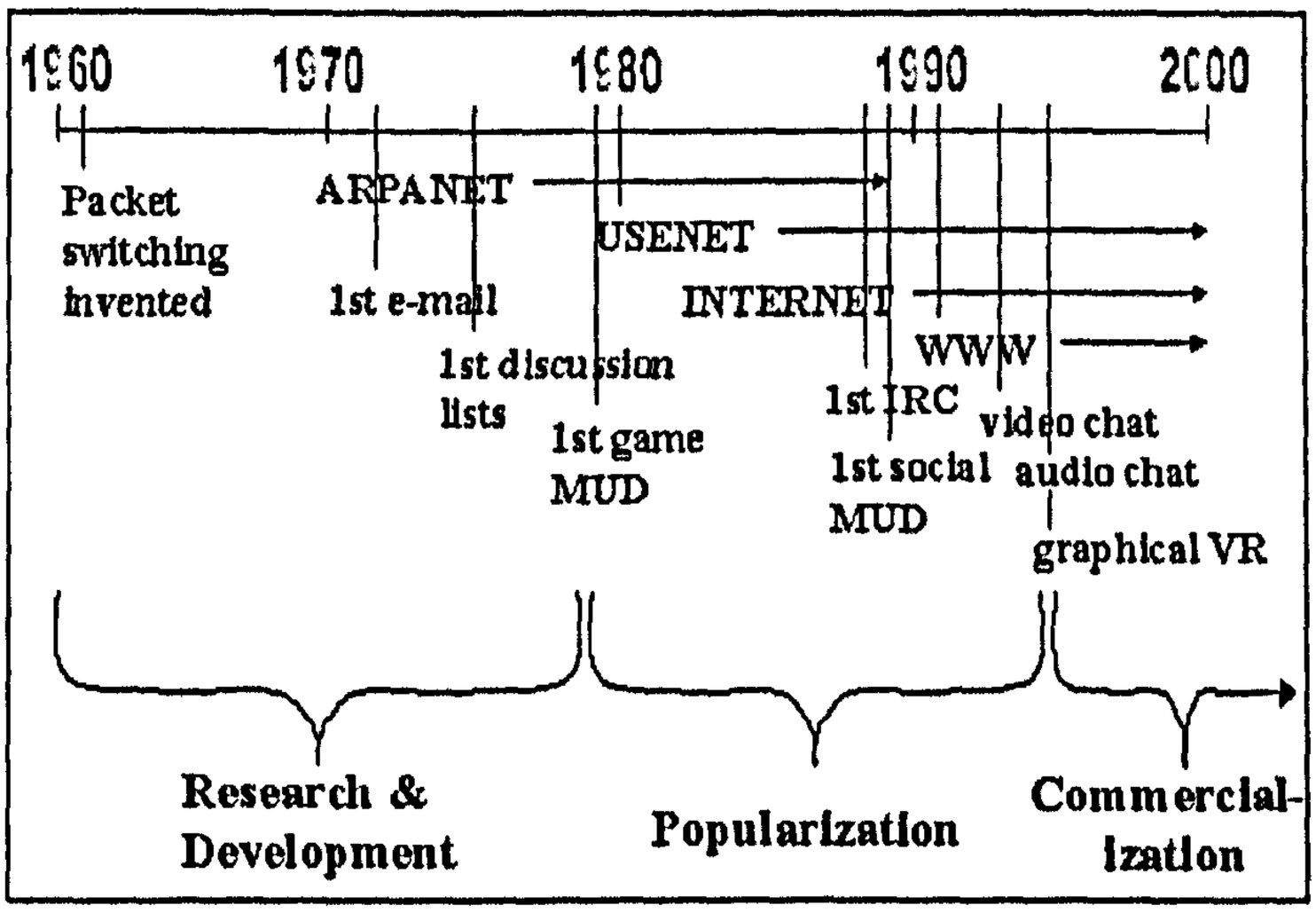


Figure 2.7: History of computer networking and CMC (Herring, 2001).

Examples of CMC include asynchronous communication like email and bulletin boards; synchronous communication like chatting; and information manipulation, retrieval and storage through computers and electronic databases (Ferris, 1997). Table 2.2 shows the main types of CMC, their mode (synchronous or asynchronous) and the type of media they support (text, graphics, audio, video).

Table 2.2: CMC systems, modes, and types of media that they support

Type of CMC	Communication Mode	Supports			
		Text	Graphics	Audio	Video
Audio conferencing	Synchronous	Some applications	No	Yes	No
Video conferencing	Synchronous	Yes	Yes	Yes	Yes
IRC	Synchronous	Yes	as attachments	as attachments	as attachments
MUD	Synchronous	Yes	No	No	No
WWW	Sync & Async	Yes	Yes	Yes	Yes
E-mail	Asynchronous	Yes	as attachments	as attachments	as attachments
Newsgroups/BBS	Asynchronous	Yes	No	No	No
Discussion Boards	Asynchronous	Yes	as attachments	as attachments	as attachments
Voice mail	Asynchronous	Some applications	No	Yes	No

CMC has its benefits as well as its limitations. For instance, a benefit of CMC is that the discussions are potentially richer than in face-to-face classrooms (Scotcit, 2003), but on the other hand, users with poor writing skills may be at a disadvantage when using text-based CMC (Scotcit, 2003). Furthermore. asynchronous discussions allow for "reflective study followed by complex exchanges and genuine collaboration in the application of theory" (Sumner & Dewar, 2002, pp1). Table 2.3 summarizes the advantages and disadvantages of CMC.

Table 2.3: Advantages and Disadvantages of CMC (Scotcit, 2003)

Advantages of CMC
• Time and place independence • No need to travel to the place of learning • Time lapse between messages allows for reflection • Speakers of other languages have added time to read and compose answers • Questions can be asked without waiting for a 'turn' • It allows all students to have a voice without the need to fight for 'airtime', as in a face-to-face situation • The lack of visual cues provides participants with a more equal footing • Many to many interaction may enhance peer learning • Answers to questions can be seen by all - and argued • Discussion is potentially richer than in a face to face classroom • Messages are archived centrally providing a database of interactions which can be revisited • The process of learning becomes more visible to learners and tutors
Disadvantages of CMC
• Communication takes place via written messages so learners with poor writing skills may be at a disadvantage • Paralinguistic cues (facial expression, intonation, gesture, body orientation) as to a speakers' intention are not available, except through combinations of keystrokes (emoticons) or the use of typeface emphasis (italics, bold) • Time gaps within exchanges may affect the pace and rhythm of communications leading to a possible loss in textual coherence • The medium is socially opaque; participants may not know who or how many people they may be addressing • The normal repair strategies of face-to-face communication are not available and misunderstandings may be harder to overcome • Context and reference of messages may be unclear and misunderstandings may occur

When it comes to website designers, choosing which CMC to employ (for instance, forum or chat-room) is not a matter of luck or randomness. The determining factor when selecting a CMC is whether the communication should be synchronous or asynchronous. In the case of e-Learning, the choice of the appropriate mode of CMC will be made by asking and answering questions such as (Bates, 1995; CAP, 2004; Heeren, 1996; Resier & Gagne, 1983):

- Are the users spread across time zones?
- Can all participants meet at the same time?
- Do the users have access to the necessary equipment?
- What is the role of CMC in the course?
- Are the users good readers/writers?
- Are the activities time independent?
- How much control is allowed to the students?

2.5 Online Communities

Through the use of CMC applications, online communities emerge. As Korzeny pointed out even as early as 1978, the new social communities that are built from CMC, are formed around interests and not physical proximity (Korzeny, 1978). CMC gives people around the world the opportunity to communicate with others who share their interests, as unpopular as these interests may be, which does not happen in the 'real' world where the smaller the interest in a particular scene is, the less likely it will exist. This is due mainly to the internet's connectivity and plethora of information available posted by anyone anywhere in the world.

The term online community is multidisciplinary in its nature, means different things to different people, and is slippery to define (Preece, 2000). The relevance

of certain attributes in the descriptions of online communities, like the need to respect the feelings and property of others, is debated (Preece, 2000). Online communities are also referred to as cyber societies, cyber communities, web groups, virtual communities, web communities, virtual social networks and e-communities among several others.

For purposes of a general understanding of what virtual communities are, Rheingold's definition is presented. "Virtual communities are social aggregations that emerge from the Net when enough people carry on those public discussions long enough, with sufficient human feeling, to form webs of personal relationships in cyberspace" (Rheingold, 1993, pp.5). Rheingold further expands this definition by defining the Net as "an informal term for the loosely interconnected computer networks that use CMC technology to link people around the world into public discussions", and cyberspace as "the conceptual space where words, human relationships, data, wealth, and power are manifested by people using CMC technology"(1993, pp.5).

Due to the internet and its related technologies, the population of these cyber communities is global. The emergence of the so-called "global village" was predicted years ago as a result of television and satellite technologies by McLuhan (1964), although it is argued by Fortner (1993) that "global metropolis" is a more representative term (Choi & Danowski, 2002). It is estimated that as of September 2002 there are 605.60 million people online (Nua Internet Surveys, 2004). If one takes into account that the estimated world population of 2002 was 6.2 billion (U.S Census Bureau, 2004), then the online population is nearly 10% of the world population. In most online communities, time, distance and availability are no longer disseminating factors. Given that the same individual may be part of several different and numerous online communities, it is obvious why more and more online communities keep emerging and increasing in size. There are many reasons that bring people

together in online groups. These include hobbies, ethnicity, education, beliefs and just about any other topic or area of interest. Wallace (1999) points out that meeting in online communities eliminates prejudging based on someone's appearance, and thus people with similar attitudes and ideas are attracted to each other.

Preece (2002) states that an online community consists of people, a shared purpose, policies and computer systems while identifying the following member roles:

- Moderators and mediators: who guide discussions/serve as arbiters
- Professional commentators: who give opinions/guide discussions
- Provocateurs: who provoke
- General Participants: who contribute to discussions
- Lurkers: who silently observe

With regards to online learning communities, O Murchu (2005) and McGhee and Kozma (2001) investigated the roles that students take on as a result of computer based technologies and they have identified three student roles: the self-learner, the team member and the knowledge manager.

Cyberspace is the new frontier in social relationships, and people are using the internet to make friends, colleagues, lovers, as well as enemies (Suler, 2004). This statement pretty much sums up the importance of a person being part of an online community as well as the problems that may arise.

2.6 Social Interaction Research in e-Learning

In this section I discuss research of social interaction in-Learning with the aim of gaining knowledge in what influences social interaction and how issues like collaboration and peer support can benefit the learners.

2.6.1 Factors that Influence Social Interaction

There have been several studies which investigate the factors that influence social interaction in online courses. Vrasidas and McIsaac (1999) examined a university graduate online course in the use of telecommunications for instruction. The course consisted of eight students and one professor and was supported with FirstClass and a website with course material and other resources. Their data collection included observations which were tape-recorded, interviews, student work and the teacher's mailbox messages.

Their analysis showed that four major factors influenced interaction: course structure, class size, feedback and prior CMC experience (Vrasidas & McIsaac, 1999). For course structure the authors mention that required activities and collaboration on peer editing of students' papers led to more interactions. Regarding class size, the authors concluded that there would have been more interactions in the course if there were more students enrolled in it. Furthermore, the students felt that the feedback they got in the course was not adequate, and this kept interaction levels low. Finally, the authors provide some insights into the relevance of prior CMC experience with interactivity. They found that students with no previous experience felt more comfortable using asynchronous communication where they had time to reflect on their ideas, as opposed to synchronous communication which they found hard to keep up with. Students

with prior CMC experience enjoyed both modes of communication and used emoticons more frequently.

The authors state that online interaction is solely constructed through language and suggest that educators should structure online courses for dialogue and interaction, that timely feedback should be provided to the students, and that students should be trained early in the course to use the conferencing systems and emoticons (Vrasidas & McIsaac, 1999).

In comparison to face-to-face interaction, "online interaction may be slower and 'lacking' in continuity, richness and immediacy... however in some ways online interaction may be as good or even superior to face-to-face interaction" (Vrasidas & Zembylas, 2003, p1). Group activities planned in advance can increase the feeling of social presence and learner-learner interaction (Vrasidas & McIsaac, 2000), while gaining access and status in a setting and socializing are examples of intentions that drive interaction (Vrasidas, 2002).

2.6.2 Peer Support and Student-Centered Learning

A type of interaction in online courses is peer support. "Peer support is a system of giving and receiving help founded on key principles of respect, shared responsibility, and mutual agreement of what is helpful" (Mead, Hilton & Curtis, 2001, pp140). When people find others that they feel are like them, they feel a connection and a deep understanding based on mutual experience (Mead et al, 2001).

"Student centered learning is supported theoretically by various overlapping pedagogical concepts such as self-directed learning (Candy, 1991), student-centered instruction or learning (Felder & Brent, 2001), active learning

(Ramsdenl, 1992), vicarious learning (Lee &.McKendree, 1999) and cooperative learning (Felder & Brent, 2001)" (Kurhila, Miettinen, Nokelainen & Tirri, 2004, pp. 1). Examples of contemporary ways to support collaborative learning include: awareness of others; joint building of knowledge; and matching unknown actors or resources, and these can lead to positive interdependence within the learning community as well as engagement, autonomy and independence. It is important to have tools that allow easy and straightforward ways for community members to interact with and support each other in a peer-to-peer fashion (Kurhila et al, 2004).

Online peer support occurs through the use of Computer-Mediated-Communication. The importance of students learning from their study peers is increasingly being recognized by the eLearning community. "In some instances eLearning can foster a greater degree of communication and closeness among students and tutors than face-to-face learning" (Sumner & Dewar, 2002, pp1).

Furthermore, studies show that students would prefer to contact their peer students (rather than their tutor) when they have difficulty with coursework, difficulty understanding lectures and difficulty assessing facilities (Lockley, Pritchard & Foster, 2004). Thus the peer-support is an important aspect of e-Learning in both the findings of researchers and the opinions of students (see chapter 4).

2.6.3 Collaboration and Cooperation

In a study of the modes of learning, Chi, Bassok, Lewis, Reimann & Glaser (1989) found that collaboration produces a 70% retention rate. Online courses are cited as having an average completion rate between 25% and 70% and it was

found that a key driver for completion is codependency (Chi, Bassok, Lewis, Reimann & Glaser, 1989).

It is suggested that learners should be informed of who is present in the online sessions and how the group is composed in order to recognize each other and to develop a sense of direction (Hamburg, Lindecke and Thij, 2003). The authors also emphasize the importance of e-moderators helping the students by initiating and supporting chats and online socializing, since this makes the students feel at home and more willing to contribute. Finally, they state that compared to individual and competitive learning, collaborative learning raises the students' achievement level and problem-solving activities and enhances the development of personal traits (Hamburg, Lindecke and Thij, 2003). Interaction benefits and motivates the learners and facilitates higher order learning (McLoughlin, 2004)

Some authors argue that e-learning systems do not sufficiently acknowledge the importance of the social process and rely on passive material limiting interactivity. They suggest that e-learning should be socially situated thus providing active interaction with the users (Angehrn, Nabeth & Roda, 2001). Communities of Practise (Wenger, 1998) is a theory of social learning where learning is a social process rooted in specific social context. Although there have been numerous tools developed for supporting student collaboration, the use of facilities that sustain collaborative work by students in different locations are not emphasized in their environments (Fakas, Nguyen and Gillet, 2005).

Fakas, Nguyen and Gillet (2005) proposed an Electronic Laboratory Journal (eJournal) paradigm as a collaborative and cooperative environment for Web-based experimentation in education. The eJournal provides students with the web-based tools needed to complete their assignments by discussing, exchanging, sharing and documenting information (Fakas et al, 2005). These data chunks or fragments can be objects in any format like text, graphics,

experimental results and so on. The eJournal was evaluated by facilitating a group of engineering students at the School of Engineering of the Ecole Polytechnique Fédérale de Lausanne. The authors report that the fragments created by the students contained discussions, knowledge exchange, and sharing of outcomes (Fakas et al, 2005). Furthermore, they found the students' collaboration and participation encouraging, since significant amounts of fragments were created by the students (Fakas et al, 2005).

2.6.4 Interaction and Learning

Studies show that interaction is a fundamental process for learning (Vygotsky, 1978, Vrasidas, 2000; Dewey, 1938) and knowledge is constructed in communities of practice through social interaction (De Angeli, Sue, 2005). Social problems affecting online communities include social loafing which leads to low participation rates, disinhibited behaviour (like flaming and abuse), and diffusion of responsibility. A solution to this is the presence of a moderator who can reduce the antisocial behaviours that are triggered by anonymity (De Angeli, Sue, 2005). In addition, the authors believe that the sense of community is greatest for the student when there is a sense of connectedness with the course, and it is engendered by both social and learning dimensions (De Angeli, Sue, 2005). They also note that people who interact more in an online course tend to achieve higher marks at exams, as opposed to lurking which is not as successful (De Angeli, Sue, 2005).

Furthermore, learners perceive the content of communication as an information source (Aviv, 2000). The Social Interdependence Theory of Cooperative Learning (Johnson & Johnson, 1999) suggests that the way social interdependence is structured determines how individuals interact, which in turn determines their learning outcomes. Cooperative experiences promote greater

social support than competitive or individualistic efforts (Johnson & Johnson, 1999), while stronger effects exist for peer support than for superior (teacher) support (Aviv, 2000).

2.6.5 Section Summary

Studies have shown that interaction is influenced by four major factors: course structure, class size, feedback and prior CMC experience. In addition it has been identified that students prefer to contact their peer students rather than their tutor when they have difficulties with the online lessons. Student collaboration is seen to produce high retention rates, and online interaction with fellow peers has been linked with greater learning outcomes. These findings stress the importance of students interacting with each other when taking part in online learning courses.

2.7 Social Interaction Research in CALL

While the design of CALL interfaces has become easier, its development must better harness new technology, build on its knowledge of users, and be receptive to their needs (Hemard & Cushion, 2001). By using the Participatory Design methodology when developing the courses, users are said to be more motivated, committed and satisfied with the systems (Zaphiris & Zacharia, 2002). Furthermore, enhancing the way people communicate, interact and work is a key principle for usability (Kukulska-Hulme and Shield, 2004).

The sections that follow discuss the integration of CMC technology into Language Learning environments and their outcomes. In addition, the benefits of Social Interaction with native speakers are addressed.

2.7.1 Interaction and Language Learning

Linguistic Interactions play a positive role in Second Language Acquisition (SLA) (Blake, 2005). Human Interactions like the negotiation of meaning and pair work are examples of constructs that stimulate the process of SLA. CMC is at the forefront of the techniques promoting collaborative exchanges which make language learning engaging (Blake, 2005). The author also believes that at the beginning levels of foreign language learning "the aymmetric power relationship between the teacher (a.k.a. the all knowing expert) and the rank beginner can also pose a significant deterrent to the necessary interactions that prime the SLA pump, over and beyond the usual leaning barriers engendered by worry over public embarrassement" (Blake, 2005, pp. 508). Moreover, he states that CMC stimulates linguistic interactions in a way which produces similar benefits to the ones generated by face-to-face collaborations and gives the example of students carrying out intensive practise both in writing and in speech. However the author mentions that CMC is not an activity that comes naturally to students and they should be trained in its use, but emphasizes the fact that "in an exclusively distant language-learning course, CMC is one of the only channels available to establish the type of human interactions that help motivate us all to learn (Blake, 2005, pp509)".

Another study explored the relationship between pupils' use of ICT and their performance at GCSE. From a total of 700 questionnaire responses, the greatest difference in mean performance was found between students in modern foreign languges, with the students having a high ICT usage greatly outscoring those with low ICT usage (Harrison et. Al, 2002).

In 1998 van Lier looked at the relationship between consciousness, language learning, and social interaction and argues that consciousness and interaction are integral parts of the human ecology (van Lier, 1998). "Language, especially in

the form of social interaction, is related to consciousness and learning [and] our interactions with others constantly provide pedagogical moments or learning oppurtunities" (van Lier, 1998, pp.128). Finally he suggests that teachers should allow learners to be "perceiving, thinking, acting and interacting persons, rather than passive receivers of knowledge" (van Lier, 1998, pp.128).

2.7.2 Interaction with Native Speakers

Long and Robinson (1998) point out that "A crucial site for language development is the interaction between learners and other speakers" (pp. 22). Studies show that communication with native speakers and the culture of the target language contribute to language learning (Becta, 2004). There is a high value of establishing links with schools abroad for email exhanges and videoconferencing and when planned thoroughly these can bring a real and rich experience for the language learners (Becta, 2004). On the other hand, when synchronous CMC takes place in real time as written conversation, it can lack the verbal and visual cues of spoken discourse (Simpson, 2005).

Hadley Wood Primary School gave its children penpals and introduced them to ICT projects that would help them communicate in a different language. The outcomes of this project were that the children had a purpose for learning, which raised their levels of enthusiasm and motivation, and also increased their confidence and sense of achievement (TeacherNet, 2006).

Lee (2004) investigated learners' perspectives on networked collaborative interaction with native speakers of Spanish in the US. She found that this collaboration assisted the non-native speakers in composing meaning (ideas) and form (grammar). She also notes, that the students perceived that "open-ended questions for two-way exchange were meaningful for them because they were encouraged to use specific vocabulary and structures during the discussions"

(Lee, 2004, pp83). Finally, she concludes that learners' language proficiency, computer skills, and age differences may lingustically and socially affect students' motivation and the quality of online negotiation (Lee, 2004).

Blyth (2001) carried out a study of email communication to support the teaching and learning of modern foreign languages between year 9s in an English and German school. She found that maintaining email contact in the target language was beneficial for the students' target language writing skills, while their partners feedback enhaced their vocabulary and accuracy. Furtheremore, due to the fact that the email recipients were native speakers, this motivated some of the pupils to raise their writing standard to try and write at a similar level as them (Blyth, 2001).

A study by Leh investigated the difference of language performance of participants who used e-mail and those who did not, in foreign language learning (Leh, 1999). Both groups had the same instructor and were taught on the same days. The email group would communicate with students in Mexico in Spanish for 10 weeks, and although not required to do so, they were encouraged to communicate with their pen pals. The authors' findings were that CMC motivated the learners and fostered learning while the messages exchanged between them were warm and friendly and many of the students became friends. In addition, the participants had a strong desire to continue using CMC even after the study was completed (Leh, 1999).

2.7.3 Section Summary

Social and linguistic interactions have been shown to play a positive role in learning languages. Studies in language learning report that the students who used CMC during their learning benefited in their writing skills and vocabulary. In addition, studies have shown that interaction with native speakers contribute

highly to language learning. These findings show that interaction and communication are both very important when learning languages.

2.8 Existing CMC Analysis methods

In this section I present the literature review on current methods for analyzing CMC activity. This was done in order to find out what the existing methods are, identify their characteristics, benefits and limitations, and investigate whether or not they are applicable to e-Learning environments and especially for the evolution of social networks in e-Learning environments. As mentioned earlier, the Internet plays a vital role in socially connecting people worldwide (Laghos & Zaphiris, 2005a). The virtual communities that emerge have complex structures, social dynamics and patterns of interaction that must be better understood. Through the use of CMC we are provided with a richness of information and pools of valuable data ready to be analysed (Laghos & Zaphiris, 2005b).

There are various aspects and attributes of CMC that can be studied. For instance, the formation of social networks and their characteristics, including density, centrality, cores and cliques (Laghos & Zaphiris, 2005c). An approach to this is called Social Network Analysis (SNA) (Laghos & Zaphiris, 2006b; Wellman, 1997; Scott, 2002; Wasserman et. al, 1994). Three important and widely used types of CMC analysis are Content Analysis, Human-Human Interaction Analysis, and Human-Computer Interaction Analysis and are further explained in the next sections.

2.8.1 Content Analysis

Content analysis is a social science methodology where recorded human communications are studied (Babbie, 2004). It is a technique for compressing

many words of text into fewer content categories (Stemler, 2001; Weber, 1990). There have been several frameworks created for studying the content of messages exchanged in CMC. Examples include work from Archer, Garrison, Anderson and Rourke (2001) and McCreary's (1990) behavioural model which identifies different roles and uses these roles as the units of analysis. Furthermore, in Gunawardena, Lowe, and Anderson's (1997) model for examining the social construction of knowledge in computer conferencing, five phases of interaction analysis are identified:

I. Sharing/Comparing of Information;
II. The Discovery and Exploration of Dissonance or Inconsistency among Ideas, Concepts or Statements;
III. Negotation of Meaning/Co-Construction of Knowledge;
IV. Testing and Modification of Proposed Synthesis or Co-Construction;
V. Agreement Statement(s)/Applications of Newly Constructed Meaning.

Henri (1992) has also developed a content analysis model for cognitive skills and is used to analyze the process of learning within the student's messages. Furthermore, Mason's work (1991) provides descriptive methodologies using both quantitative and qualitative analysis.

In the case of e-learning for example, a useful framework is the Transcript Analysis Tool (Fahy, 2003). The Transcript Analysis Tool (TAT) focuses on the content and interaction patterns at the component level of the transcript (Fahy et al., 2001). After a lengthy experience with other transcript tools and reviews of previous studies Fahy et al. (2001), chose to adapt Zhu's (1996) analytical model for the TAT. Zhu's model (1996) examines the forms of electronic interaction and discourse, the forms of participation and the direction of participant interaction in computer conferences. The TAT also contains echoes of Vygotskian theory, primarily those dealing with collaborative sense making, social negotiation and proximal development (Cook & Ralston, 2003). The TAT

developers have come up with the following strategic decisions (Fahy, 2001): The sentense is the unit of analysis; the TAT is the method of analysis; interaction is the criterion for judging conference success and topical progression (types and patterns) is the focus of analysis.

The TAT was designed to permit transcript content to be coded reliably and efficiently (Fahy, Crawford, Ally, 2001), while the advantages of TAT are: It reveals interaction patterns useful in assessing different communication styles and online behavioral preferences among participants; It regonizes the complexity of e-conferences and measures the intensity of interaction; It enables the processes occurring within the conferences to be noted and recorded; It probes beyond superficial systems data, which mask the actual patterns of discussion; It relates usefully to other work in the area; It discriminates among the types of sentences within the transcript; It reflects the importance of both social and task-related content and outcomes in transcript analysis research (Fahy, 2003; Fahy, 2002; Cook & Ralston, 2003; Fahy et al, 2001).

The unit of analysis of the TAT is the sentence. In the case of highly elaborated sentences, the units of analysis can be independent clauses which, punctuated differently, could be sentences (Fahy 2001). Fahy et al (2002), have concluded that the selection of message-level units of analysis might partially explain problematic results that numerous researchers have had with previous transcript analysis work. They also believe that the finer granularity of sentence-level analysis results in several advantages (Fahy, 2001; Ridley & Avery, 1979): Reliability; Ability to detect and describe the nature of the widely varying social interaction, and differences in networking pattern, in the interactive behavior of an online community, including measures of social network density and intensity; Confirmation of gender associations in epistolary/expository interaction patterns, and in the use of linguistic qualifiers and intensifiers. Table 2.4 shows the TAT categories (Fahy et al., 2001; Fahy, 2002; Fahy, 2003).

Table 2.4: TAT Categories

Category	Description and Examples	
1: Questioning This category consists of two sub-categories:	**1A Vertical Questions** These are questions which assume a "correct" answer exists, and that they can be answered if the right authority to supply it can be found. Example: "Does anybody know what time the library opens on Saturdays?"	**1B Horizontal Questions** For these questions, there may not be only one right answer. These questions invite negotiation. Example: "Do you really think mp3 files are should become illegal, or you don't see any harm by them?"
2: Statements This category consists of two sub-categories:	**2A Non-referential Statements** These statements contain little self-revelation and usually do not invite response or dialogue and their main intent is to impart facts or information. Example: "We found that keeping content up-to-date, distribution and PC compatibility issues were causing a huge draw on Ed. Centre time."	**2B Referential Statements** Referential statements are direct answers to questions. They can include comments referring to specific preceding statements. Example: "That's right, it's the 1997 issue that you want."
3: Reflections	Reflections are significant personal revelations, where the speaker expresses personal or private thoughts, judgments, opinions or information. Example: "My personal opinion is that it shouldn't have been a penalty kick."	
4: Scaffolding and Engaging	Scaffolding and engaging initiate, continue or acknowledge interpersonal interaction. They personalize the discussion and can agree with, thank or otherwise recognize someone for their the helpfulness and comments. Example, "Thanks Dave, I've been trying to figure that out for ages ☺"	
5: References/Authorities Category 5 is compromised of two types:	**5A: Quotations, references to, paraphrases of other sources.** Example, "You said, 'I'll be out of the city that day'."	**5B: Citations, attributions of quotations and paraphrases.** Example: "Mathew, P. (2001). A beginners guide to mountain climbing."

2.8.2 Human-Human Interaction Analysis

Over the years there have been several techniques by different researchers for analyzing interaction. It is important to note that the type of interaction studied in this case is interpersonal interaction, more specifically the human-human interaction that takes place through the use of CMC. Examples of Interaction Analysis models include Bale's Interaction Process analysis (Bales, 1950; Bales & Strodbeck, 1951), the SIDE model (Spears & Lea, 1992), a four-part model of cyber-interactivity (McMillan, 2002) Vrasidas's (2001) framework for studying human-human interaction in Computer-Mediated Online Environments and a technique called Social Network Analysis (SNA).

SNA has been chosen to be an integral part of my FESNeL and is explained in more detail in section 3.2.1.

2.8.3 Human-Computer Interaction Analysis

A working definition of Human-Computer Interaction (HCI) as provided by ACM SIGCHI (2002, pp. 8) is: "Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them". The focus is on the interaction between one or more humans and one or more computational machines (ACM SIGCHI, 2002). HCI is a multidisciplinary subject which draws on areas such as computer science, sociology, cognitive psychology and so on (Schneiderman, 1998). The concept of HCI consists of many tools and techniques that are used for information gathering and evaluation. Important HCI techniques include Questionnaires, Interviews, Personas and Log Analysis.

Questionnaires

A questionnaire is a self-reporting technique whereby subjects fill in the answers to questions themselves (Nielsen, 1993). Questionnaires were typically produced on printed paper, but due to recent technology and in particular the internet, many researchers engage in the use of online questionnaires thus saving time, money and eliminating the problem of a subject's distance. There are three types of questions that can be used with questionnaires: Open questions, where the participants are free to respond however they like, closed questions, which provide the participants with several choices for the answer, and scales where the respondents must answer on a pre determined scale. The purpose of a questionnaire is to elicit facts about the respondents, their behavior and their beliefs/attitudes (Nielsen, 1993). The data is first recorded and then analyzed. The main advantages of questionnaires are that they are faster to carry out than observational techniques and can cover low probability events, while the disadvantages are that information is idealized version of what should rather than what does happen, responses may lack accuracy or honesty, there is a danger of researcher bias towards subset of knowledge he/she possesses, and they must be used in conjunction with other techniques for validity.

Interviews

An interview can be defined as type of conversation that is initiated by the interviewer in order to obtain research relevant information (Preece et al., 2002). The interview reports have to be carefully targeted and analyzed to make their impact (Usability Net, 2003). Interviews are usually done on a one-to-one basis where the interviewer collects information from the interviewee. Interviews can take place by telephone and face to face (Burge & Roberts, 1993). They can also take place via non-real time methods like fax and e-mail, although in these cases

they function like questionnaires. Interviews are useful for obtaining information that is difficult to elicit through approaches such as background knowledge and general principles. There are three types of interviews (Preece et al., 1994):

Structured: (Pre-determined questions, Asked in fixed order, Like questionnaires)
Semi-structured: (Questions determined in advance and may be reordered, reworded, omitted, and elaborated)
Unstructured: (No pre-determined questions, Interview has a general area of interest, Conversation may develop freely)

The advantages of interviews (Usability Net, 2003) are that what is talked about can address directly the informant's individual concerns, mistakes and misunderstandings can be quickly identified and cleared up, more flexible than questionnaires and can cover low probability events, while the disadvantages are the danger of analyst bias towards own knowledge and beliefs, accuracy and honesty of responses, for validity must be used with other data collection techniques.

Personas

A persona is a precise description of the user of a system, and of what he/she wishes to accomplish (Cooper, 1999). The specific purpose of a persona is to serve as a tool for software and product design and although personas are not real people, they represent them throughout the design stage (Blomkvist, 2002). Personas are rich in details, include name, social history and goals, and are synthesized from interviews with real people (Cooper, 1999). The technique takes user characteristics into account and creates a concrete profile of the typical user (Cooper, 1999). Personas are typically used in the design stages of a course.

Advantages of personas are that they can be used to create user scenarios, they can be anonymous protecting use privacy and they represent the user stereotypes and characteristics, while their disadvantages are that if not enough personas are used, users are forced to fall into a certain persona type which might not accurately represent them, and they are time-consuming.

Log Analysis

A log, also referred to as web-log, server log or log-file is usually in the form of a text file and is used to track the users' interactions with the computer system they are using. The types of interaction recorded include key presses, device movements and other information about the users' activities. The data is collected and analysed using specialist software tools and the range of data collected depends on the log settings. Logs are also time stamped and can be used to calculate how long a user spends on a particular task or how long a user is lingered in a certain part of the website (Preece, Rogers & Sharp, 2002). Examples of what information can be collected include:

- When people visited the site
- The areas they navigated
- The length of the visit
- Frequency of visits
- Patterns of navigation
- Where they are connected from
- Details of the computer they are using

The advantages of logs (Preece et al., 2002) are that they help evaluators analyse users behaviour and understand how users worked on specific tasks. They are unobtrusive, and large volumes of data can be logged automatically, while their

disadvantages are that powerful tools are needed to explore and analyse the data quantitatively and qualitatively, and user privacy issues.

2.8.4 Section Summary

My findings indicate that most existing methods make either a qualitative or quantitative analysis of CMC, but rarely do we see a mixture of these techniques. Also, some methods can be used only on synchronous communication whereas others focus on the asynchronous communication that takes place. As new teaching methods and different learning activities emerge, new types of interaction and evaluation are necessary. The analysis of CMC should take all these updates into consideration, and incorporate them into future CMC analysis models. Therefore, I conclude that there is a need for a synthesis of such CMC methods into a unified framework which will take into account more aspects of the interactivity, and therefore give clearer and more concise evaluation. My opinion is that it is important that a unified framework is developed for the complete evaluation of online communication in e-Learning and therefore I have created FESNeL which is explained in the next chapter.

2.9 Conclusion

The purpose of this chapter was to give a thorough description of the key concepts of this thesis, namely: e-Learning, CALL, CMC and Online Communities. It is important to understand the characteristics and technologies surrounding these areas before attempting to analyze the way students use them. To begin with, an overview of e-Learning, along with its technologies and tools, and its key players was presented. Then, a look into the historical development and methodology of CALL was carried out since my case study (chapters 5 and

6) is a CALL course and it was necessary to see the distinct characteristics of such a course.

Furthermore, I have talked about Computer Mediated Communication and the formation of Online Communities. In addition I presented research about Social Interaction and Communication in e-Learning and CALL, including the factors that drive interaction and a number of other interaction case studies. Research has shown that CMC is important for knowledge building and this is especially important for languages since communication is a key aspect of learning a language. Finally, I have discussed the existing methods for analyzing CMC activity and have commented on their drawbacks which usually focus on a single aspect of CMC analysis omitting important e-Learning communication aspects.

Chapter 3: The FESNeL Framework

3.1 Introduction

The literature review of the current CMC analysis methods showed a lack in an overall CMC assessment addressing the need for the development of a new method. Furthermore, these findings were backed-up through personal conversations of mine with the lecturers in the department where I was studying for my PhD, as well as professors at the Universities where I obtained my BSc and MSc degrees. Such a methodological framework incorporates the two areas that I was keen to research, namely: e-Learning/CALL and computer-mediated communication. Most of the educators reported that some of their courses are administered completely or partially online, they find it hard to track students' progress, as well as their attendance/participation. Also, they find it hard to visualize the students' interactions and dynamics in the discussion boards, as they can in face-to-face lectures. Furthermore they had not found any existing methodological frameworks that could help them carry out all the aspects they wanted.

The important characteristics of the desired framework are listed below:

- Visualize the student interactions
- Obtain statistics of the student networks
- Receive student feedback about the course
- Acquire the students' learning styles
- Statistics on what topics the students talk about.

3.2 The FESNeL Framework

Individual elements of the characteristics mentioned in section 3.1 (eg. Visualizations of the students' interactions) could be obtained through the use of

some of the existing methods, however none of them had encompassed the 'ideal' framework which offered everything I was looking for. Therefore, I decided to construct a methodological framework for assessing the evolution of social networks that are formed around e-Learning Courses. Analyzing the evolution is an important aspect of my framework since these people networks continuously evolve and change over time, and therefore keeping track of the network changes will enable people who use my framework to predict how certain actions will affect their network, and to incorporate various methodologies to alter their state.

There have been some other studies that follow the evolution of social networks. For instance Holme, Edling and Lijeros (2003) who studied the structure and time-evolution of an Internet dating community. However these studies are not targeted to the analysis of the evolution of social networks in e-Learning communities. E-Learning communities have distinct characteristics (eg. their purpose is learning, students can cooperate and help each other, etc) compared to other online communities, and thus a framework specifically designed to analyze these communities is necessary.

My framework has been developed using a combination of existing methods and new methods and assesses the dynamics of the e-learning networks over the duration of a course. Thirteen different techniques were studied. In order to eliminate some models I made a table (table 3.1) with the available methods and whether or not they can be used for the purposes I require. Some of the methods could do some of the things I required, some couldn't do any of the things and not one of them was exactly what I wanted. However, several factors of a number of the methods would be very useful in creating my framework. These methods were: SNA and Questionnaires.

SNA was chosen over the other interaction methods, since it provides both a visual and mathematical analysis of the networks. SNA can be carried out for each lesson of a course in order to map the evolving structre of the social network and provide the educators with important characteristic of the netoworks like density, centrality and student cliques. Since SNA will be done at different times of the course, this will also result in a visible interpretation of the evolution of this social network during the duration of the course. Successful pilot tests were carried out using SNA (Laghos & Zaphiris, 2005c).

Table 3.1: CMC Analysis methods

Method / Author	**Type of Analysis**	**Student Feedback**	**Visualize Interactions**	**Network Statistics**	**Topic Analysis**	**Learning Styles**
Bale's (1950)	Interaction	N	N	Y	N	N
Social Network Analysis	Interaction	N	**Y**	**Y**	N	N
Spears & Lea (1992)	Interaction	N	N	Y	N	N
McMillan (2002)	Interaction	N	N	Y	N	N
Questionnaires	HCI	**Y**	N	N	N	**Y**
Personas	HCI	N	N	N	N	N
Log Analysis	HCI	N	N	N	N	N
Interviews	HCI	Y	N	N	N	**Y**
Gunawardena et al (1997)	Content	N	N	N	N	N
Henri (1992)	Content	N	N	N	N	N
Archer et al (2001)	Content	N	N	N	N	N
Fahy (2001)	Content	N	N	N	N	N

For student feedback, Questionnaires were chosen over Interviews since they are easier to administer, take less time to complete and can be filled in during the students' own time. Furthermore, questionnaire data is easier to collect and analyze. More specifically two questionnaires were chosen and these were the ATTLS and COLLES (Appendices B & C respectively). The ATTLS is a survey used to solicit information from the students regarding their attitudes towards thinking and learning, while the COLLES obtains measures of the students' perceptions of their online learning environments. A successful pilot test was also carried out using the ATTLS (Laghos & Zaphiris, 2005).

The methods studied for content analysis were not useful for the requirements of my framework. More specifically, Gunawardena et al's (1997) model examines the social construction of knowledge in computer conferencing, Henri's model (1992) is an analytical model for cognitive skills and is used to analyze the process of learning within the student's messages, Archer et al's framework (2001) is used for analyzing critical thinking in computer conferences, and Fahy's Transcript Analysis tool categorizes the sentence level of the topics corresponding to different modes of interaction (questions, statements, reflections, engaging comments, and quotations/citations). However these models do not match the characteristics of the CMC system (a threaded discussion board) that was used in my case study. For example, they do not look at the conversation topics, and do not take into account other conversations that the students have that are not related to the course, therefore, I created my own content analysis method called "Topic Relation Analysis" (TRA) (Laghos, 2005) (see section 3.3.2).

My developed framework has been given the acronym **FESNeL** standing for "Framework for assessing the Evolution of Social Networks in e-Learning" It has been developed to allow e-educators and online course instructors/maintainers to perform in-depth analyses of the communication

patterns of the students of their e-Learning courses and to follow their course CMC progression. FESNeL assess the social network of the students over the duration of the course thus mapping out the changes and evolution of these social structures over time. It is useful for monitoring the networks and keeping track of their changes, while investigating how specific course amendments, participation in computer-mediated communication, and/or conversation topics positively or negatively influence the dynamics of the online community. When using this framework to assess their e-Learning community, e-educators are able to predict how certain actions will affect their network, and can incorporate various methodologies to alter the state of their network.

FESNeL is a unified framework compiled of both qualitative and quantitative methods where the unit of analysis is the Social Networks. The four components of FESNeL are (Fig 3.1): **Attitudes Towards Thinking and Learning Survey** (ATTLS), **Social Network Analysis** (SNA), **Topic Relation Analysis** (TRA), and the **Constructivist On-Line Learning Environment Survey** (COLLES). An explanation of the FESNeL components follows.

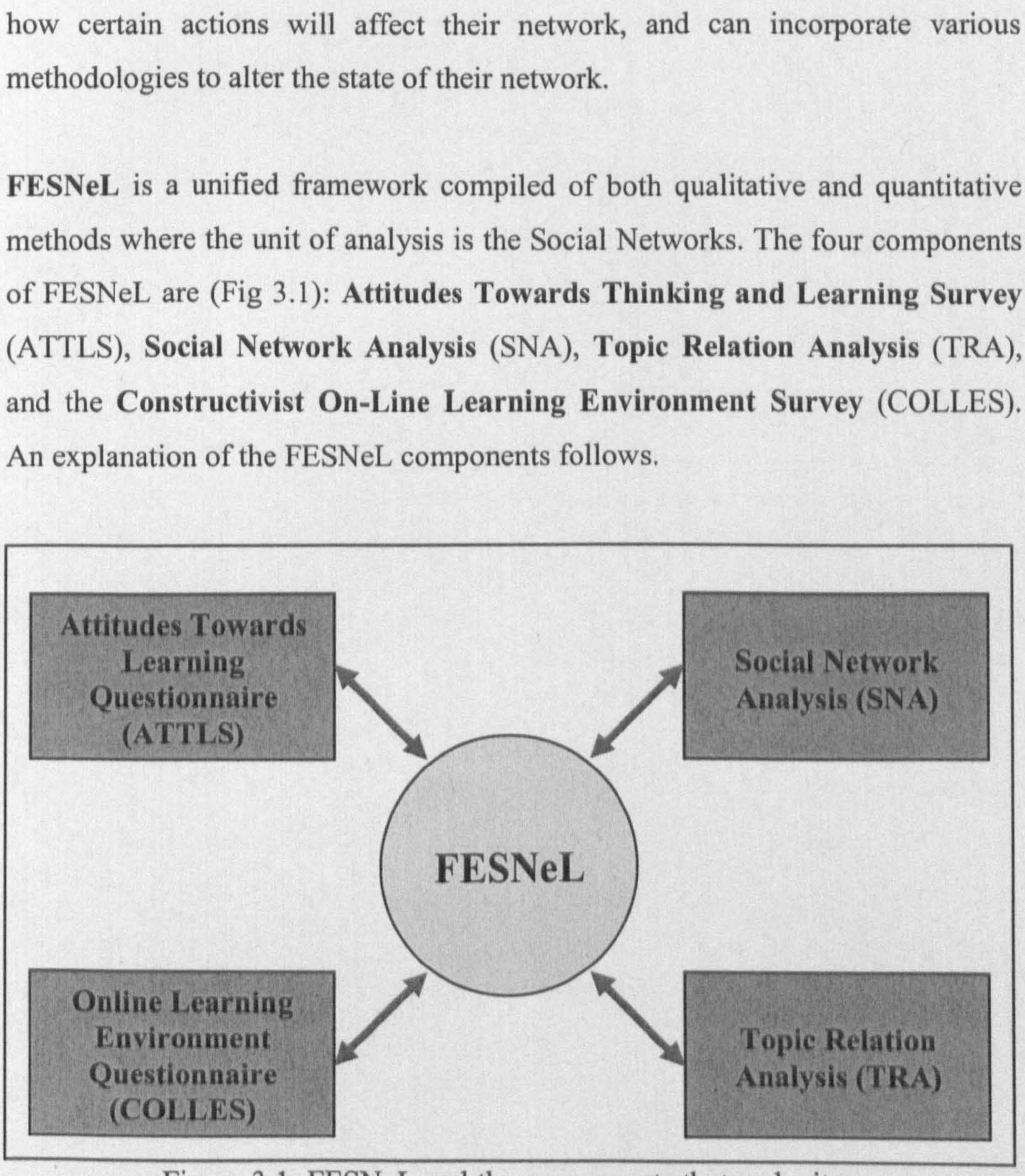


Figure 3.1: FESNeL and the components that make it up

3.2.1 Social Network Analysis (SNA)

"Social Network Analysis (SNA) is the mapping and measuring of relationships and flows between people, groups, organizations, computers or other information/knowledge processing entities. The nodes in the network are the people and groups while the links show relationships or flows between the nodes. SNA provides both a visual and a mathematical analysis of human relationships" (Krebs, 2004, pp.1). Preece (2000) adds that it provides a philosophy and set of techniques for understanding how people and groups relate to each other. It is concerned about dyadic attributes between pairs of actors (like kinship, roles, and actions), and has been used extensively by sociologists (Wellman, 1982; Wellman 1992), communication researchers (Rice, 1994; Rice et al., 1990) and others. Analysts use SNA to determine if a network is tightly bounded, diversified or constricted, to find its density and clustering, and to study how the behaviour of netwok members is affected by their positions and connections (Garton, Haythornhwaite & Wellman, 1997; Wellman, 1997; Henneman, 1998; Scott, 2000; Knoke & Kuklinski, 1982).

Network researchers have developed a set of theoretical perspectives of network analysis. Some of these are (Bargotti, 2002):

- Focus on relationships between actors than the attributes of actors
- Sense of interdependence: a molecular rather atomistic view
- Structure affects substantive outcomes
- Emergent effects

Aim and goals of SNA

"The aim of social network analysis is to describe *why* people communicate individually or in groups" (Preece, 2000, pp. 183), while the goals of SNA are (Dekker, 2002):

- to visualize relationships/communication between people and/or groups using diagrams
- to study the factors which influence relationships and the correlations between them.
- to draw out implications of the relational data, including bottlenecks
- to make recommendations to improve communication and workflow in an organisation

Limitations of SNA

Preece (2002) and Beidernikl & Paier (2003) list the following as the limitations of SNA:

- More theory that speaks directly to developers of online communities is needed
- The data collected may be personal or private
- The analysis of the data is quantitative and specific to the particular network, while common survey data are qualitative and generalize answers on the parent population
- Don't say anything about the nature and "content" of interaction

SNA Approaches

There are two approaches to SNA:

Ego-centered analysis – Focuses on the individual as opposed to the whole network, and only a random sample of network population is normally involved (Zaphiris, Zacharia, & Rajasekaran, 2003). The data collected can be analyzed using standard computer packages for statistical analysis like SAS and SPSS (Garton, Haythornthwaite, & Wellman, 1997).

Whole network analysis – The whole population of the network is surveyed and this facilitates conceptualization of the complete network (Zaphiris et al., 2003). The data collected can be analyzed using microcomputer programs like UCINET and Krackplot (Garton et al., 1997). SNA data is represented using matrices, graphs and sociograms.

Units of Analysis and Network Characteristics

There are several characteristics of social networks many of which will be investigated when we use SNA in our unified model. The following are important units of analysis and concepts (Garton et al., 1997; Wellman, 1982; Hanneman, 2001; Zaphiris et al, 2003; Wellman, 1992):

Nodes – The actors or subjects of study.

Relations – The strands between actors. They are characterized by content, direction and strength.

Ties – Connect a pair of actors by one or more relations.

Multiplexity – The more relations in a tie, the more multiplex the tie is.

Composition – This is derived from the social attributes of both participants.

Range - The size and heterogeneity of the social networks.

Centrality - Measures who is central (powerful) or isolated in networks.

Roles - Network roles are suggested by similarities in network members'behavior.

Density - The number of actual ties in a network compare to the total amount of ties that the network can theoretically support.

Reachability - In order to be reachable, connections that can be traced from the source to the required actor must exit.

Distance - The number of actors that information has to pass through to connect the one actor with another in the network.

Cliques - Sub-sets of actors in a network, who are more closely tied to each other than to the other actor who are not part of the subset.

SNA Applications

As mentioned previously, researchers have used SNA in a variety of areas. In this section I discuss some of these SNA applications.

Aviv (2004) investigated 15 textual documents and comments of students about e-Learning experiences. High-level concepts were extracted from the texts and used to form statements. Following this SNA was used to measure the strength and centrality of the relationships between concepts that form a statement. In addition, using SNA the author was able to model the students' ideas and comments (Aviv, 2004).

In another study Aviv, Erlich and Ravid (2003) contrasted two cooperative asynchronous learning groups (one structured and one non-structured) and performed SNA on their discussion forums. They investigated cohesion, centrality, cliques and role structures. They found that the structured group constructed knowledge at high levels of critical thinking and that the students took leading and bridging roles constructing many cliques. On the other hand, the non-structured group constructed knowledge at low level of cognitive activities and the students took the roles of teacher followers and constructed few cliques.

In 2003 Rajasekaran et al investigated a Web-based training system with the aim of discovering differences between people who were part of the participatory design team of the system, and people who were not. They used SNA and measured the centrality and cliques of their social network. They found that the members who were part of the participatory design team had distinct positions in the network and had established long-term relationships and enduring interests (Rajasekara et al., 2003).

Cho et al (2002) used SNA to analyze community-based activities in a Computer supported collaborative learning environment, in which 32 students were enrolled in a communication class of Cornell University. They found SNA to be a valuable tool for analyzing peer interaction. Furthermore, their findings showed that "social influences, in the form of network prestige effects, strongly affected the likelihood and the extent to which information posted in the CSCL environment was shared by peers" (Cho et al, 2002, pp. 1).

SNA is not only used in online environments. For instance, Martinez et al (2003) used SNA to study the students' social interactions in classroom settings and report that this made them identify critical issues which helped focus future qualitative analysis on specific issues (rather than analyzing all the qualitative data).

Apart from analyzing cooperation and learning environments, analysts have used SNA in a number of other areas as well. For example, Holme et al (2004) used SNA to study the structure of the users' activities in an Internet dating community. Based on the members' communications, they were able to calculate the members' degrees and geodesic distances and perform other statistical analysis with SNA.

Aalast, Reijers and Song (2002) carried out a case study on a Dutch national public works department. They collected their data from the event logs which recorded the execution of activities in business processes and then performed SNA on this data enabling them to construct sociograms. The authors report success in using SNA with event logs.

3.2.2 Topic Relation Analysis (TRA)

The TRA model (Laghos, 2005; Laghos & Zaphiris, 2006a) is a content analysis tool. Content analysis is a technique used in qualitative analysis to study written material by breaking it into meaningful units (Babbie, 2004). The data is collected directly from the discussion boards of the class and then sorted into the TRA categories. The TRA is a newly developed tool where the units of analysis are the threads and messages of each of the discussions of the forum. The data collected includes the messages per thread, the participants per thread, the discussion topic and its relevance to the course. The tool assists us in understanding the messages and communication between the learners, and how important the discussed topics are for the learners to remain and complete the online course.

The TRA was developed to group the messages that the students post into categories, enabling us to determine which type of messages (peer-support, off-topic conversations, etc) engage the student more in the course and contribute to course retention. TRA is compromised of 3 main categories some of which have sub-categories. These categories were deduced by observations of e-Learning discussion boards and the different types of conversations that take place. The TRA categories are:

A - Course Material related

Category A deals with conversations in the discussion boards of the e-Learning courses that are related to the course material, and is broken down into two further categories, A1 and A2.

A1 - Related to current Lesson

Threads that belong in A1 are conversations that have to do with the course material of the current Lesson. Examples of such topics include questions and answers and correcting peers mistakes.

A2 - Related to course (but not current lesson)

Threads that belong in A2 are conversations that have to do with the course, but their subject is not in the current lesson's syllabus. For example, a conversation about an exercise of Lesson 3, posted in the discussion forum of Lesson 1, would go in this category. Also, a general question about mathematics (in an area that is not included in the Mathematics lesson's syllabus) would also go in A2.

B - Course Website/Technical Related

Category B is specific to conversations regarding the course website, and technical issues. Problems listening to audio files, accessing specific parts of the site, or usage issues are all in this category.

C - Not related to course

Finally, posts that are categorized in C are those that have nothing to do with the course in hand or its usage. Category C has two sub-categories:

C1 - Peer socializing

C1 is a broad category that covers conversation types where peers socialize with each other. Examples include students introducing themselves, discussions about football games and concerts, making new friends and so on.

C2 – other

Category C2 basically includes all the other off-topic conversations that are not about peers socializing with each other. Examples of posts that belong in this category are spam and advertisements.

3.2.3 Constructivist On-Line Learning Environment Survey (COLLES)

The Constructivist On-Line Learning Environment Survey (COLLES) measures students' perceptions and preferences and was designed to help teachers assess, from a social constructivist perspective, the quality of their online learning environment (Taylor and Maor, 2000).

The COLLES electronic questionnaire was designed to support the use of the web for teaching programs for which social constructionism is a key pedagogical referent and can be used to monitor the quality of innovative online teaching and learning (Taylor and Maor, 2000). Social Constructionism is a sociological theory of knowledge focusing on uncovering the ways in which individuals and groups participate in the creation of their perceived reality (Berger and Luckmann, 1966). Taylor and Maor (2000, pp1) state that "the efficacy of innovative web based teaching for engaging distance learners in enriching their epistemological growth cannot be evaluated adequately without obtaining a measure of learners' perceptions of their online class room environment".

In social constructivism the learner is portrayed as an active conceptualiser within a socially interactive learning environment. The theory describes an epistemology where learners collaborate reflectively to co-construct new understandings in the context of mutual inquiry grounded in their personal experience (O'Conner, 1998) by developing a communicative competence that

enables them to engage in critical discourse with their peers (Taylor & Maor, 2000) and is characterized by an empathic orientation to constructing reciprocal understanding (Dawson & Taylor, 1998; Sfard, 1998).

There are 24 questions arranged into 6 scales (Dougiamas and Taylor, 2003):

- **Relevance** – how relevant is online learning to students' professional practices?
- **Reflection** – does online learning stimulate students' critical reflective thinking?
- **Interactivity** – to what extent do students engage online in rich educative dialogue?
- **Tutor Support** – how well do tutors enable students to participate in online learning?
- **Peer Support** – do fellow students provide sensitive and encouraging support?
- **Interpretation** – do students and tutors make good sense of each other's communications?

These scales are new to the learning environment research and are concerned with the students' perceptions of the existence of a virtual classroom environment that supports them to reconstruct themselves as both reflective and collaborative learners. The scales were developed from the theory of "social constructivism (including social constructionism, critical constructionism, co-participation, and socially situated cognition) which is guiding leading edge research on the role of students' predispositions in shaping the quality of their discourse in Web based teaching and learning" (Taylor and Maor, 2000, pp2).

Taylor and Maor (2000) administered the COLLES questionnaire to a group of masters students which were taking the online course 'Multimedia in Science and Mathematics education'. Their findings about the students were that they:

- Prefer to be engaged often in thinking critically about their own and other students' ideas (mean = 4)
- Expect their tutors to almost always to encourage, praise and value their participation (mean = 4.6)
- Expect their online learning to almost always be interesting and related to their professional practice (mean = 4.8)
- Expect their selves and fellow students and tutors to make good sense of their posted messages (mean = 4.2)
- The students perceived to only sometimes have the opportunity to engage in exchange of ideas with other students (mean = 3.1)
- The students value the opportunity to interact with each other, however less often that the authors had anticipated (mean = 3.8).

3.2.4 Attitudes Towards Thinking and Learning Survey (ATTLS)

The Attitudes towards Thinking and Learning survey (ATTLS) is used to measure the quality of discourse within the course. It measures the extent to which a person is a 'connected knower' (CK) or a 'separate knower' (SK). People with higher CK scores tend to find learning more enjoyable, and are often more cooperative, congenial and more willing to build on the ideas of others, while those with higher SK scores tend to take a more critical and argumentative stance to learning (Galotti, Clinchy, Ainsworth, Lavin, & Mansfield, 1999).

The two different types of procedural knowledge (separate and connected knowing) were identified by Belenky, Clinchy, Goldberger & Tarule (1986). Separate knowing involves objective, analytical, detached evaluation of an argument or piece of work and takes on an adversarial tone which involves argument, debate or critical thinking (Galotti et al, 1999). "Separate knowers attempt to 'rigorously exclude' their own feelings and beliefs when evaluating a proposal or idea" (Belenky et al., 1986, p.111; Galotti et al, 1999). Separate knowers look for what is wrong with other people's ideas, whereas connected knowers look for why other people's ideas make sense or how they might be right, since they try to look at things from the other person's point of view and try to understand it rather than evaluate it (Clinchy 1989, Galotti et al, 1999). These two learning modes are not mutually exclusive, and may 'coexist within the same individual' (Clinchy, 1996, p. 207).

Initially the ATTLS consisted of 25 questions each for separate and connected knowing and contained quotations from original papers on the 'Ways of Knowing' framework (Belenky et al, 1986; Clinchy 1990; Galotti et al, 1999). However it took a long time to administer and thus the authors developed a shorter version consisting of 20 self-report Likert-scaled items. This shortened version is highly correlated with the longer version, nearly as reliable, and the authors propose that this shorter version be used in future research (Galotti et al, 1999). Based on their findings, the authors argue that differences in SK and CK scores 'produce different behaviors during an actual episode of learning, and do result in different descriptions of, and reactions to, that session' (Galotti et al, 1999, p. 435).

Galotti et al (2001) administered the ATTLS survey to 192 Bachelor students (50% male, 50% female) at Carleton College in Minnesota to examine the gender differences in SK and CK scores. The authors' results show that mean CK scores were higher than the mean SK scores. Furthermore the mean CK scores for

females (56.36) were higher than for males (51.13) although the mean SK scores were higher for males (45.17) than for females (41.20). In addition they state that they did not find any correlations between the students' measures of performance with their CK and SK scores (Galotti et al, 2001).

3.3 Conclusion

In this chapter I have proposed and designed a methodological framework called FESNeL which builds on the weakness of the previously studied models. I have explained each of the components of FESNeL, which is comprosied of SNA, TRA, and the ATTLS and COLLES questionnaires. The application of FESNeL on a characteristic case study is presented in Chapters 5 and 6.

Chapter 4: The Importance & Current State of CMC in CALL

4.1 Introduction

The purpose of this chapter is to test my first hypothesis. The rest of the hypotheses are tested in Chapter 6. As stated in section 1.2, Hypothesis 1 is:

"Students consider CMC tools to be important when learning online."

In order to investigate the significance of CMC components in online CALL courses an online questionnaire was used to solicit information regarding what current and potential users of such online courses find to be useful and important for them. In addition, the features and multimedia tools offered by web-based Computer Assisted Language Learning (CALL) courses and commercial and open-source Course Management Systems (CMS) were matched with user expectations to reveal the current state of these websites.

The findings of this study indicate that current CALL systems make limited use of several features/tools that users consider important like the use of discussion boards and spell-checkers that in my view can enhance and speed-up the learning process. In addition, CMS lack in the provision of features/tools more specific to language learning and teaching like the use of embedded dictionaries and thesauruses. Thus, although the main focus was to examine the utility of CMC elements, the results provide us with a more comprehensive overview of the current state of CALL including all tools/features.

The focus has been on the official languages of the EU, including the new ones added by the ten new countries in May 2004. Considering that one of the principal pillars of EU doctrines is the free flow of people among all countries of the EU (Council of Europe, 2004), one would expect to see a multitude of 'foreign language' speakers settling in countries where their mother language is different. It is also the EU policy to encourage and support maintaining national

languages and culture as a most valuable characteristic of the emerging EU (Council of Europe, 2004). One way to make this even more attractive to users is to offer free online courses where people can learn at their own pace and time, and have access to other users, students or native speakers.

Although there are a number of websites that claim to provide distance learning of foreign languages very few have performed proper evaluations (both in terms of pedagogical achievements but also usability) of their courses/websites. As noted also by Kukulska-Hulme and Shield, "Little research directly related to the usability of language learning websites has, as yet, been carried out" (Kukulska-Hulme and Shield, 2004, pp 4240). This investigation was carried out to find out which features are provided by current online CALL systems and CMS, and to compare them with the user requirements solicitation results, to see to what extent their expectations are met by these systems.

The chapter continues with a description of how the study was conducted. Following this, the results are presented and discussed. The chapter ends with conclusions and a set of recommendations for further work.

4.2 Methods

The methodology used consisted of four key activities:

4.2.1 Activity 1: Identification of existing features in online CALL courses

As pointed out earlier, one of the policies of the EU is to encourage and support the learning and maintenance of its languages. Providing this sort of education for free, is the greatest motivation for everyone. Even people who are not

planning on learning another language, will be more likely to use a free online language website than any at all. This was the reason why free websites were chosen to be evaluated rather than fee-based ones. The respondents' opinions on whether they believe these services should be free or not are also discussed in the findings. It did not matter if the end-users could attend the courses as guests, or have to register, as long as they did not have to pay to use them.

There are currently nineteen official languages of the European Union – Danish, Dutch, English, Finnish, French, German, Greek, Italian, Portuguese, Spanish, Swedish, Estonian, Latvian, Lithuanian, Polish, Czech, Slovak, Hungarian and Slovene (Council of Europe, 2004). *The aim was to find and evaluate two free online CALL websites for each of the languages.* Many resources were found for the languages that are used and spoken more widely across the globe like Spanish, English and German. However, languages that are not so popular around the world had only limited websites teaching the language. No free resources were found for Slovak and Slovene, so these languages had to be omitted from the study. Additionally, only one free reliable resource was found for each of Estonian and Hungarian. For the languages where there were many websites preference was given to those websites that were supported by national governments. Websites that were very basic or incomplete were not included, thus giving a more accurate reflection of the major websites offering EU language teaching. A total of thirty-two websites were studied. The 32 websites were visited and explored and the features that they provide were noted.

4.2.2 Activity 2: User Requirements Elicitation

The second part of the project dealt with user requirements solicitation. An online questionnaire (see Appendix A) was prepared whereby participants could post their views and suggestions, and concurrently give feedback about the

importance of including specific features in CALL websites. The questionnaire (Appendix A) contained closed and open ended questions. A section asked the respondents to rate each of the currently available features (collected in Activity 1) on a Likert scale from 1 (least important to them) to 5 (most important to them). The feedback from the rest of the questionnaire assisted in collecting more information specific to what the users want from these websites, as well as certain statistical data about education over the internet in general. The questionnaire was sent to current students of an MSc module and a mailing list of CALL professionals and users. 63 responses were received.

4.2.3 Activity 3: Comparison of currently available CALL features/tools versus user expectations and needs

In the third part of the study the results of the questionnaire were compared to the results of the initial study of the features/tools currently available in the 32 online CALL websites. This revealed the limitations and strengths of these websites, and allowed recommendations for future designs and updates to be made so that users' expectations will be more accurately met.

4.2.3 Activity 4: Identification of existing features/tools in online CMS

"A course management system (CMS) is a computer program that facilitates computerised learning or e-learning, especially by helping teachers and learners with course administration. Such e-learning systems are sometimes also called Learning Management Systems (LMS) and Virtual Learning Environments (VLE)" (Wikipedia, 2006).

Given the current popularity of use of course management systems (CMS) for the delivery of language course, I thought it was necessary to include an evaluation of the most popular CMS in the study. So, in activity 4 the features/tools provided by the most commonly used CMS systems were investigated and compared with user requirements. The objective here was to identify the limitations and strengths of these systems and make recommendations for future designs and updates in line with user expectations. The purpose of this stage was to extend other studies that compared different CMS (Retalis, 2003) and more specifically to see if the existing CMS are suitable to administer foreign language learning courses. In an earlier study, Retalis created a model to analyze the acceptability of contemporary learning technology systems in which the goals were to discover which features LMSs support and how well each feature is supported (Retalis, 2003). His findings were that the two most full featured and powerful systems were WebCT and Blackboard. Furthermore, he found that most of the LMSs studied were characterized by an acceptable degree of usability as far as the students were concerned. These systems were however less usable for instructors, administrators and designers (Retalis, 2003).

In my investigation the aim was to analyze the features/tools provided by the current CMS market leaders in relation to the administration of CALL material and courses. The investigation was carried out using CMS that provided demos, or where licenses could be acquired. Other resources that were used included comparisons of CMS and their features/tools that are readily available on the World Wide Web.

The 5 CMS included in the study were:

- WebCT (http://www.webct.com/)

- LearningSpace (http://www.lotus.com/home.nsf/welcome/learnspace)
- Blackboard (http://www.blackboard.com/)
- TopClass (http://www.wbtsystems.com)
- FirstClass (http://www.firstclass.com)

In the following section the results for each activity are presented.

4.3 Results

4.3.1 Results from Activity 1: Current features available in online CALL courses

The following features were identified: Links to external resources, Audio, Dictionary-Translator, Discussion Board, Quiz-Tests, Games, Chatrooms, FAQ-Help, Website News, Horoscopes, Penfriend finders, Video, Spell-Checker and Thesaurus. Figure 4.1 shows the relationship between each of the features and how many of the websites offered them.

With regards to CMC, discussion boards were utilized by eleven (34.38%) of these CALL courses. These provided an asynchronous mode of communication between the users. Topics could be started by any of the users on anything they wanted. Main topics included technical difficulties, language difficulties and general discussion about various aspects of the languages and the people.

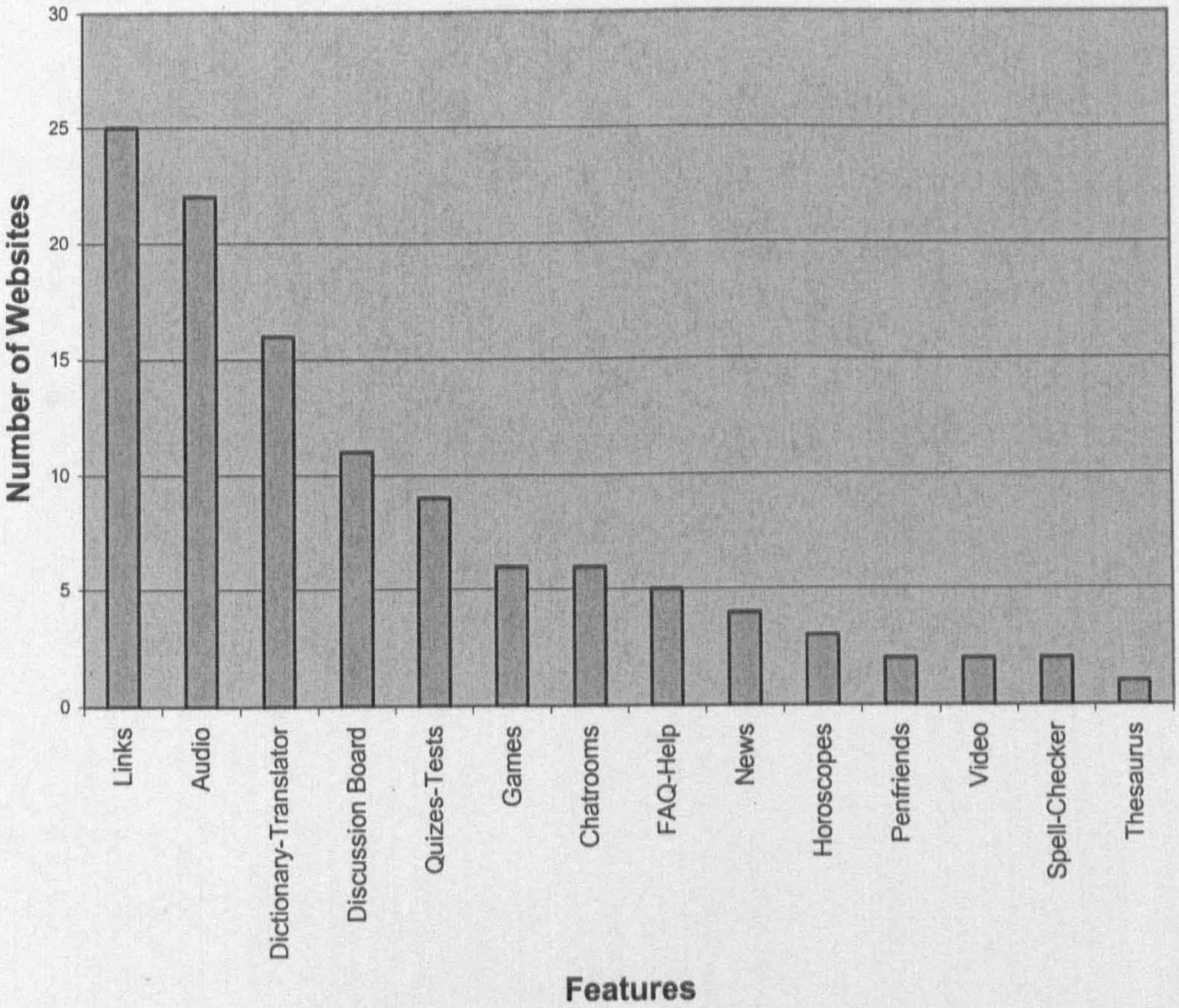


Figure 4.1: Mapping of the number of CALL websites that currently provide each of the features.

Furthermore, synchronous communication was very limited since only six of the websites offered chatrooms where online users could chat with one another. FAQ/Help and website news features were also limited and were offered only by five and four websites respectively.

As can be seen in Figure 4.1, most of these websites make use of external links. These links refer users to other websites and sources that they might find useful. Examples of these links included webpages providing historical and cultural information of the languages and their countries, as well as other tools and activities that could enrich the learning experience even more, like social events

or even discounted visits and excursions to the countries where the target languages are spoken.

The second most popular feature was the use of audio. Twenty-two out of the thirty-two online language courses offered some sort of audio support to the users. Pronunciations of the letters of the alphabet was the most common use and this is in line with CALL pedagogical theories that suggest repetition and pronunciation modules in their teaching. This extended onto audio clips of words and phrases and in several of the sites included large clips of conversations where the users could listen, and at the same time read the transcripts of these audio files. However none of these websites supported audio recognition whereby the users could speak into their microphone and have their pronunciations and their accent tested giving them feedback about their progress.

Sixteen websites offered a dictionary and translator. By using this feature the users could get the meanings of words in the language they were learning at any time they wanted, rather than having to wait for the specific words to come up in one of the lessons. In the more advanced cases the dictionaries could translate entire documents or websites that the users wanted from the language that the users knew to the language that they were learning and vice-versa.

Nine of the websites offered some sort of tests or quizzes where the users could check their progress and receive feedback on how well they were doing. A further six websites included simple interactive games like cross-word puzzles and hangman with the purpose of user self-testing again, but by the means of a more attractive and fun approach.

Three of the websites included the feature of horoscopes trying to give the users more motivation to read something that was of more personal interest to them in the target language. Another feature that was only offered by two websites was

that of a pen-friend finder. This feature enabled the users to search and contact people who were native speakers of the language they were learning, and frequently send emails back and forth thus enhancing the learning progress whilst making new friends at the same time.

Lastly, video resources and spell-checkers were only utilized by two websites, and only one of the thirty-two courses offered a thesaurus.

4.3.2 Results from Activity 2: User Requirements Elicitation

There were a total of 63 responses to the questionnaire and the logs showed that the respondents were from several different countries. The user feedback was organized and tabulated to show what their preferences and expectations of the features provided by the online CALL courses are. A significant part of the questionnaire asked the users to rate each of the currently available features (collected in Activity 1) on a Likert scale from 1 (least important to them) to 5 (most important to them). The average rating of each feature was calculated and the results are summarized in Table 4.1.

Figure 4.2 shows these features in order of importance from the users' perspective. A quick glance at the findings shows that the respondents rated almost all the features as being important to very important. Apart from horoscopes, which were rated as the least important with a score of 1.68 out of 5, all the other features scored over 2.50.

The feature of audio clips in the online courses was the most popular one receiving an average user rating of 4.63 out of 5. This feature was followed closely by the dictionary-translator, the spell-checker, the FAQ/help, video, and the quizzes-tests which all scored 4 and above.

Table 4.1: User Responses to the importance of the current features available in the online language courses

Likert Scale	Least Important 1	2	3	4	Very Important 5	Mean Score (St.d.)
Links	1	6	25	20	11	**3.54** (0.95)
Audio	0	1	5	10	47	**4.63** (0.70)
Dictionary Translator	1	2	10	16	34	**4.27** (0.95)
Discussion Board	3	4	23	14	19	**3.67** (1.12)
Quizzes-Tests	0	1	16	27	18	**4.00** (0.79)
Games	13	16	18	8	7	**2.68** (1.26)
Chatrooms	8	11	25	7	12	**3.06** (1.26)
FAQ-Help	1	1	12	24	25	**4.13** (0.89)
News	10	8	31	10	4	**2.84** (1.08)
Horoscopes	35	15	9	3	0	**1.68** (0.90)
Penfriends	16	12	15	9	11	**2.79** (1.43)
Video	3	2	12	18	28	**4.05** (1.10)
Spell-Checker	2	4	8	13	36	**4.22** (1.10)
Thesaurus	1	5	17	25	15	**3.76** (0.96)

As far as the CMC features go, discussion boards and chatrooms both received an average user rating between 3 and 4, showing the users do indeed deem these features as important to be included in the courses. In the same rating category also fall the features of the thesaurus and links to external resources.

Website news, penfriend finders and games received a score between 2.5 and 3 which shows that the respondents might not find this features as important as the audio feature for example, but they still find them important enough to be included in online CALL courses.

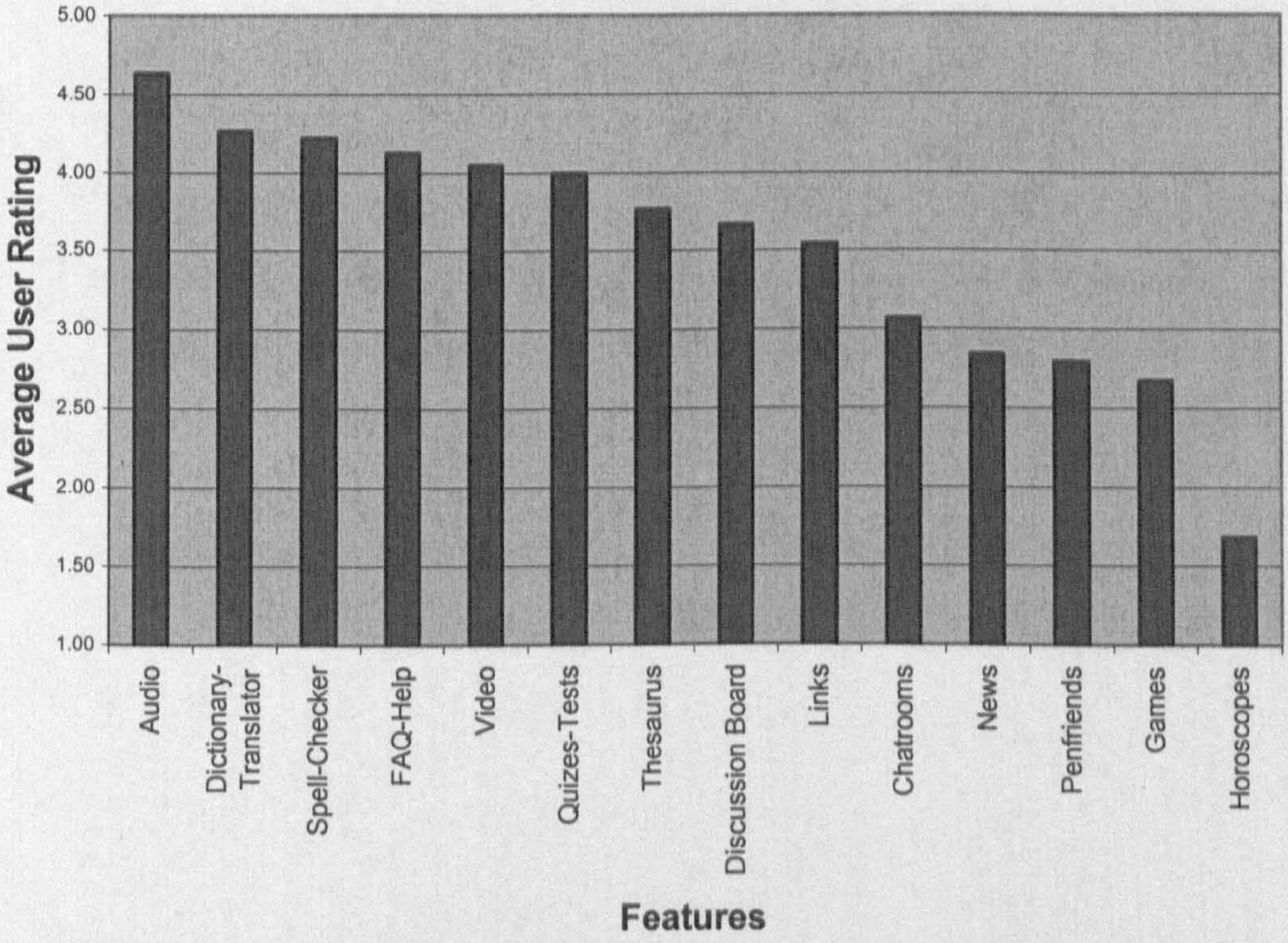


Figure 4.2: User ratings of currently available features.

The analysis of the responses to the questionnaire also revealed the following information about the respondents:

- 90.48% speak at least one more language other than their mother tongue
- 34.92% have taken part in an online course before
- 15.87% have taken part in an online 'language' course before
- 88.89% would consider learning a foreign language course from the internet
- 30.16% would be willing to pay for an online foreign language course
- 61.90% would prefer to follow an online language course at their own pace (38.10% prefer a pre-set schedule)

Finally, the respondents rated website "Content" to be the most important criterion when accessing websites, followed by the upload/download "Speed", whereas only one person found the "Appearance/Look" to be the most important.

Additionally, the respondents were asked to mention other features (not included in the previous websites) that they think are important to be included on these courses. Their most popular suggestions were:

- Integrated email features
- Personal journals/notes
- Support for Groupwork activities

Furthermore, this study shows one more interesting outcome. Contrary to popular belief where one of the main advantages of e-learning is the self-paced progress of the courses, from the responses of the questionnaire a considerable 38.10% of the people would rather have a pre-set schedule to follow, rather than completely attend the online courses on their own pace (which was 61.90% of the replies).

4.3.3 Results from Activity 3: Comparison of currently available CALL features/tools versus user expectations and needs

In Activity 3, the results of the questionnaire regarding user expectations were compared to the results of the study of the features/tools currently available in the 32 online CALL websites. Some strengths and several weaknesses of these websites were identified. The use of audio in these websites is the most successful example, with the respondents rating audio as the most important feature in online foreign language courses. Other strengths of the websites were the use of external links to other sources and the facility of a dictionary/translator.

However, there were also many weaknesses identified with the current state of these CALL websites. The most revealing example is that of a spell-checker on the websites. Although from the respondents' answers spell-checkers were the third most important feature that they would have wanted, only two out of the thirty-two websites actually had a spell-checker embedded in their online language course. This is a huge gap between user expectations and what is actually offered by the online CALL courses. Another problem was in the area of video support which the users rated high, but once again were only offered by only two language course websites. Similar problems, but to a lesser extent occur in the lack or minimal use of FAQ/Help, Quiz/Tests, chatrooms and games. The users also rated the thesaurus as in important feature, but only one website utilized a thesaurus out of the thirty-two websites in the study. Penfriend finders received high importance ratings, but again the lack of their use by the websites causes problems.

In their study on 'student involvement in designing an online foreign language course' Zaphiris and Zacharia (2002) state that the discussion board proved to be

the most constructive tool for the students learning experience and the main source of feedback for the maintainers of the project. The authors came to this conclusion after a study where they created a CALL website by having the users participate in the design, and by integrating an iterative evaluation of the course. However the findings of my study indicate that even though the respondents themselves also rate discussion boards as being important, still fewer than half of the websites offered this feature to their users (Laghos and Zaphiris, 2004a).

A mean overall correlation coefficient (r=0.35) was found between the users' responses and the features/tools currently available. One can argue that the reason these sites lack these features/tools and functionality is because they are free and may receive no or minimal income. However, the results of the online questionnaire indicate that 50.79% of the respondents would probably not want to pay for an online language course, 19.05% said definitely not, and only 30.16 % said yes they would be willing to pay. This shows that the providers of these online language courses should take the users' preferences/requirements into consideration, and find and use other methods to make revenue.

4.3.4 Results from Activity 4: Identification of existing features/tools in online CMS

The results (table 4.2) show some strengths but also some weaknesses of using CMS for language teaching and learning. An example of the strengths lies in the use of external links. All 5 of the CMS provided this option. The same applies for the use of discussion boards which were again supported by all 5 CMS studied. 4 of the 5 CMS had a Help or FAQ section, integrated e-mail and support for groupwork.

Table 4.2: Language Learning related features/tools provided by CMS

Feature	WebCT	LearningSpace	Blackboard	TopClass	FirstClass
External Links	Y	Y	Y	Y	Y
Audio Support	Y	Y	Y	Y	Y
Audio Conferencing	N	Y	N	N	N
Video Support	Y	Y	Y	Y	Y
Video Conferencing	N	Y	N	N	N
Syllabus Template	N	N	N	N	N
Dictionary-Translator	N	N	N	N	N
Discussion Board	Y	Y	Y	Y	Y
Quizzes-Tests	Y	Y	Y	Y	N
Games	N	N	N	N	N
Chatrooms	Y	Y	Y	N	N
FAQ-Help	Y	Y	Y	Y	N
News / Announcements	Y	N	Y	Y	N
Penfriends	N	N	N	N	N
Glossary	Y	Y	Y	N	N
Spell-Checker	N	N	N	N	N
Thesaurus	N	N	N	N	N
Integrated e-mail	Y	Y	Y	Y	N
Personal journals/notes	N	Y	N	N	Y
Calendar	Y	Y	Y	N	N
Multiple Language Support	Y	N	N	Y	N
Groupwork	Y	Y	Y	N	Y
TOTAL	13/22	14/22	12/22	9/22	6/22

The weaknesses lie in areas more specific to language learning. None of the CMS provided an embedded dictionary or translator, and none of them provided a spell-checker and thesaurus, which are all vital for language learning. Although all 5 CMS support audio and video, these functionalities are only available as multimedia uploads and there is no template provided, meaning that a substantial amount of programming code is necessary from the webmaster or instructor to make these multimedia elements available and accessible to the users. Another drawback is that only 1 of the 5 CMS supported audio conferencing and videoconferencing.

LearningSpace and WebCT cater for most of the features/tools the users need. LearningSpace even supports audio and videoconferencing which can be very useful for language learners. On the downside, however, LearningSpace does not have multiple language support and thus limits its interface design and also the language courses that can be offered through this system. There is extra work for the programmers and instructors as there are no templates that can be re-used specifically for language courses.

A correlation was carried out between the users' responses and the features/tools currently available by the CMS and the result was ($r = 0.35$). This is a weak correlation indicating that the users' needs are not met accurately by the CMS.

4.4 Conclusion

This chapter dealt with the evaluation of features supported by CALL websites and CMS. Findings indicate that there is a gap between user expectations and requirements in relation to what is actually offered by these websites and systems. Results show that major weaknesses lie in the functionality currently provided by these websites. Feedback from the questionnaire helped to identify

where these drawbacks lie, and therefore suggestions for future re-designs could be made. For instance, the questionnaire respondents found spell-checkers to be very important, but very few of the websites evaluated actually offered this facility to the users. Also the websites were weak in offering facilities for collaborative learning and student interaction, which is in line with Fakas et al's (2005) findings (see Chapter 2).

Finally, as an addition to Chapter 2 where the literature review has shown that CMC discussion boards are important when learning online, the students themselves also rate discussion boards to be important (Laghos and Zaphiris, 2004b), therefore proving hypothesis 1 which states that "*Students consider CMC tools to be important when learning online*".

Chapter 5: Case Study (Analysis of the Social Network)

5.1 Introduction

Once the methodological framework was constructed, I applied FESNeL on a case study to test its overall validity. The data collected and all images created for this case study can be found in Appendices D to J. The chapter begins by providing information about the case study and the reasons it has been chosen to test FESNeL. In addition the methodology is explained and a short description of the choice of the SNA software used is presented. Following this the framework is used as follows:

Chapter 5 (Analysis of the Social Network): Partial use of the framework to investigate the environment/context of the case study and the dynamics of the Social Network that lives within this environment. All the results from the SNA are presented and discussed including network properties, connection, centrality, cohesion and equivalence.

Chapter 6 (Hypotheses Testing): Here the whole framework is used and the results of the TRA are presented and the four identified role groups are then discussed and compared in more detail. Furthermore, the two questionnaire results (COLLES and ATTLS) are discussed. The chapter ends with a number of correlations used to test the hypotheses stated in Chapter 1.

5.2 Learn Greek Online

The case study used to test the hypotheses was 'Learn Greek Online!' (LGO). LGO (http://www.kypros.org/LearnGreek) (Figure 5.1) is an online CALL course for learning the Modern Greek language. The course is hosted on Kypros.org, a non-profit organization for the promotion of the culture and

language of Cyprus. It uses the Moodle (www.moodle.org) open source course management system.

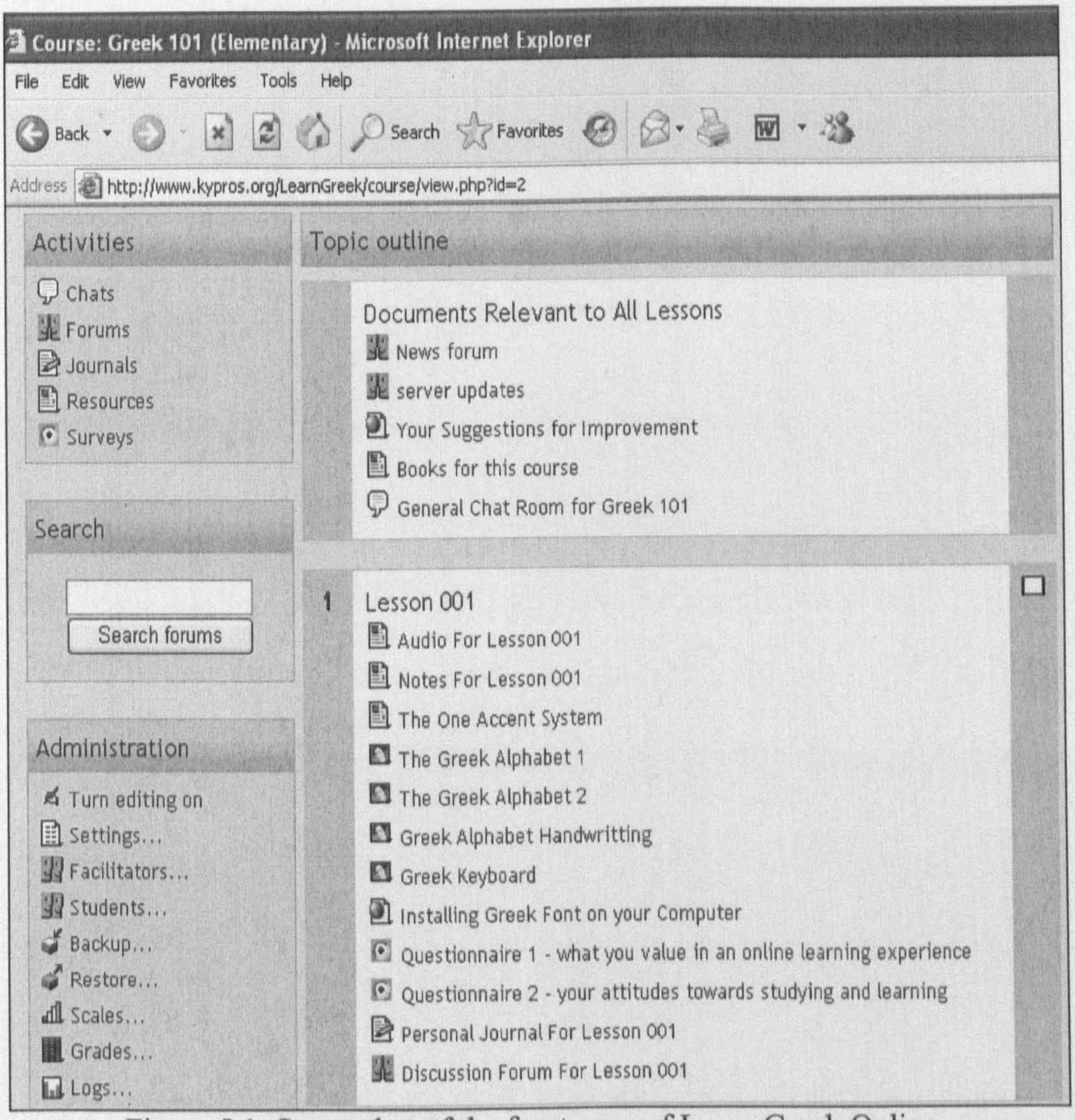


Figure 5.1: Screenshot of the front page of Learn Greek Online.

5.2.1 Reasons for choosing LGO as the case study

My project builds on the work of Zaphiris and Zacharia (2001) who developed LGO. As they reported, a weakness in analyzing the interactions in the system is that the number of students is rapidly increasing and it is becoming difficult to

keep track of the students' activities. The main reasons for my choosing LGO for the case study are listed below:

- LGO has one of the largest student databases (over 50,000 students) allowing me to collect large sample sizes for analysis.

- LGO is not a required course. The students enroll on their own will and their CMC participation is completely voluntary. Unlike other courses where the students are required to post in the discussions allowing for experimental bias, LGO students contribute to the discussions because they want to and not because they have to.

- LGO is student-centered and facilities are provided that allow the students to engage in peer-support which is one of the themes of the project.

- The maintainers and developers of LGO have granted me permission to use their data for my study.

In order to gain more insights on LGO's online community, the history of the development of the course is briefly explained.

5.2.2 Development history of LGO

Design Approach

The developers of LGO stated that their focus was to design an online learning community around a Computer Aided Language Learning (CALL) course by using the Participatory Design methodology. Participatory Design (PD) focuses

on the intended user of a service or product, and advocates the active involvement of users throughout the design process (Zaphiris & Zacharia, 2001).

The authors argue that user involvement is critical both because users are the experts in the work practices supported by these technologies and because users ultimately will be the ones creating new practices in response to new technologies (Ellis et al, 1998). Also, it is thought to lead to greater user commitment, acceptance, usage, and satisfaction with the system (Baroudi, et al, 1986).

The PD approach advocates three tenets (Blomberg and Henderson, 1990):

- The goal is to improve the quality of life.
- The orientation is collaborative.
- The process is iterative.

In the design phase of the on-line course (Zaphiris & Zacharia, 2001) PD was implemented as a four-step process (Ellis et al, 1998):

a) Building bridges with the intended users: In this step new methods of communication with the users were created, key groups of users were identified and a multidisciplinary development team was initialized.

b) Mapping user needs and suggestions to the system: Here the users' needs (collected from questions and inquiries) were matched with LGO's conceptual design model.

c) Developing a prototype: The lessons were designed as a complete standalone course and included 105 audio files (originally recorded as Radio Lessons in Modern Greek for English speakers in 1960's by the Cyprus Broadcasting Corporation). Further tools like a dictionary and discussion board were included to assist the students.

d) Integrating feedback and continuing the cycle: Suggestions from the users were incorporated into the LGO design through additions and corrections.

Course Evolution with Distributed Constructionism

As the developers of LGO report, the students of the courses included people with no knowledge of the Greek language, bilingual members of the Greek Diaspora, as well as teachers/professors of non-Greek languages. The students created an open online community whose collaboration had boosted the learning experience of the whole community (Zaphiris & Zacharia, 2002).

In addition the authors found that the web-based discussion board of LGO was the most constructive tool for the students' learning experience and the main source of feedback for the project maintainers. The students' use of the discussion boards included tips on how to record the audio files, installation of Greek fonts, learning methodologies and questions about the Greek language itself that arise from the lessons (Zaphiris & Zacharia, 2002). Experienced users had become the communication interface between the community's requests and the project maintainers and had taken a lead role in the discussion boards answering many of the questions and encouraging the beginners to study the lessons further (Zaphiris & Zacharia, 2001).

Technical support was provided to the students who had initiated Distributed Constructionism themselves (Zaphiris & Zacharia, 2002). Distrubuted Constructionism (Resnick, 1996) extends the Constructionism theory (Papert, 1991; Papert 1993) to knowledge building communities, where the online learning community as a whole collaboratively constructs knowledge artifacts (Zaphiris and Zacharia, 2002). There are three major distributed constructionism

activities within the context of an online learning community and these are (Resnick, 1996; Zaphiris & Zacharia, 2002):

1. Discussing Constructions: Students discuss their constructions during the design, implementation, evaluation and reiteration phases
2. Sharing Constructions: Web based systems allow students to share their constructions and make them part of the shared knowledge.
3. Collaborating on Constructions: The community can use online communication, to collaborate on the design and development of the knowledge artifacts.

5.3 Methodology

In order to study this online community FESNeL was applied to the students' discussions. The four components of the framework were used as follows:

- **SNA & TRA:** Data was collected directly from the discussion boards of the course Greek 101 (Elementary). Figure 5.2 is a screenshot of the discussion forum of LGO. I have carried out SNA on the 618 actors (in this case the active students of the course) that used the discussion forums of the LGO course.

  Due to the complexity of the interactions in the LGO discussion boards I had to make several assumptions in my analysis. These were:

  - The 52 posts that received 0 replies were excluded from the analysis. This was necessary in order to obtain meaningful visualizations of interaction. Without this assumption it would be difficult to know to which students the posts were directed (unless specified by the senders). On the other hand if these posts were

considered broadcasts (messages sent to all the students in LGO) then the out-degree scores of the senders would be misleading due to the large student size.

- Open posts were assumed to be directed to everyone who replied. This was important since all the members of a thread are assumed to be taking part in the same conversation even though some students might contribute more than the others.

- Replies were directed to all the existing actors of the specific discussion thread unless the reply or post was specifically directed to a particular actor.

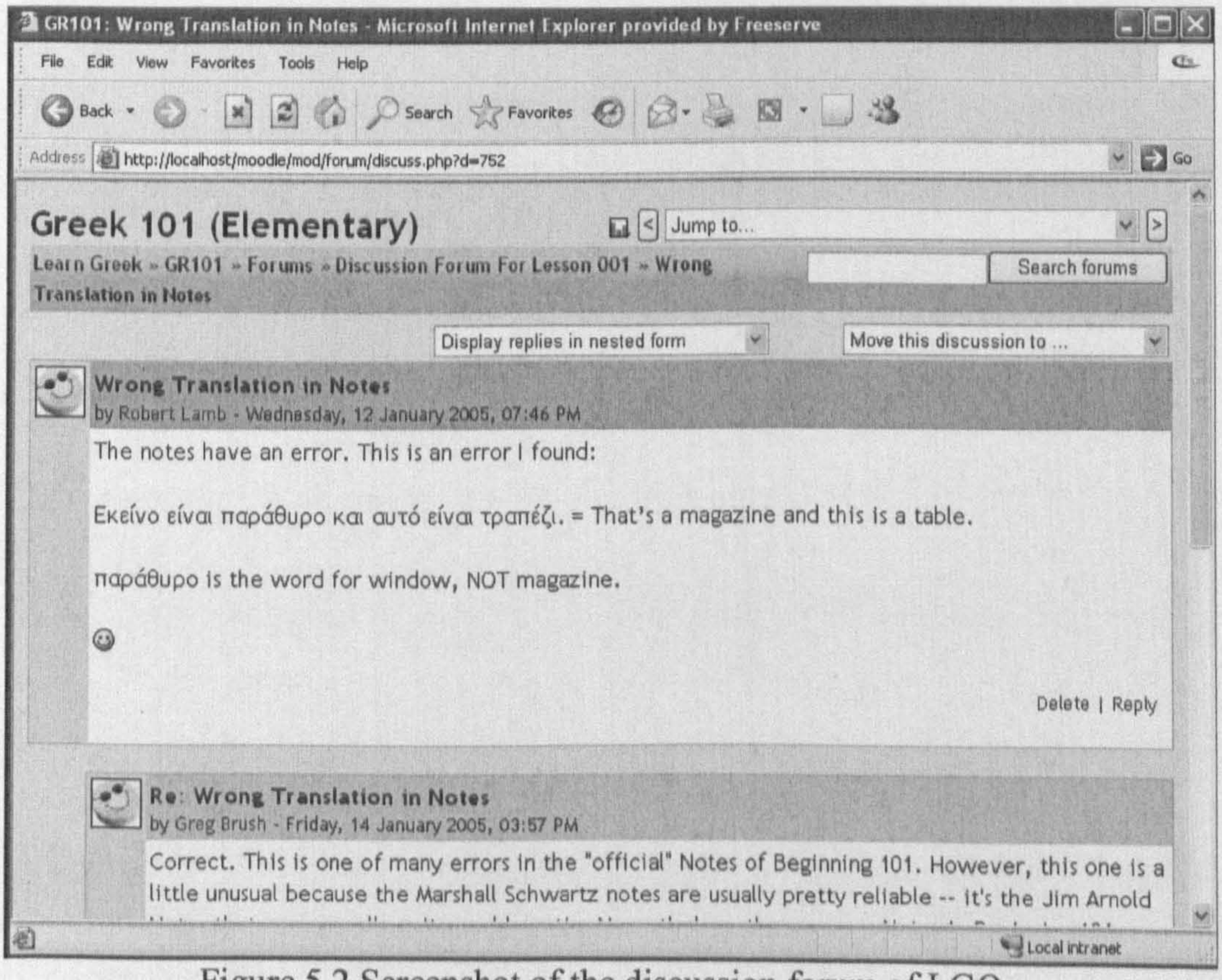
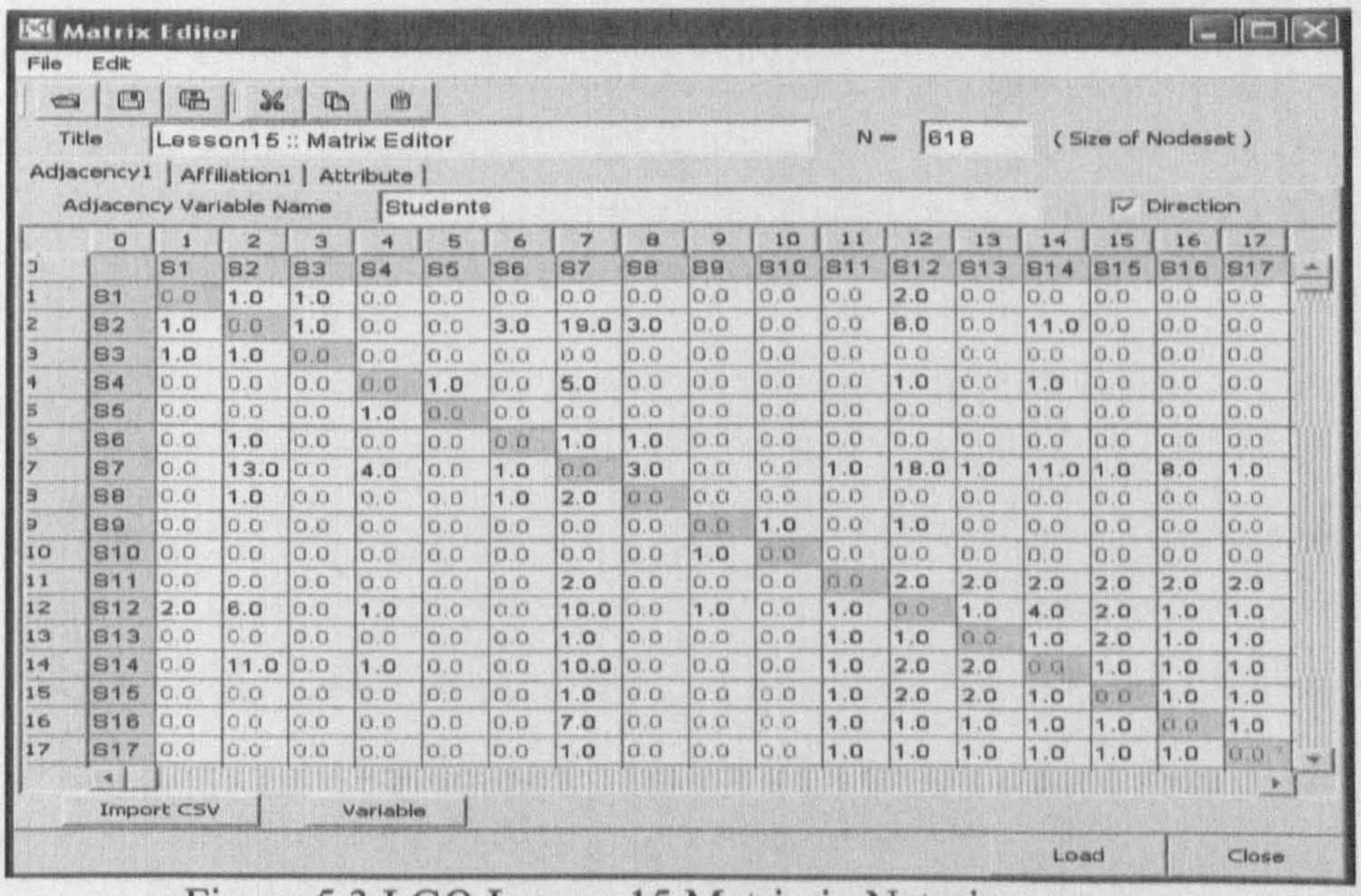


Figure 5.2 Screenshot of the discussion forum of LGO.

The data collected for each posted message included:

- The sender
- The receivers
- The topic of the message
- The thread of the message

Once this information was obtained, the students' communication interactions were tabulated in the form of network matrices (figure 5.3). Note that the student names have been renamed S1 – S618 for privacy and anonymity reasons. The rows and columns represent the students and the numbers in the grid represent the amount of messages sent by each student to his/her peers. 'Direction' of the message also exists since the number of messages sent and received between a pair of students is not necessarily equal. For example as can be seen in figure 5.3, student S7 has sent 13 messages to student S2, whereas S2 has sent 19 messages to S7.


Matrix Editor

File Edit

Title Lesson15 :: Matrix Editor N = 618 (Size of Nodeset)

Adjacency1 | Affiliation1 | Attribute |

Adjacency Variable Name Students Direction

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
0		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17
1	S1	0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0
2	S2	1.0	0.0	1.0	0.0	0.0	3.0	19.0	3.0	0.0	0.0	0.0	6.0	0.0	11.0	0.0	0.0	0.0
3	S3	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	S4	0.0	0.0	0.0	0.0	1.0	0.0	5.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0
5	S5	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	S6	0.0	1.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	S7	0.0	13.0	0.0	4.0	0.0	1.0	0.0	3.0	0.0	0.0	1.0	18.0	1.0	11.0	1.0	8.0	1.0
8	S8	0.0	1.0	0.0	0.0	0.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	S9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
10	S10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	S11	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	2.0	2.0	2.0	2.0	2.0	2.0
12	S12	2.0	6.0	0.0	1.0	0.0	0.0	10.0	0.0	1.0	0.0	1.0	0.0	1.0	4.0	2.0	1.0	1.0
13	S13	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	1.0	0.0	1.0	2.0	1.0	1.0
14	S14	0.0	11.0	0.0	1.0	0.0	0.0	10.0	0.0	0.0	0.0	1.0	2.0	2.0	0.0	1.0	1.0	1.0
15	S15	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	2.0	2.0	1.0	0.0	1.0	1.0
16	S16	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	0.0	1.0
17	S17	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0

Import CSV Variable

Load Close

Figure 5.3 LGO Lesson 15 Matrix in Netminer

In addition while collecting the messages to enter into the network matrices, I also documented the topic of the message and conversation threads into the predefined TRA categories (section 3.3.2) as can be seen in Figure 5.4.

Microsoft Excel - TRA-Lesson1.xls

File Edit View Insert Format Tools Data Window Help

Arial 10

B7

	A	B	C	D	E	F	G	H	I	J	K
1		THREADS					Messages Posted				
2		A1	A2	B	C1	C2	A1	A2	B	C1	C2
3	S1	1	0	0	0	0	1	0	0	0	0
4	S2	4	4	1	0	0	4	10	2	0	0
5	S3	1					1				
6	S4		1		6			1		7	
7	S5				1					1	
8	S6		1					1			
9	S7	15	29	24	18		18	36	26	38	
10	S8		1		1			1		1	
11	S9				1					1	
12	S10				1					1	
13	S11		1					2			
14	S12	3	1		2		4	1		2	
15	S13		1		1			1		1	
16	S14	2	2		3		2	2		3	
17	S15		1		3			1		3	
18	S16	1	3				2	3			
19	S17		1					1			
20	S18		1					1			
21	S19	1	1		1		1	1		1	
22	S20		1					1			
23	S21		1					1			
24	S22				1					1	
25	S23		1		2			2		2	
26	S24				1					1	

Threads Messages Cummulative

Ready

Figure 5.4 LGO Lesson 1 TRA collection

This process was repeated 15 times (for SNA and TRA), once for each of the 15 lessons on the LGO course (each lesson had its own discussion board). This way the evolution of the social network could be documented and visualized.

- **COLLES & ATTLS:** To obtain the students' Learning Styles along with their feedback on the course and online learning, the two questionnaires COLLES and ATTLS were used. They were both included on the homepage of Lesson 1 of the course and like everything in the course it was up to the students if they wanted to answer them or not. Figure 5.5

shows a screenshot of the collection of the students' answers to each of the questions of the COLLES survey.

Microsoft Excel - COLLES.xls

File Edit View Insert Format Tools Data Window Help

Arial 10

A1 group

	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Student	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q1
2	S6	5	3	3	3	5	4	3	4	3	3	4	4	3	3	4
3	S7	1	1	1	1	5	5	5	5	2	3	2	3	4	3	4
4	S14	5	1	3	2	3	3	4	4	3	2	1	4	1	1	1
5	S31	5	5	5	5	5	5	5	5	1	1	1	1	1	1	1
6	S32	4	3	3	3	4	4	2	4	2	2	2	2	4	4	4
7	S40	4	1	4	2	4	4	4	4	3	3	2	2	3	3	3
8	S42	5	1	1	1	3	3	3	5	3	3	3	3	3	3	5
9	S44	5	2	1	1	4	1	1	3	1	1	1	1	1	1	1
10	S51	5	5	5	5	3	4	3	3	3	3	3	3	5	5	5
11	S59	4	1	1	1	5	1	3	5	3	3	3	5	5	4	4
12	S63	4	2	2	2	4	4	2	4	1	1	1	1	4	4	4
13	S67	5	3	4	4	4	4	3	5	3	2	2	4	4	3	4
14	S68	5	1	1	1	4	1	1	1	1	1	1	1	1	1	1
15	S75	5	3	3	3	4	4	4	4	4	4	4	4	4	4	4
16	S81	4	3	3	3	4	4	3	4	1	1	1	1	1	1	1
17	S83	5	1	1	1	5	3	3	5	3	3	3	3	3	3	3

Figure 5.5 Student answers to the COLLES

Once all of the data was collected I was able to carry out their analysis. For the SNA part of the analysis I used an SNA tool called "NetMiner for Windows" (Cyram, 2004). NetMiner is explained below.

5.3.1 Netminer for Windows

In this study I wanted to analyze the students' behavior in an online learning environment. The software chosen for the data analysis was Netminer for Windows (Cyram, 2004). For my purposes Netminer's functionality fitted better than the other leading SNA packages since it provides both a statistical and visual representation, which are both needed in my investigation. Table 5.1 shows the scores (on a range from -- to ++) on a comparative study Huisman et al (2005) conducted on SNA software.

Table 5.1: Scores for SNA software (Huisman et al., 2005)

	Funtctionality					Support		User-
	Data	**Visual**	**Descr.**	**Proc.**	**Stat.**	**Manual**	**Help**	**Friendliness**
MultiNet	+-	+	+-	+	+-	+-	++	+
NetMiner	++	++	++	++	+-	+	+	++
Pajek	+	++	+	++	0	-	0	+-
StOCNET	+-	0	+-	0	++	+	+	+
STRUCTURE	-	0	+-	++	+	++	0	+-
UCINET	++	+	++	++	+-	+	+	+

Furthermore, as can be seen from Table 5.1, Netminer also scored higher than its competitors in the following areas: Data, Visual, Descriptions and User-friendliness. Not all of the SNA software provided the visual analysis and sociograms that I needed and since this was an important aspect of my framework I preferred to use a single program that was capable of both the statistical and visual analysis. In addition NetMiner is straightforward to use. The only drawback was that the various analyses would take a long time, but this was not a limitation of the software, it was due to the large number of students taking part in the course.

After successfully using Netminer on a case study (Laghos & Zaphiris, 2005), I have decided to continue using the software for my new SNA studies.

5.4 SNA results

SNA is useful for describing relations based on traditional synchronous communications like face-to-face and telephones, and extending them to online asynchronous communication is a significant step (Aviv, Erlich & Ravid 2003).

To better understand the formation of the social network of LGO, a closer look was taken at its evolution. The vast majority of SNA studies focus on the final state of a network, but do not look into detail at how it was formed through time. Investigating the evolution of a course has several advantages. It enables the mapping out of the changes the network goes through and in addition, it becomes possible to investigate how specific course amendments, participation in computer-mediated communication, and/or conversation topics positively or negatively influence the dynamics of the online community. Thus, users of FESNeL can predict how certain actions will affect their network, and can incorporate various methodologies to alter the state of their network.

In the LGO course, there were 15 lessons - each with its own discussion board. Beginning from Lesson 1 the various types of SNA were carried out up until Lesson 15. This enabled me to follow closely the formation and evolution of the network. In order to better follow the evolution of the social network, the SNA results for the lessons are accumulated. For instance, L1 refers to Lesson 1, whereas L2 refers to both Lesson 2 and Lesson 1 combined. The next section discusses the network properties of LGO and this is followed by the evolution of the network.

5.4.1 Network Properties

After the students' communication interactions were collected and tabulated into the matrices, they were loaded into NetMiner so that the analysis could be carried out. In the first part of the analysis, the basic network properties of LGO were obtained.

As mentioned earlier LGO has a student database of around 50,000 students, however in my case study I have evaluated the interactions between students that used the discussion boards of one of the modules, specifically "Modern Greek

101 – Elementary", and in this case there were 618 students (also referred to as nodes in SNA terminology).

The students had contributed to 18,025 communication links between them (the strands between the actors). Their communication was characterized by direction (who sent a message to whom) and strength (ie. how many times student x sent a message to student y) (De Nooy and Batagelj., 2005). The majority of the communication strands in LGO were made in Lesson 1's discussion board (15583) and rose through the lessons to 18025 by Lesson 15. This shows that at the beginning of the course the students were very active and would send many messages to their peers. During the course progression however, even though their communication links increased, the rate of their communication fell (figure 5.6).

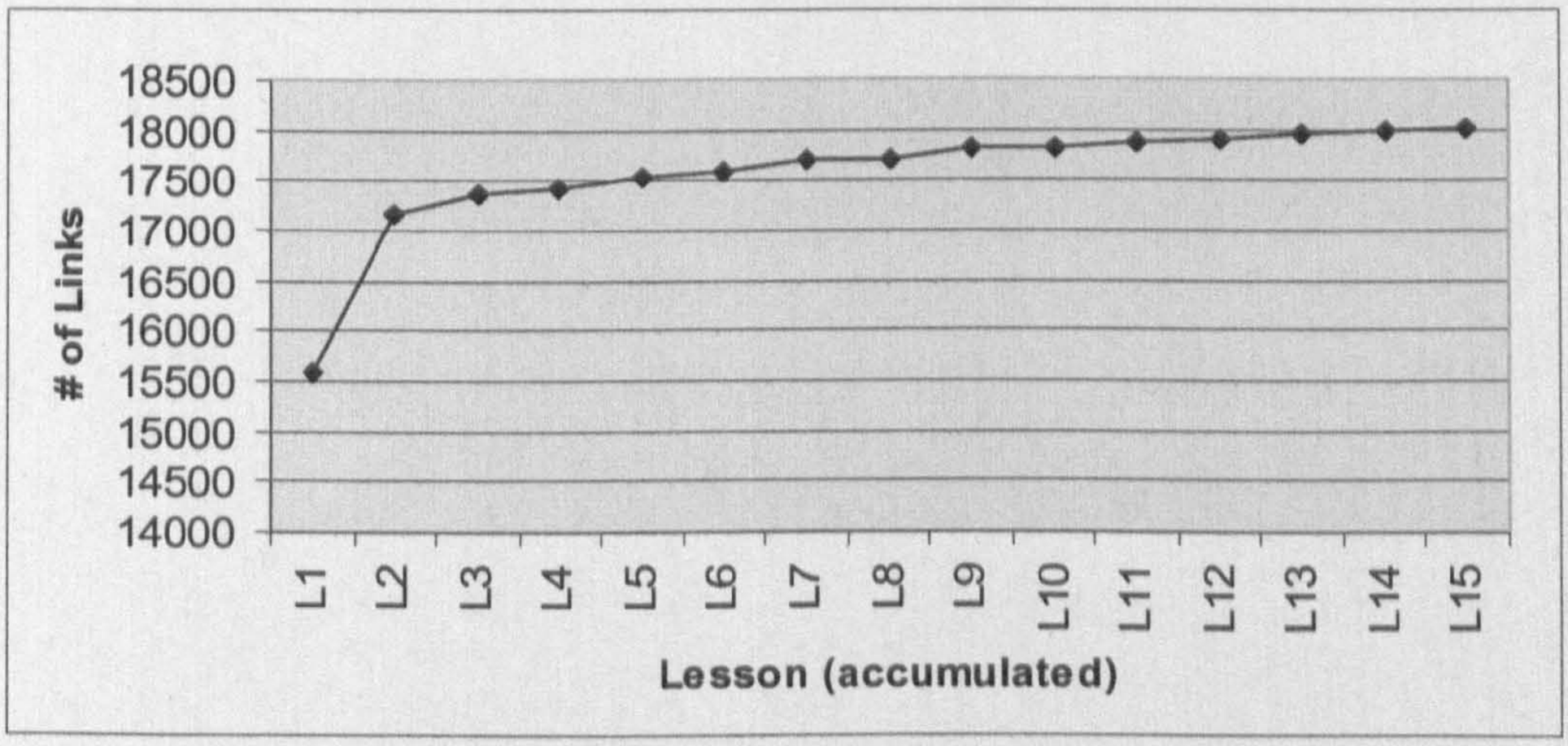


Figure 5.6 Student communication links in LGO

The other network properties that I have analyzed were the density of the network, the inclusiveness of the students, and the matrix statistics and they are explained below.

The density of a network is the ratio of the number of links present in the network, to the maximum possible links. Density values range from 0 to 1. In the simple example of a 3 person network, the maximum number of possible links is 3 (given that all actors are connected to each other). However if only 2 of the students are connected then there is only 1 link between them, and therefore the density of that network would be 1/3. In the case of the LGO network the density is 0.047. This means that 4.7% of all the possible links are present. This is quite a low density but this is expected because of the large population of the course. In networks with few members it is easier for the students to communicate with most of their other peers, but since this LGO course has 618 students this was not the case.

Inclusiveness is the number of connected points expressed as a proportion of the total number of points (Roberts Jr., 2000). In other words it is the number of connected students over the total number of students in the course. Students that have no connections with other students are called Isolates. In the LGO case inclusiveness is 1, which means that by the end of the course, all of the studied students had posted at least one message each in the discussion board making a connection with at least one of their peers.

Figure 5.7, shows the evolution of participants vs. isolates of all the students in the LGO network. Before the course began isolates was 100% since there were no participants, and therefore no connections. At lesson 15, there were no isolates and thus the inclusiveness was 100%. The major shift was at lesson 1 were over 80% of the students participated in the discussion forums. This is due mainly because at the beginning of the course the students were more excited, they wanted to make sure they are in the right course, and they wanted to meet their fellow class mates. Gradually this number went to 100% by the end of the lesson.

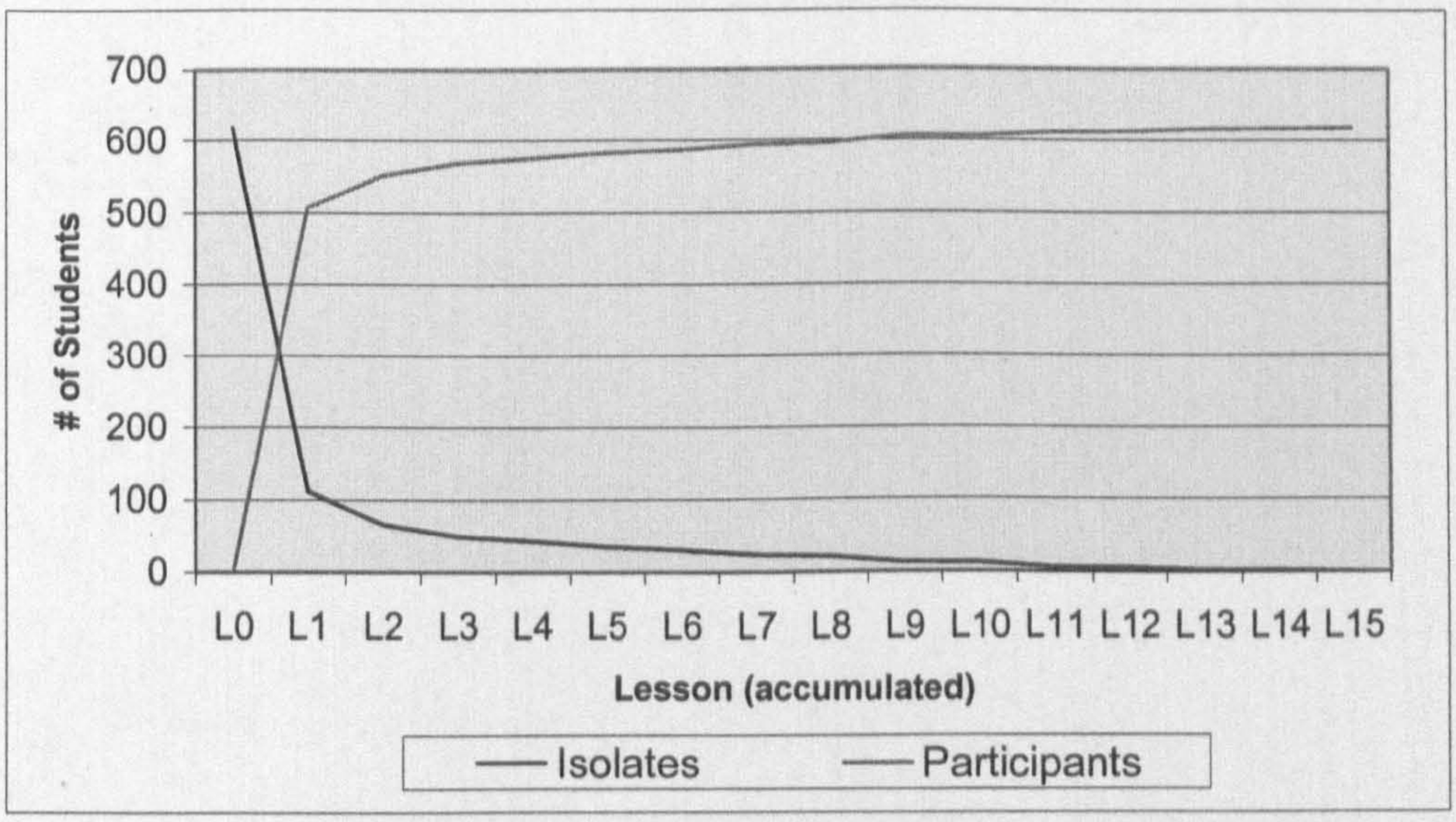


Figure 5.7: Evolution of Participants vs Isolates in LGO

Furthermore, the LGO matrix statistics were obtained. Table 5.2 shows the result of the frequency matrix, that is, how many times a specific value (the number of connections between a pair of students) appears in the matrix.

The most frequent value was 0 which made up 95.3% of the total values in the matrix. This tells us that only 4.7% of all the possible student-student pairs had interacted with each other. As can be seen in Table 5.2, the frequency of each value decreases as the value itself increases. This means that the higher the number of interactions between a pair of students, the lower its occurrence. For example if students X and Y had 200 interactions between them, since this is a high frequency it would not occur often.

The proportion represents the ratio of the frequency of a value over the total of frequencies which is 381,306 (there are 618 students in the course therefore it is a 618 x 618 matrix).

Table 5.2: Result of Frequency Matrix

Value	Frequency	Proportion	Cumulative Proportion
0	363281	0.953	0.953
1	14701	0.039	0.991
2	2587	0.007	0.998
3	457	0.001	0.999
4	102	0	1
5	62	0	1
6	35	0	1
7	26	0	1
8	10	0	1
9	8	0	1
10	11	0	1
11	6	0	1
12	6	0	1
13	2	0	1
15	4	0	1
17	2	0	1
18	2	0	1
19	1	0	1
20	1	0	1
27	1	0	1
35	1	0	1
Total	381,306	1	
Mean	0.06		
St. Dev	0.33		

The mean frequency is 0.06 and tells us that if every student had interacted with his/her peers, this would only be on an average of 0.06 times per student. This is understandable since in large networks of this size it is not expected that the students will interact with so many of their peers. Also, as will be seen in section 5.4.4 the students form cliques (subgroups) with other students and usually interact with the students in the same cliques as them.

The highest values of the matrix (19, 20, 27, 35) were only present in the matrix once each. These values show the number of messages sent from one student to another. Therefore, the highest amount of communication between any 2 students was 35 messages. This shows that several pairs of students had chosen to interact at a much higher frequency with a specific peer of theirs, and at lesser extent with the other students in their course.

Following the network properties, I have used SNA to analyze the 4 categories of the standard social network analysis modules, namely the connection, centrality, cohesion and equivalence of the LGO network and these are explained in more detail in the sections that follow.

5.4.2 Connection

In this section I have analyzed the basic connection structure of the LGO network. Figures 5.8 and 5.9 are connection sociograms that show the structure of the state of the LGO network in Lesson 1 and Lesson 15 respectively (connection sociograms for all 15 lessons on the LGO network can be found in Appendix E). Connection Sociograms are graphs used in SNA where the nodes represent the students (the student names have been renamed S1 – S618 for privacy and anonymity reasons), while the strands between them represent their communication interactions. They are useful for providing visualizations of the

whole network, the students that are part of it, and the connections they have made with their peers. In addition the arrows show the direction of the message (which actor sent a message to which other actor).

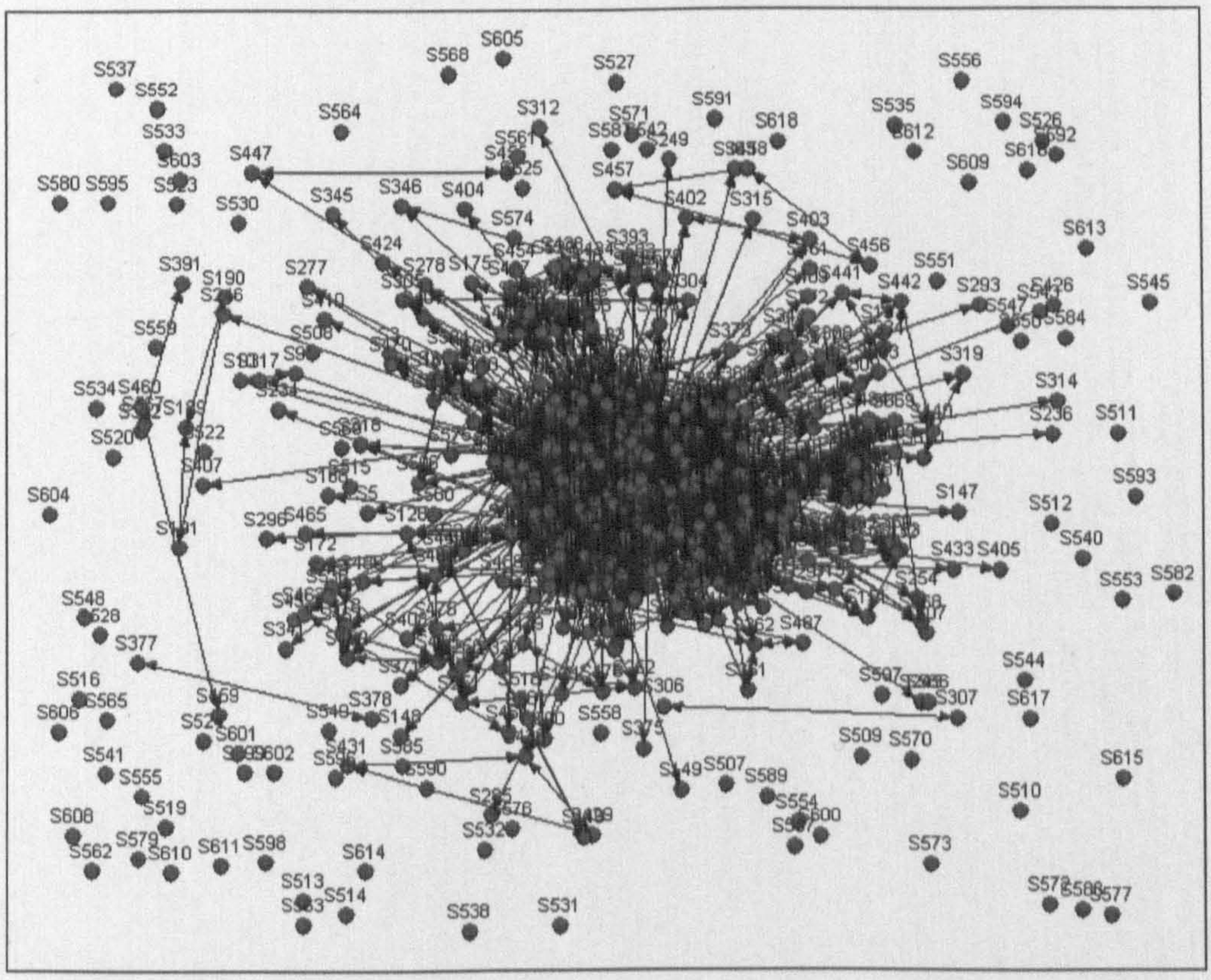


Figure 5.8: Lesson 1 Sociogram of the LGO students and their interactions.

When there is a line directly connecting two nodes (students) then these nodes are adjacent. When a node is one of a pair of nodes defining the line then this node is incident to the line. The number of lines that are incident with it is called nodal degree (Wasserman and Faust, 1994). In-degree is the number of lines that are incident to a node while out-degree is the number of lines that are incident from it. In other words, in-degree is the number of incoming connections a student has, whereas out-degree is the number of out-going communications. In LGO the degree values for both (in and out) is calculated to 29.17. This tells us

that on average each student receives direct communication from another 29 students, but also on average sends messages to another 29 students.

Nodes whose degree equals 0 are called isolates. Isolates are students that are part of the network but have not made any communication interactions with any of their peers. They might be observing the discussions silently, however they have not contributed to any of the discussions and no other students have made direct contact with them.

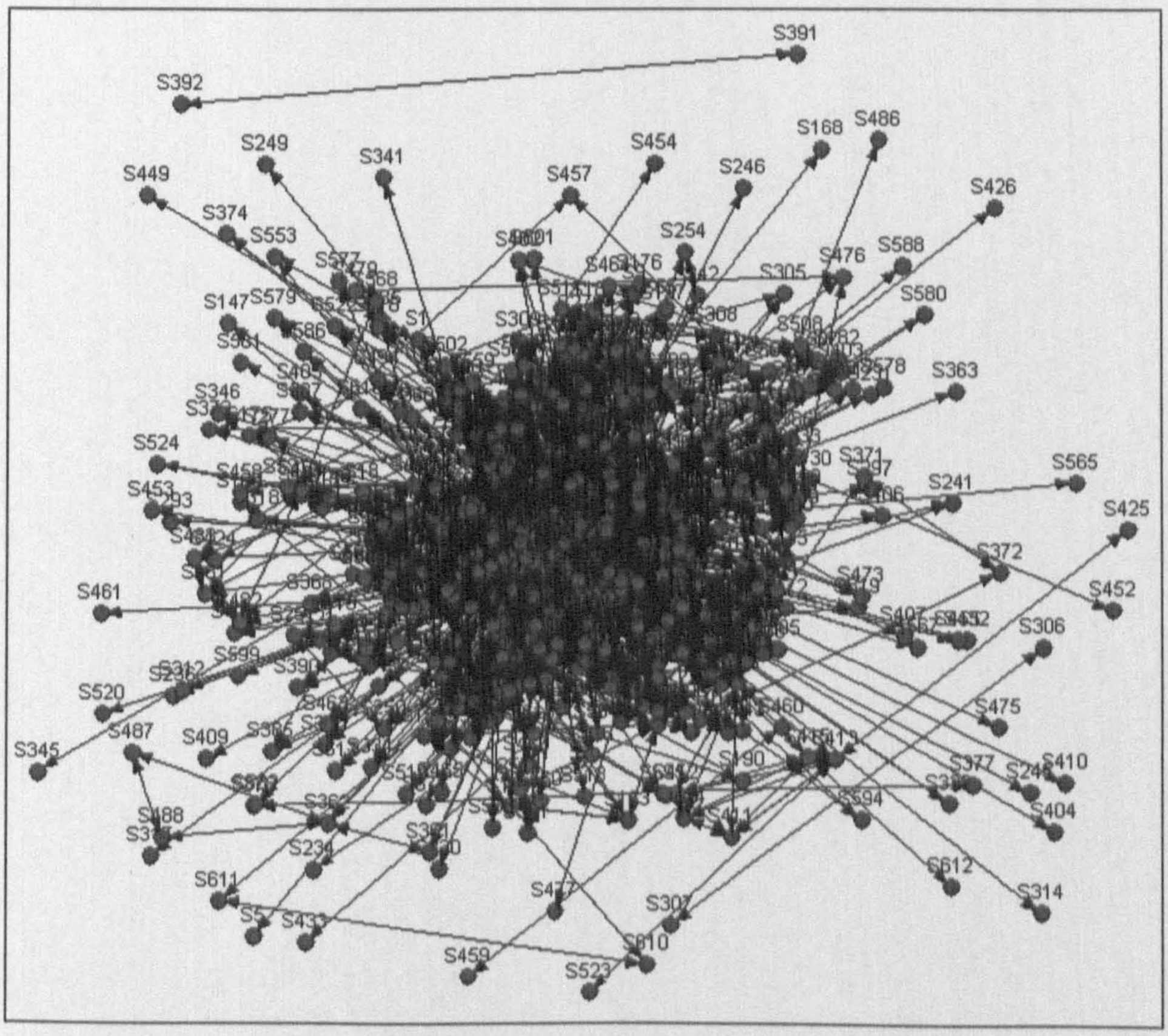


Figure 5.9: Lesson 15 Sociogram of the LGO students and their interactions.

In the first instance (Figure 5.8) it is clear that many students have no links and are isolated in the network. As the course evolved more students engaged in the discussions and finally, as depicted in Figure 5.9, every student studied ended the course with at least one connection with another student. As can be seen, most

students are closely bounded with each other but also there are some students which only interact with only one other student (e.g. S391 with S392 at the top of Figure 5.9). What this analysis tells us is that as the course progressed that students had interacted with more of their peers that they hadn't interacted with before. This made the network members closer and more connected with each other, since each student was indirectly connected to most of his/her peers through other students of the course.

In Ego-centered analysis of SNA the focus is on an individual as opposed to the whole network. This individual is called a focal node and the nodes that are adjacent to or from the focal node are called alter nodes (Burt,1992).

Ego-net size is defined as the number of nodes that are adjacent to or from a focal node (Burt, 1992). In this case the direction of the communication is not important. What counts is the number of nodes connected to the focal node (and this connection can either be incoming or outgoing). Mean value for ego-net size in LGO is 29.269. This means that on average each student in the LGO network is connected with 29 students. This value is similar with the average in and out nodal degree, since in most of their interactions the students send and receive an approximately equal amount of messages with each of their peers.

If a path exists between two nodes they are said to be reachable. The length of the shortest path between two nodes (often referred to as the optimal connection between two actors) is called Geodesic distance (Hanneman, 2001). Table 5.3

shows the reachable nodes and geodesic distances in LGO over the 15 lessons of the course.

Table 5.3 Geodesic Distance and Reachable Nodes in LGO

	Geodesic Distance				Reachable Nodes			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
L1	2.63	0.91	1	8	381.46	197.73	0	486
L2	2.59	0.85	1	7	457.16	182.43	0	532
L3	2.59	0.83	1	7	486.86	171.05	0	549
L4	2.59	0.82	1	7	497.57	166.01	0	555
L5	2.59	0.82	1	7	512.03	158.28	0	563
L6	2.59	0.81	1	7	519.34	153.92	0	567
L7	2.58	0.81	1	7	532.25	145.37	0	574
L8	2.59	0.80	1	7	535.97	142.69	0	576
L9	2.58	0.79	1	7	552.86	128.99	0	585
L10	2.57	0.78	1	7	556.65	127.71	0	586
L11	2.59	0.79	1	8	568.10	116.42	0	592
L12	2.58	0.78	1	7	570.02	114.34	0	593
L13	2.57	0.78	1	7	575.79	107.74	0	596
L14	2.57	0.78	1	7	577.73	105.40	0	597
L15	2.57	0.78	1	7	585.48	95.23	1	601

As can be seen in Figure 5.10, the mean geodesic distance is on a decreasing trend from 2.63 to 2.57 indicating that the network becomes more connected since the mean shortest path between two nodes decreases. At the same time, the average number of reachable nodes increased from 381.46 to 585.48 (Figure 5.11).

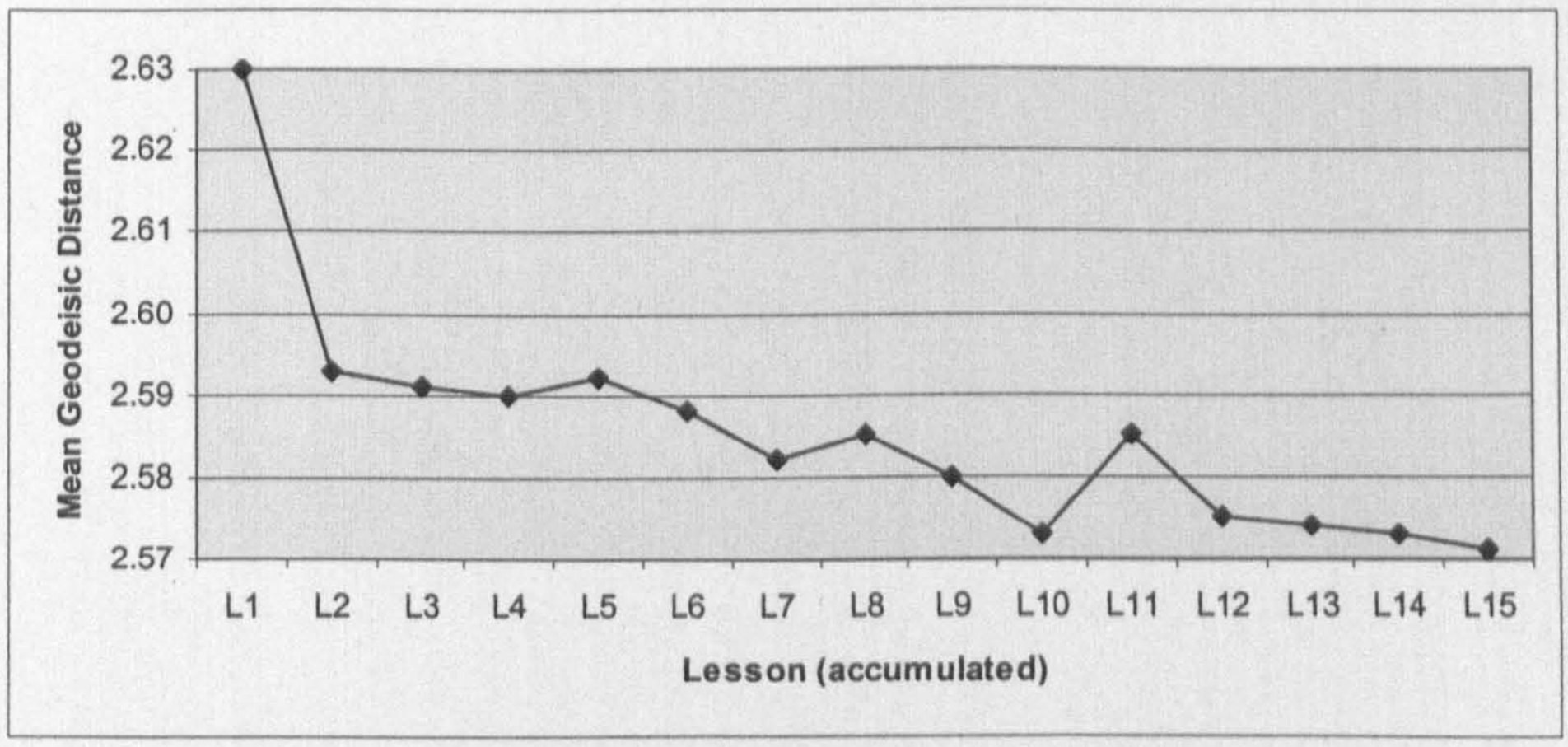


Figure 5.10 Geodesic distance in LGO

This increase in reachable nodes by around 53% indicates that the network has become more connected. Even though as pointed out earlier there are no isolates in LGO, the number of reachable nodes is not 618 (as the total number of participating students) since some of the students have only made single connections with students who themselves have no other connections. Thus although these students have made connections with each other, they are still outside of the overall network connection and a shortest path to them does not exist.

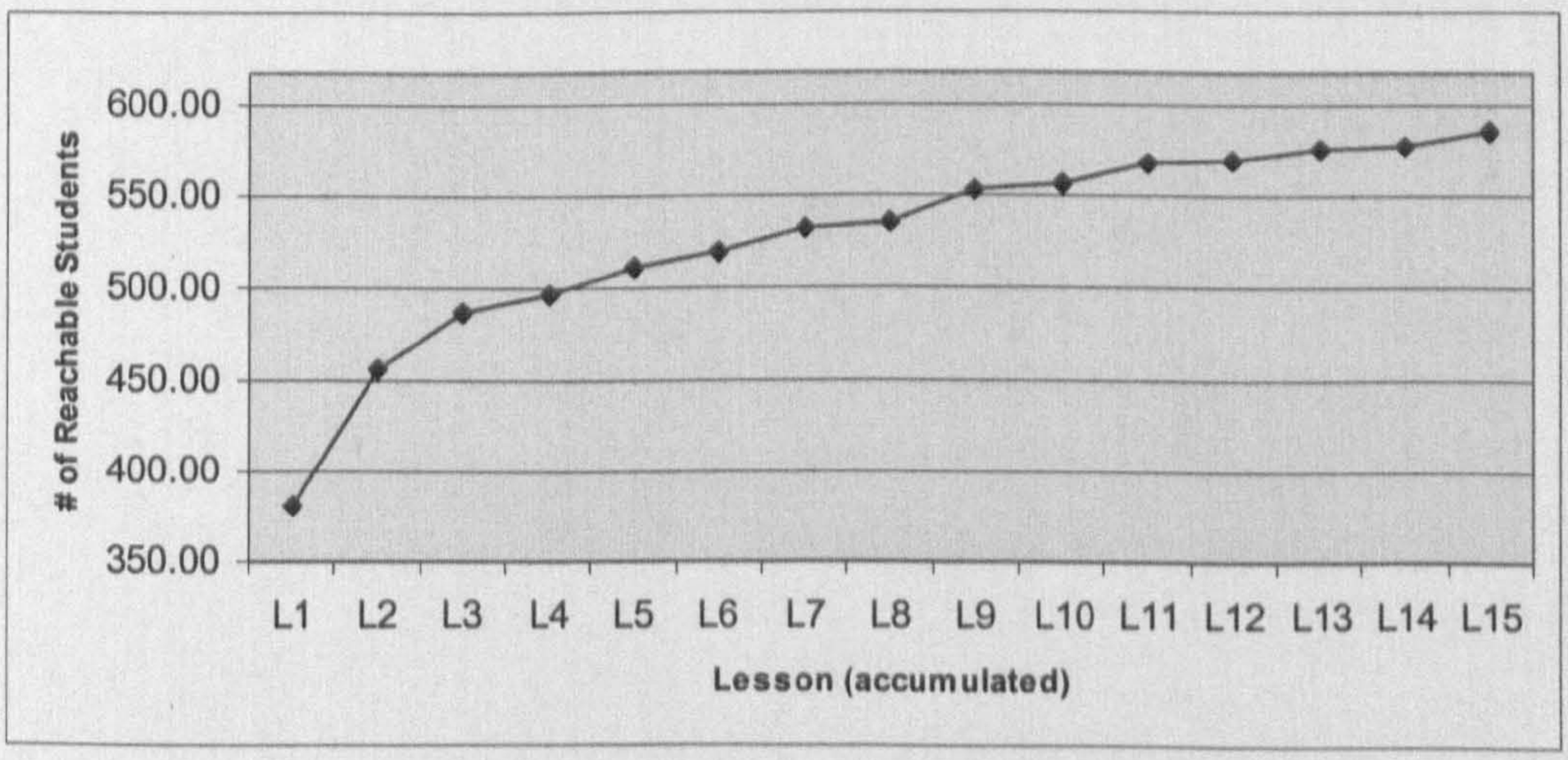


Figure 5.11 Reachable students in LGO

5.4.3 Centrality

In this section I present the analysis of the centrality structure of the LGO network. Degree centrality is measured by the portion of nodes that are adjacent to each node. The nodes with the highest degree scores are the ones who are more central (powerful) in the network. In a directed network (where the direction of the communication is important) like the LGO case, the in-degree centrality is the portion of nodes that are adjacent to each node, and out-degree centrality is the portion of nodes that are adjacent from each node (Freeman, 1979). In LGO the mean centrality in-degree and out-degree values increase from lesson 1 (0.041) to lesson 15 (0.047). I also took a more in-depth look at the evolution of the centrality degree in the course.

Table 5.4 shows the in and out centrality degree values for the LGO network. It can be seen that the mean in and out values are equal, while the standard deviation, min and max values per lesson only slightly differ between in and out. This indicates that central students of the course not only have the most incoming connections but also the most outgoing connections too.

Through the evolution of the course (Figure 5.12), the average centrality degree increased but only slightly, indicating that the more central students had gained and maintained their powerful status early on in the course. This can also be seen from Figures 5.13 and 5.14, which are the centrality sociograms of the mean out-degree values for lessons 1 and 15 of LGO (for all lessons' centrality sociograms see Appendix F).

In centrality sociograms the students with the highest centrality scores are placed in the middle of the graph, and the ones with lower centrality scores are in the graphs outer grids.

Table 5.4: Evolution of in-degree and out-degree centrality in LGO.

	In-Degree				Out-Degree			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
L1	0.041	0.064	0	0.423	0.041	0.064	0	0.425
L2	0.045	0.065	0	0.475	0.045	0.065	0	0.476
L3	0.046	0.066	0	0.488	0.046	0.065	0	0.488
L4	0.046	0.066	0	0.493	0.046	0.065	0	0.493
L5	0.046	0.066	0	0.501	0.046	0.066	0	0.501
L6	0.046	0.066	0	0.506	0.046	0.066	0	0.506
L7	0.046	0.066	0	0.515	0.046	0.066	0	0.515
L8	0.046	0.066	0	0.515	0.046	0.066	0	0.515
L9	0.047	0.066	0	0.527	0.047	0.066	0	0.527
L10	0.047	0.066	0	0.528	0.047	0.066	0	0.528
L11	0.047	0.066	0	0.533	0.047	0.066	0	0.533
L12	0.047	0.066	0	0.535	0.047	0.066	0	0.535
L13	0.047	0.066	0	0.538	0.047	0.066	0	0.538
L14	0.047	0.066	0	0.541	0.047	0.066	0	0.541
L15	0.047	0.066	0.002	0.548	0.047	0.066	0.002	0.548

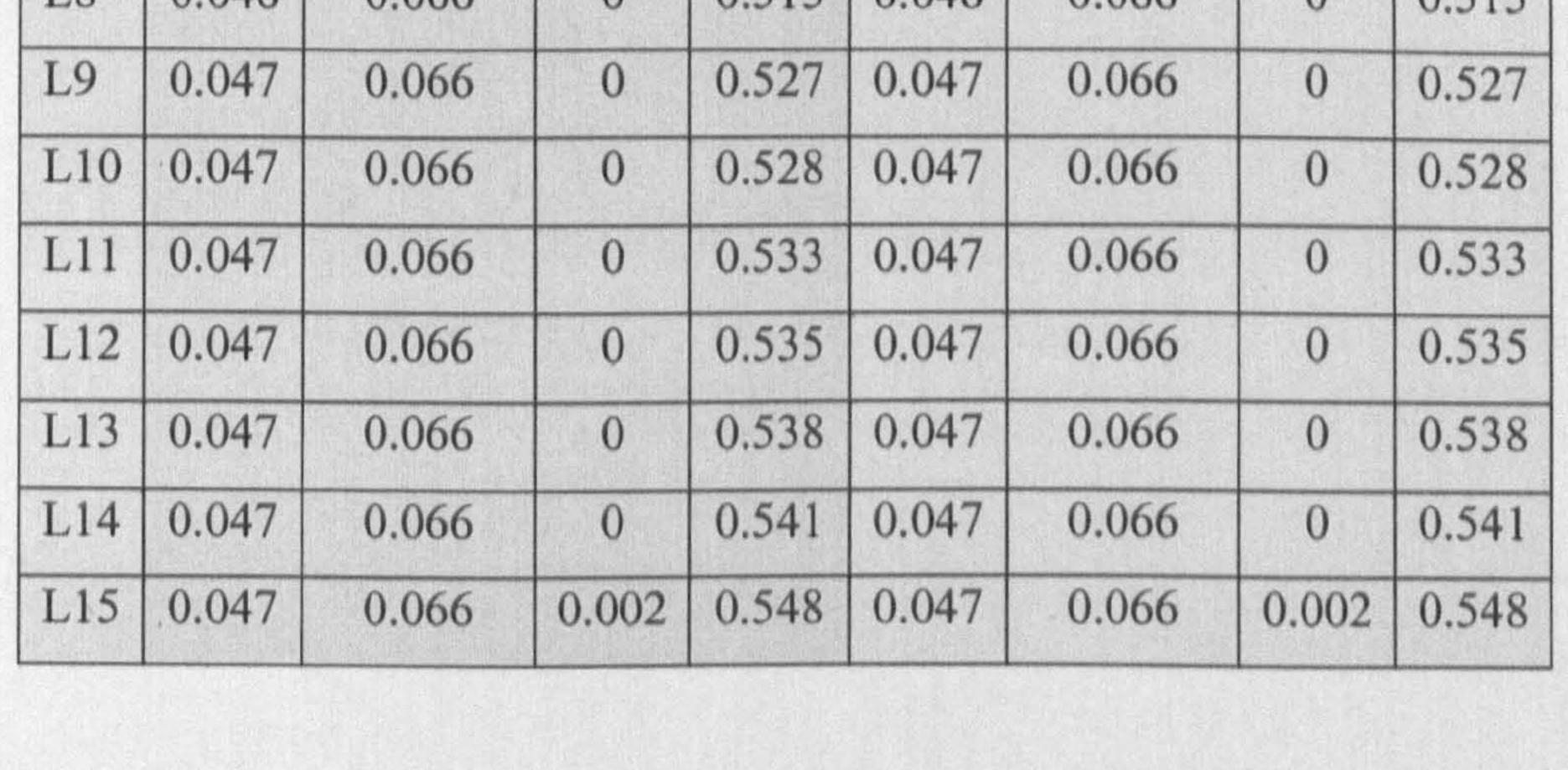


Figure 5.12 Evolution of Centrality degree in LGO

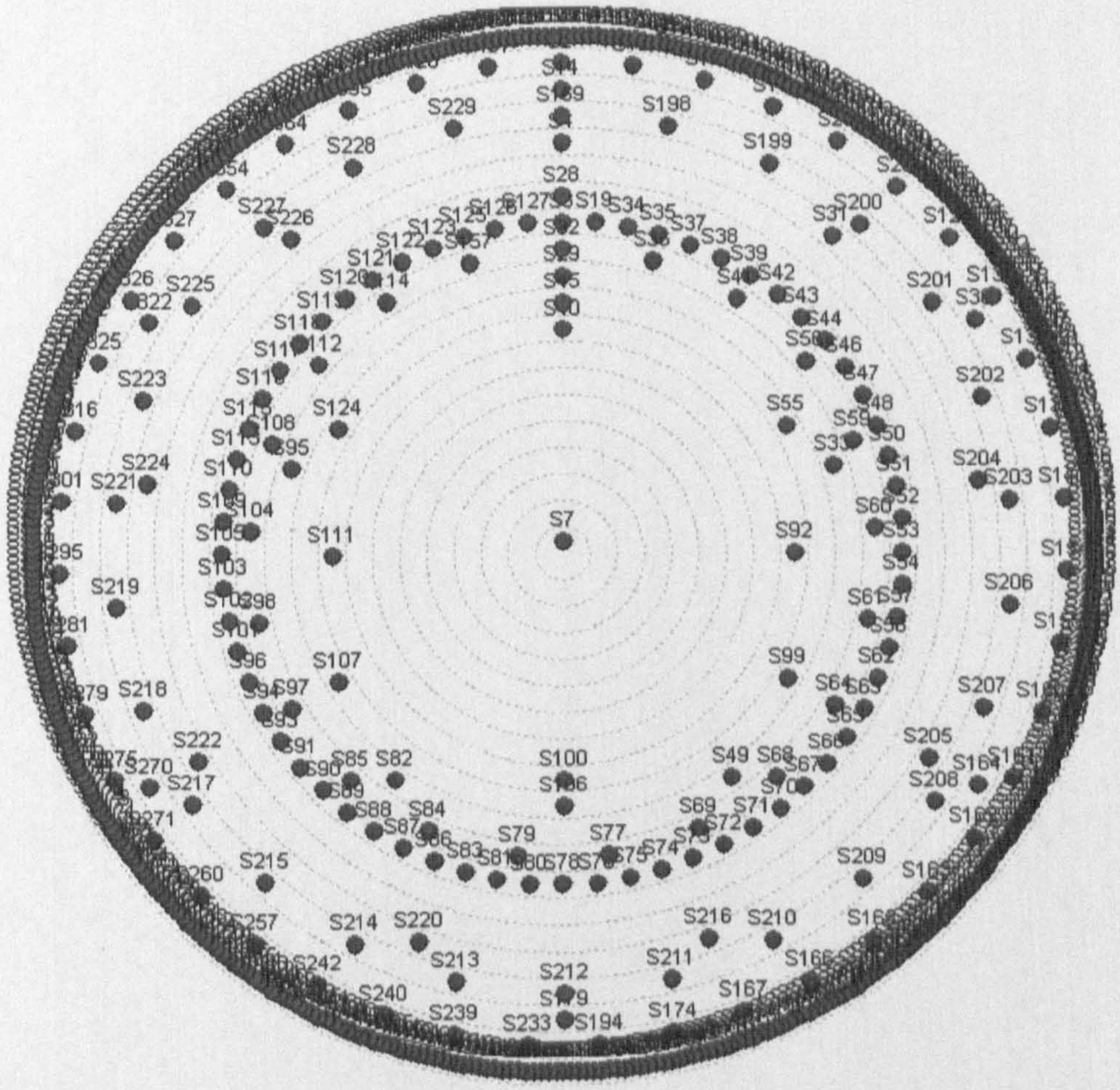


Figure 5.13: Lesson 1 out-degree centrality.

S7 is clearly the most powerful student of the course and became as such from the very first lesson. Students like S45, S111, S92, S91, S61 are not as central as S7 but they are the ones present in an outer cycle of the sociogram, whereas the majority of the students are in the farthest grid circles of the sociogram and thus have the least power in the LGO network.

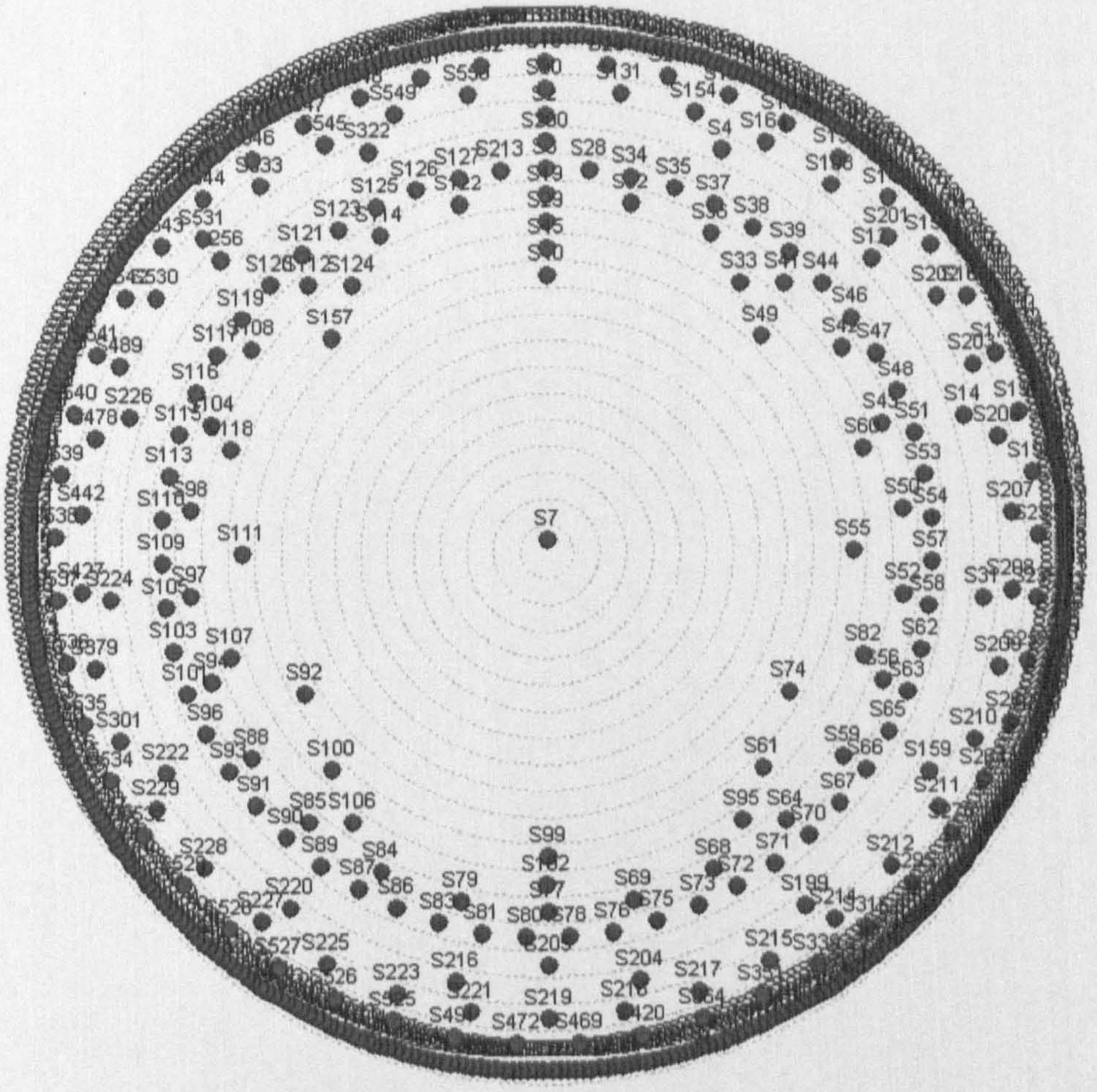


Figure 5.14: Lesson 15 out-degree centrality.

Similarly, Figures 5.15 and 5.16 show the centrality in-degree sociograms for lessons 1 and 15 respectively. As can be seen, it is the same students who possess the central positions in the in-degree and out-degree sociograms.

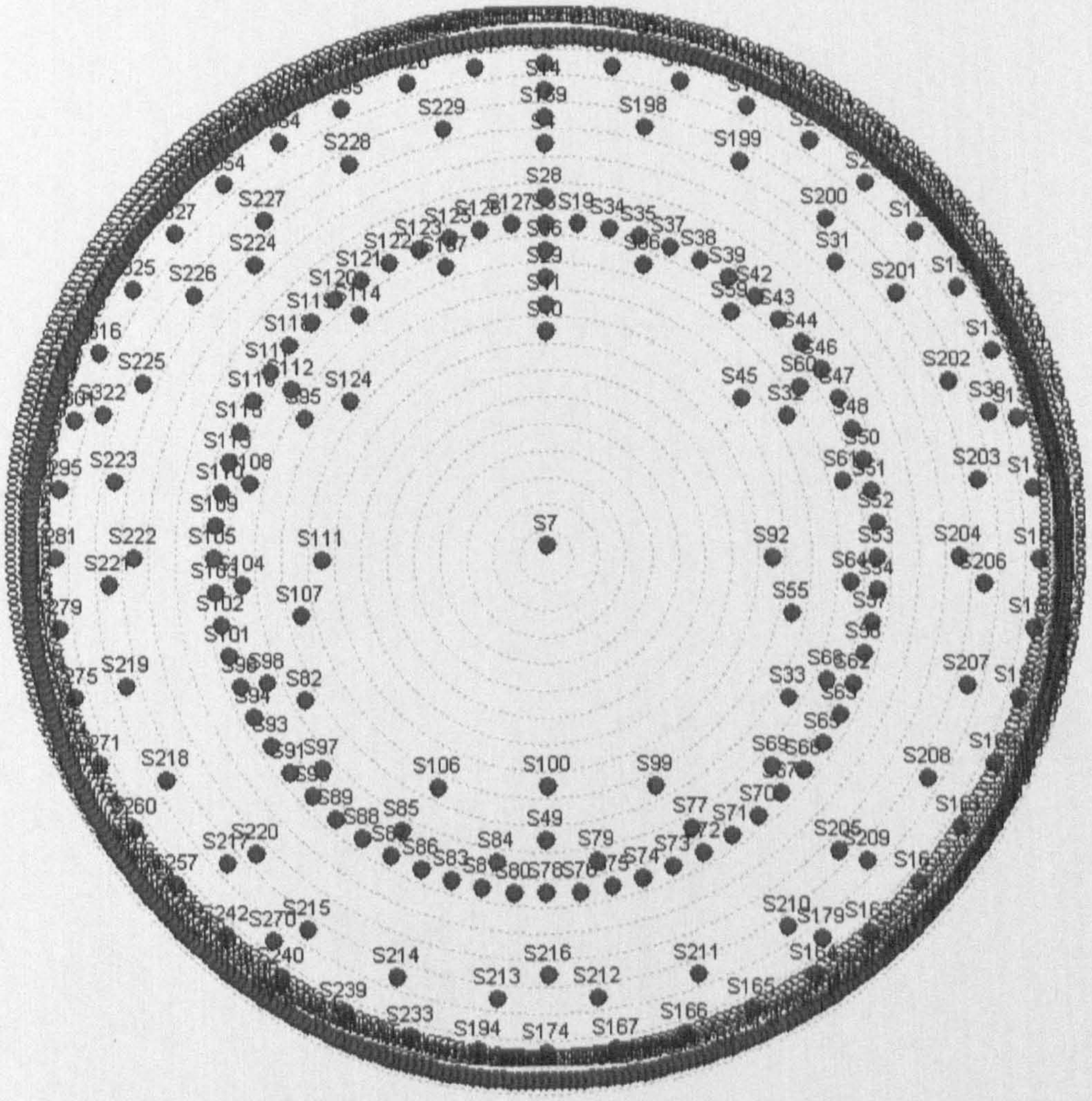


Figure 5.15: Lesson 1 In-degree Centrality

This result shows that the students who participated and posted the highest number of messages in the discussion boards were the same ones who received the highest number of incoming messages.

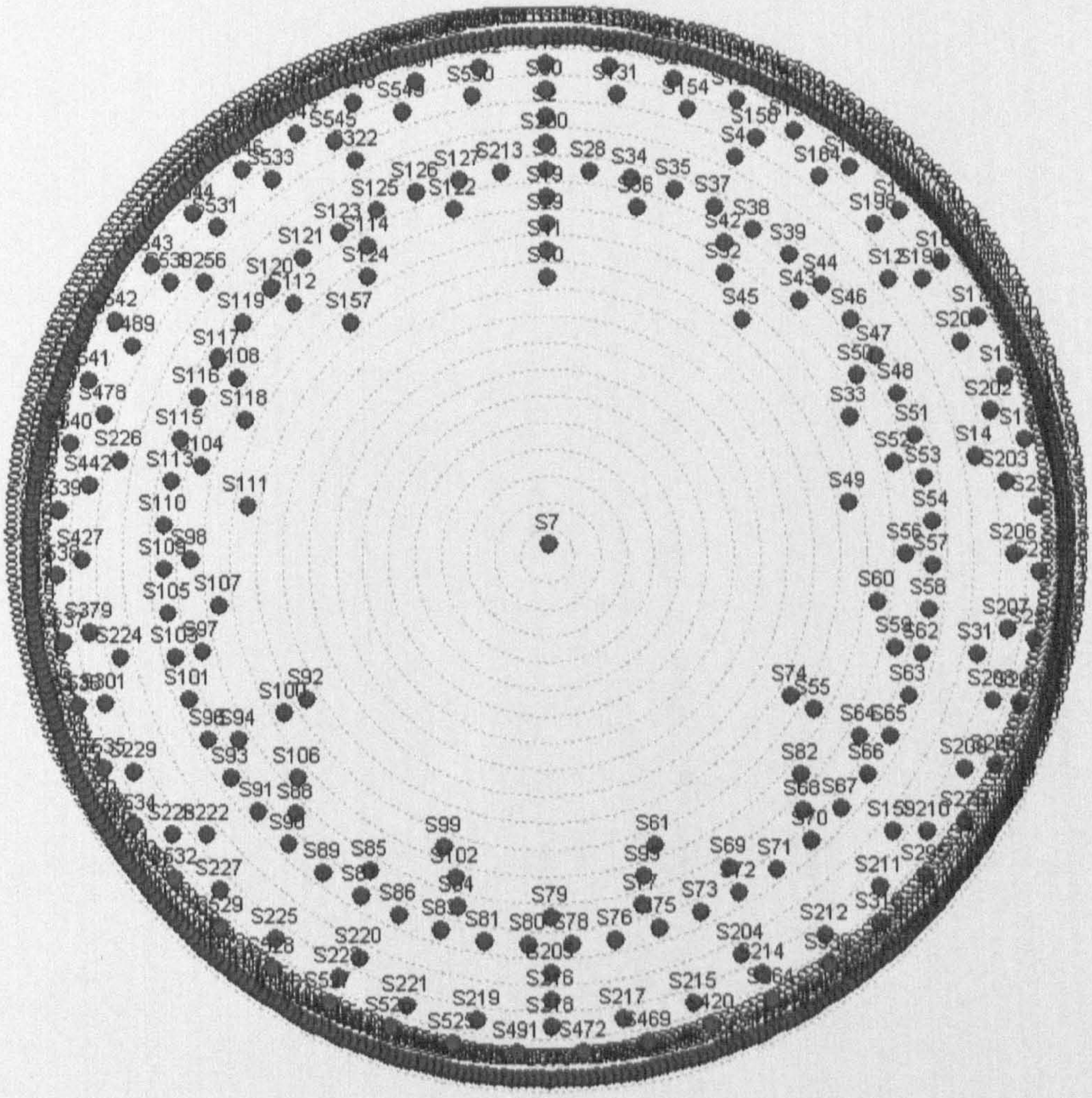


Figure 5.16: Lesson 15 In-degree Centrality

5.4.4 Cohesion

Here I present the analysis of the cohesion structure of the LGO network. A clique is a maximal complete subgraph of three or more nodes which are adjacent to each other, and there are no other nodes in the network that are also adjacent to all of the members of the clique. Cliques may overlap, meaning a node can be a member of more than one clique (Bock and Husain, 1950). In the LGO case, I have carried out the evolutionary clique analysis on cliques with a minimum

number of 3, 5, 10, 20, 50 and 100 members and the results can be seen in Table 5.5.

Table 5.5: Evolution of LGO Cliques.

	Cliques with at least n number of members					
	3+	5+	10+	20+	50+	100+
L1	259	160	38	4	1	1
L2	302	188	46	6	1	1
L3	343	215	49	6	1	1
L4	351	219	50	6	1	1
L5	380	239	53	6	1	1
L6	394	248	53	6	1	1
L7	424	271	58	7	1	1
L8	426	271	58	7	1	1
L9	440	283	58	7	1	1
L10	448	290	58	7	1	1
L11	456	299	58	7	1	1
L12	469	311	58	7	1	1
L13	469	310	58	7	1	1
L14	472	311	58	7	1	1
L15	480	321	58	7	1	1

The clique that had over 50 members (which is therefore the same clique that had 100+ members since there was only 1) had developed from as early as lesson 1 (Figure 5.17). This was because at the beginning of the course, the students were interested to get to know one another and make friends with the fellow classmates.

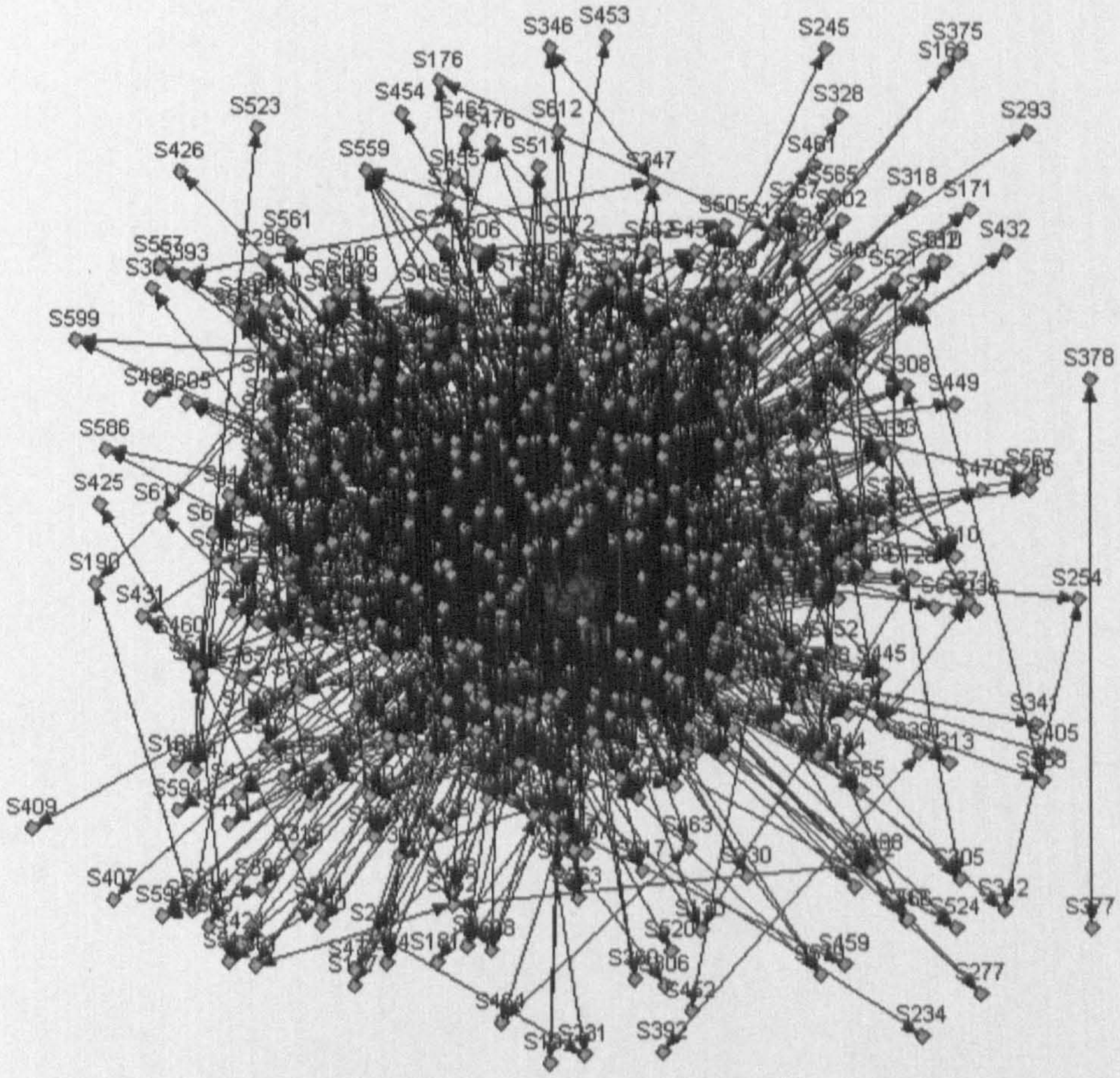


Figure 5.17: The only clique with 50+ members in LGO (G1 in centre)

The cliques with 10+ and 20+ students increased gradually from lesson to lesson (Figure 5.18). Cliques with 3+ and 5+ members kept on increasing in size with every lesson with the exception of one 5+ member clique being dropped in lesson 13.

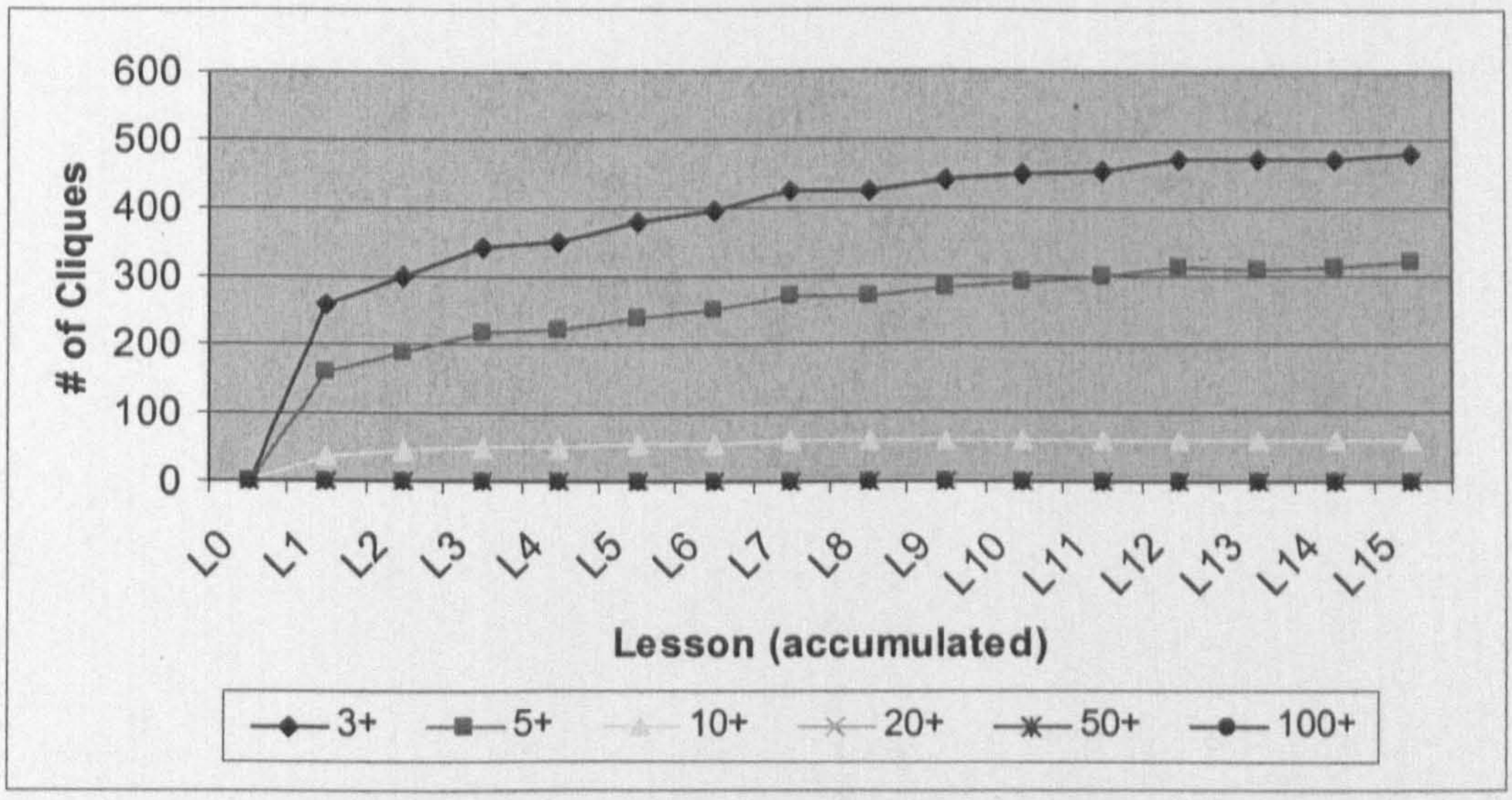


Figure 5.18 Evolution of Cliques in LGO

These results indicate that communication in the social network remained active and more and more students would interact with peers they hadn't exchanged messages with before. This increase was mostly in the cliques with a minimum of 3 or 5 since it takes less time to make subgroups with a lesser amount of peer students.

5.4.5 Equivalence

In this section I present the analysis of the equivalence of the LGO network. Equivalence of the network members shows when two actors have similar patterns of relations. In other words, students with similar communication behaviors are grouped together. As Hanneman (2001) points out, "Being able to define, theorize about, and analyze data in terms of equivalence is important because we want to be able to make generalizations about social behavior and social structure". In these circumstances, actors must not be thought about as unique persons, but as examples of categories (sets of actors) who are in some way, "equivalent" (Hanneman, 2001).

Two nodes are said to be structurally equivalent if they have identical ties with themselves, each other and all other vertices (de Nooy et al., 2005). In other words two nodes are structurally equivalent if they have the same relationships to all other nodes, and thus, the two nodes may be substitutable since they have the same social roles in the network

The aim of equivalence is to classify actors with similar roles into role groups. Figures 5.19 and 5.20 are structural profile sociograms of lesson 1 and 15 of the LGO network respectively (additionally, for the structural profile sociograms of lessons 5 and 10 see Appendix G). These types of SNA sociograms illustrate the role of the students. As can be seen from Figures 5.19 and 5.20, "the analysis consists of embedding the actors in a certain role space" (Aviv et al, 2003), identifying clusters of students and then carrying out subsequent cluster analysis to identify the roles of the groups.

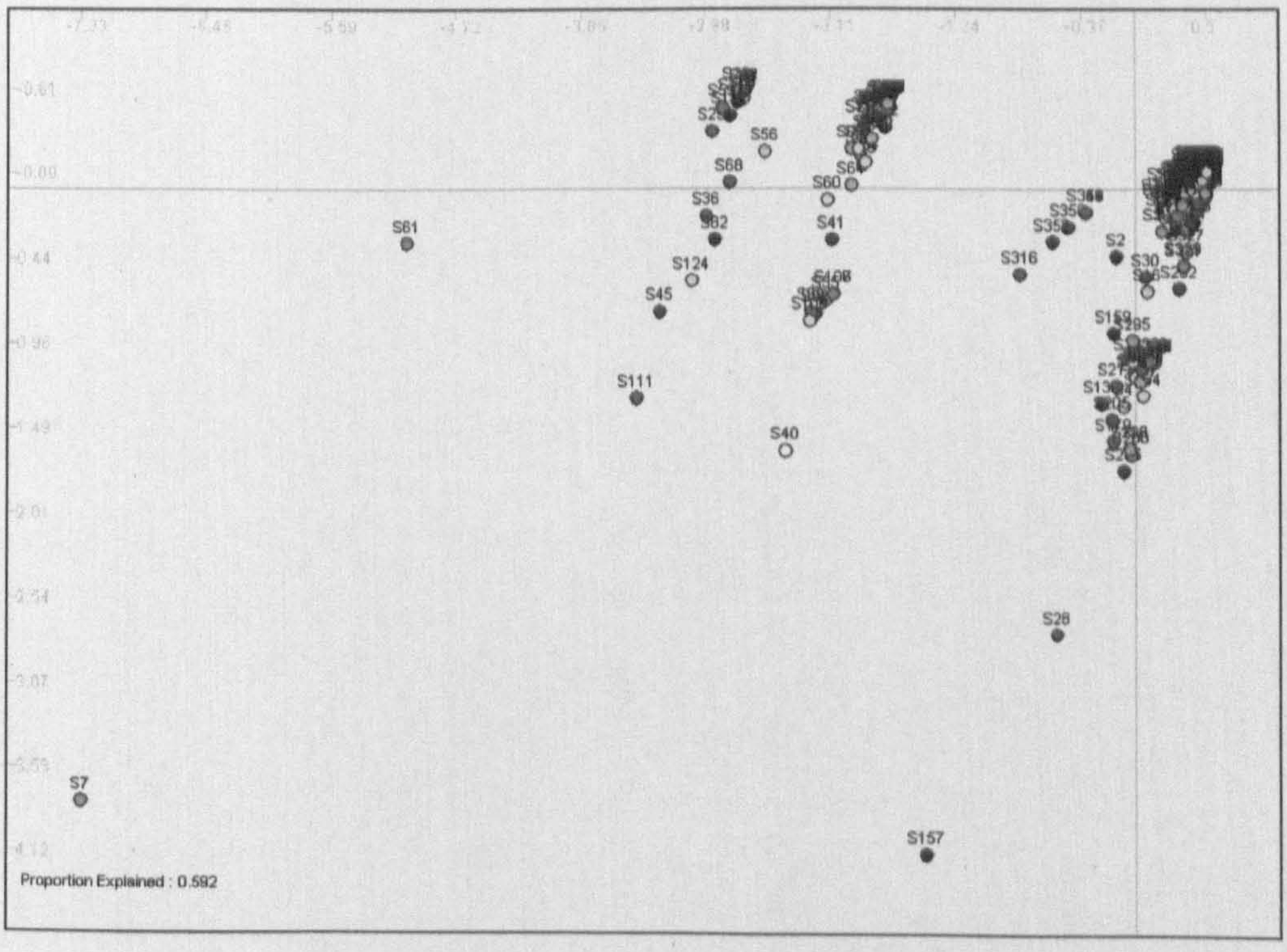


Figure 5.19: Lesson 1 Structural Profile

In such sociograms, the actors that are closer to each other are the ones with the most similar patterns of communication. The most active students (S7, S157) had separated themselves from the others as early as lesson1. As can be seen, S7 is the actor furthest away from all the other nodes suggesting that his style of interaction in LGO was unique from the rest of the students. The other students are dispersed around, but are much closer to each other in comparison to the more active individuals. During progression of the course however, these dispersed students have moved closer to each other forming clusters of students. This tells us that some groups of students had very similar interaction patters amongst them.

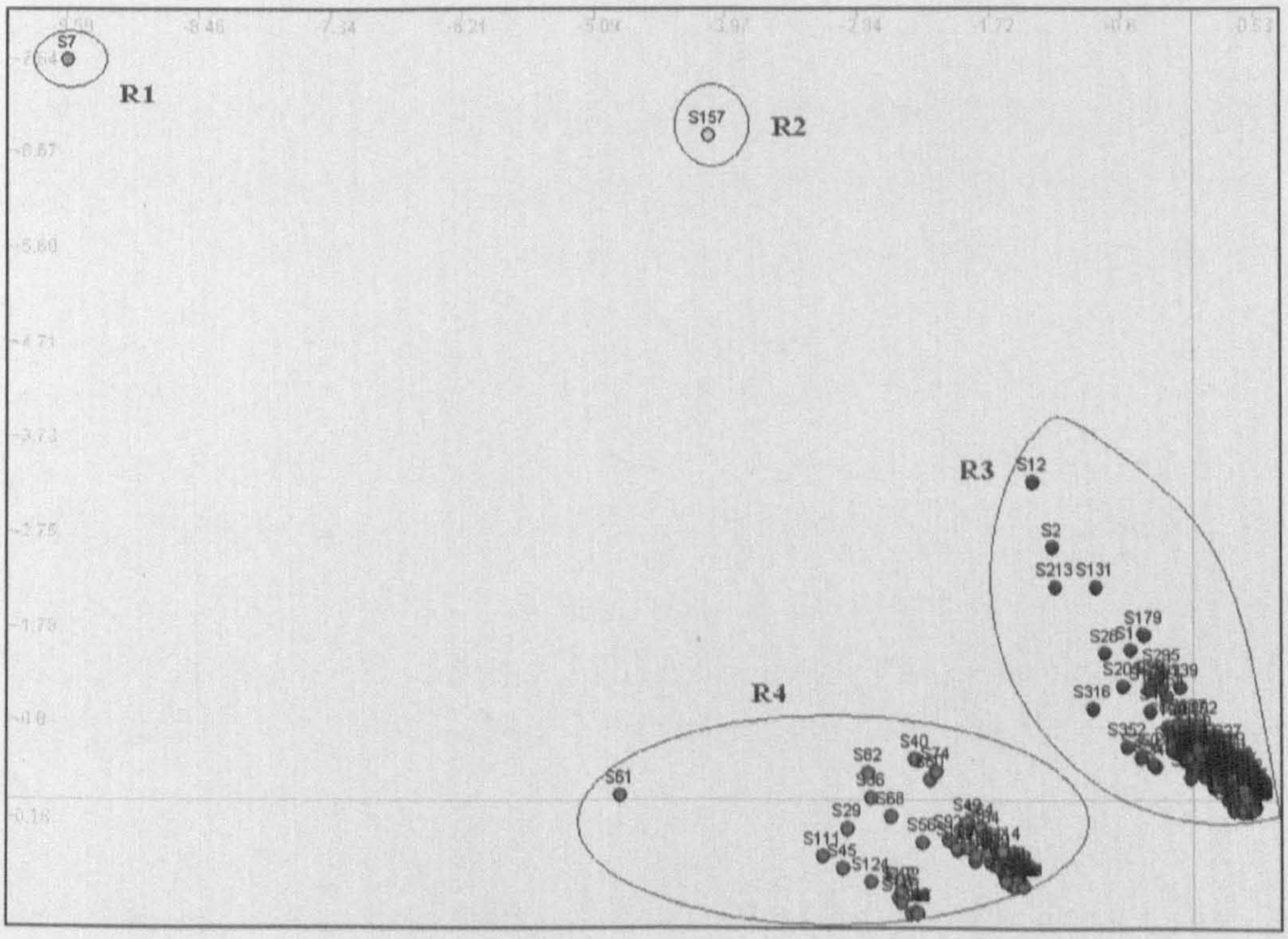


Figure 5.20: Lesson 15 Structural Profile.

By the end of the course, four main roles have been identified and these have been grouped and named R1, R2, R3 and R4 (circled in Figure 5.20). In R1 we only have one student, namely S7, and in R2 it is S157. These two students'

interaction patterns are so distinct from those of the rest of the students, so they are in a group of their own. R3 is a cluster of students with S12 and S2 managing to separate themselves a bit from the rest of the students in the cluster. Finally R4 is composed of another cluster of students where the only member who is not as similar as the rest is S61. The four role groups have been analyzed in more detail in the next section.

5.5 SNA of Role Groups

Having used SNA to categorize the students into four role groups (R1, R2, R3, R4) I have studied and analyzed these groups in more detail to produce their specific group related communication characteristics. In the next section I use the students' individual SNA results to get interaction related characteristics of the roles groups, and in the next chapter this is expanded to include the results of their TRA, COLLES and ATTLS.

5.5.1 Role Group - R1

From Figure 5.19 it can be seen that R1 is in the farthest corner of the structural profile and further away from the rest of the students. To analyze the role group R1, I collected the ego-net social network analysis measures of the only student in R1 (S7).

The in-degree and out-degree centrality score of S7 was 0.55 (that's 55% of the total contributions from all students in the course). This shows that S7 was involved in a little more than half of the overall communication that took place in the course, in both incoming and outgoing exchanges. His neighbour out and in degree were 338 messages sent and 338 messages delivered which was the highest out of all the students in the network.

In table 5.6 we can see how many cliques S7 belongs to. He is part of the only 50+ (and 100+) member clique, and part of over 60% of all the other clique categories. These factors make S7 a central figure in the class. From the log files of the course, I was able to see that student S7 had completed all 15 lessons, had visited all 15 lesson forums and read the threads, and had contributed his/her own postings to 14 out of the 15 lessons.

Table 5.6: R1 clique analysis.

Cliques of	Total	Including R1 Student	%
3+	480	324	67.50
5+	321	247	76.95
10+	58	37	63.79
20+	7	5	71.43
50+	1	1	100
100+	1	1	100

5.5.2 Role Group – R2

Like R1, role group R2 also only consisted of one student (S157). The student's ego-net social network analysis measures were obtained.

The in-degree and out-degree centrality score of S157 was 0.23 while his/her neighbour out and in degree were 144 messages sent and 144 messages delivered which was the second highest in the LGO network following R1. Table 5.7 is the clique analysis for R2. It can be seen that the student is actively participating with smaller groups of his/her classmates but is not part of the larger 50+ member clique.

Table 5.7: R2 clique Analysis

Cliques of	total	Including R2 Student	%
3+	480	157	32.71
5+	321	145	45.17
10+	58	25	43.10
20+	7	3	42.86
50+	1	0	0
100+	1	0	0

5.5.3 Role Group – R3

Role group R3 is made up of 517 students. This is the largest role group of the four, consisting of approximately 84% of all the students in this course. As can be seen in Table 5.8, the students of this group are the least vocal. The average R3 student is only in 3 cliques of 3+ members, and this value falls even lower for the cliques consisting of more students. Furthermore the students in R3 are not part of the larger 50+ member clique.

Table 5.8: R3 clique Analysis

Cliques of	total	Mean R3 Student part of	%
3+	480	3.07	0.64
5+	321	2.33	0.73
10+	58	0.60	1.03
20+	7	0.19	2.71
50+	1	0	0
100+	1	0	0

5.5.4 Role Group – R4

R4 is comprised of 99 students (16% of the students in the course). These students' participation rates are higher than the students in group R3, but lower than the ones in R1 and R2. From Table 5.9 we can notice that the average R4 student is in 11.17 cliques of 3+ members, and in 10.45 cliques of 5+ members. It is also important to note that these students are connected with a larger variety of student and are also part or the large clique of 100+ members.

Table 5.9: R4 clique Analysis

Cliques of	total	Mean R4 Student part of	%
3+	480	11.17	2.33
5+	321	10.45	3.26
10+	58	5.98	10.30
20+	7	1.76	25.10
50+	1	1	100
100+	1	1	100

5.5.5 Comparison of Role Groups' SNA

Table 5.10 compares the SNA characteristics of the four role groups. It is obvious that the highest in and out centrality degrees belong to R1 with 0.55, followed by R1, R4 and lastly the students in R3. These values are in-line with the neighbour in-degree and out-degree scores of the students showing that the higher the participation frequency of the students, the higher their numbers of connections with other students.

Table 5.10: Comparison of Role Groups SNA

	R1	R2	R3	R4
Centrality In-degree	0.55	0.23	0.02	0.18
Centrality Out-Degree	0.55	0.23	0.02	0.18
Neighbour In-degree	338	144	12.91	109.79
Neighbour Out-Degree	338	144	12.99	109.36
Cliques n3+ (member in)	324	157	3.07	11.17
Cliques n5+	247	145	2.33	10.45
Cliques n10+	37	25	0.60	5.98
Cliques n20+	5	3	0.19	1.76
Cliques n50+	1	0	0	1
Cliques n100+	1	0	0	1

It can also be noted that a major difference between groups R3 and R4 is that the students in R4 have more connections with other students, and are in more cliques, whereas the R3 students are the least vocal and are part of much fewer cliques. The student in R1 is by far the one with the most messages sent and received and also has the highest number of connections with other students and is part of the majority of cliques. The student in R2 is the second most communicative person in the LGO course. More information about the role groups is provided in the next chapter following a deeper analysis into the students TRA, ATTLS and COLLES scores.

5.6 Conclusion

In this chapter I used the SNA component of FESNeL to investigate the environment/context of the LGO case study and the dynamics of the Social Network that lives within this environment. Network properties were obtained, and an evolutionary analysis was carried out on the fifteen lessons of the course in the specific SNA modules of Connection, Centrality, Cohesion and Equivalence. Through this analysis I was able to identify clusters of students with similar interaction behaviors and they have been classified in role groups. Subsequent SNA analysis was carried out on these role groups to investigate their communication characteristics. In the next chapter I use the TRA, COLLES and ATTLS components of FESNeL to further analyze LGO and find out more information about the role groups identified in this chapter and to answer the hypothesis stated in Chapter 1.

Chapter 6: Case Study (Hypotheses Testing)

6.1 Introduction

In this chapter I have used the remaining three components of FESNeL (TRA, COLLES, ATTLS) on the LGO case study and present and discuss their results and implications. Based on this analysis, more details about the four role groups identified in the previous chapter are found and explained. In addition I carry out a number of correlations in order to test the hypotheses stated in Chapter 1.

6.2 TRA results

Following the SNA, the Topic Relation Analysis (TRA) was used to group the students' postings into categories related to what topics they were discussing. The TRA results are divided into three sections: Participants, Threads and Messages. Below is a reminder of the TRA categories (see section 3.3.2 for more details):

- A – Course Related
  - A1 - Related to current Lesson
  - A2 - Related to course (but not current lesson)

- B - Course Website/Technical Related

- C - Not related to course
  - C1 - Peer socializing
  - C2 – other

6.2.1 Participants

Table 6.1 shows the participants per TRA category per lesson for the LGO course. The Total and Unique Posters sometimes differ since the same student may have posted messages in the same Lesson's forum, however, in multiple TRA categories. It can be seen that the majority of the students have posted in Lesson 1's discussion board (506 of the 618 students). The number of students who participated in the lessons' forums decreases after lesson 1 with lesson 2 having the second most participants (90 students). The participants in Lessons 3 to 15 range from 6 to 44 students, with Lesson 8 being the least productive one with only 6 students taking part.

Table 6.1: TRA Results - Participants

	A1	A2	B	C1	C2	Total	Unique Posters
L1	97	128	162	301	0	688	506
L2	28	30	8	34	0	100	90
L3	13	26	16	0	0	55	44
L4	14	5	0	0	0	19	18
L5	25	4	4	5	0	38	33
L6	19	6	0	3	0	28	26
L7	32	0	0	0	0	32	32
L8	6	0	0	0	0	6	6
L9	21	3	2	0	0	26	24
L10	10	6	3	0	0	19	14
L11	13	0	3	0	0	16	16
L12	14	0	0	0	0	14	14
L13	12	0	0	8	0	20	16
L14	10	0	0	0	0	10	10
L15	14	0	0	0	0	14	14

Figure 6.1 shows the percentage of the participants' TRA category postings for the fifteen lessons. As can be seen through the evolution of the course, the percentage of students who posted A1 related messages increased while participants posting in A2, B and C1 decreased and there were no students posting messages that belong in the C2 category. Also, halfway through the course and more specifically for Lessons 7 and 8, all the posts were in the category A1 showing that the students who were participating were only interested to discuss about the current lesson's material and not to socialize.

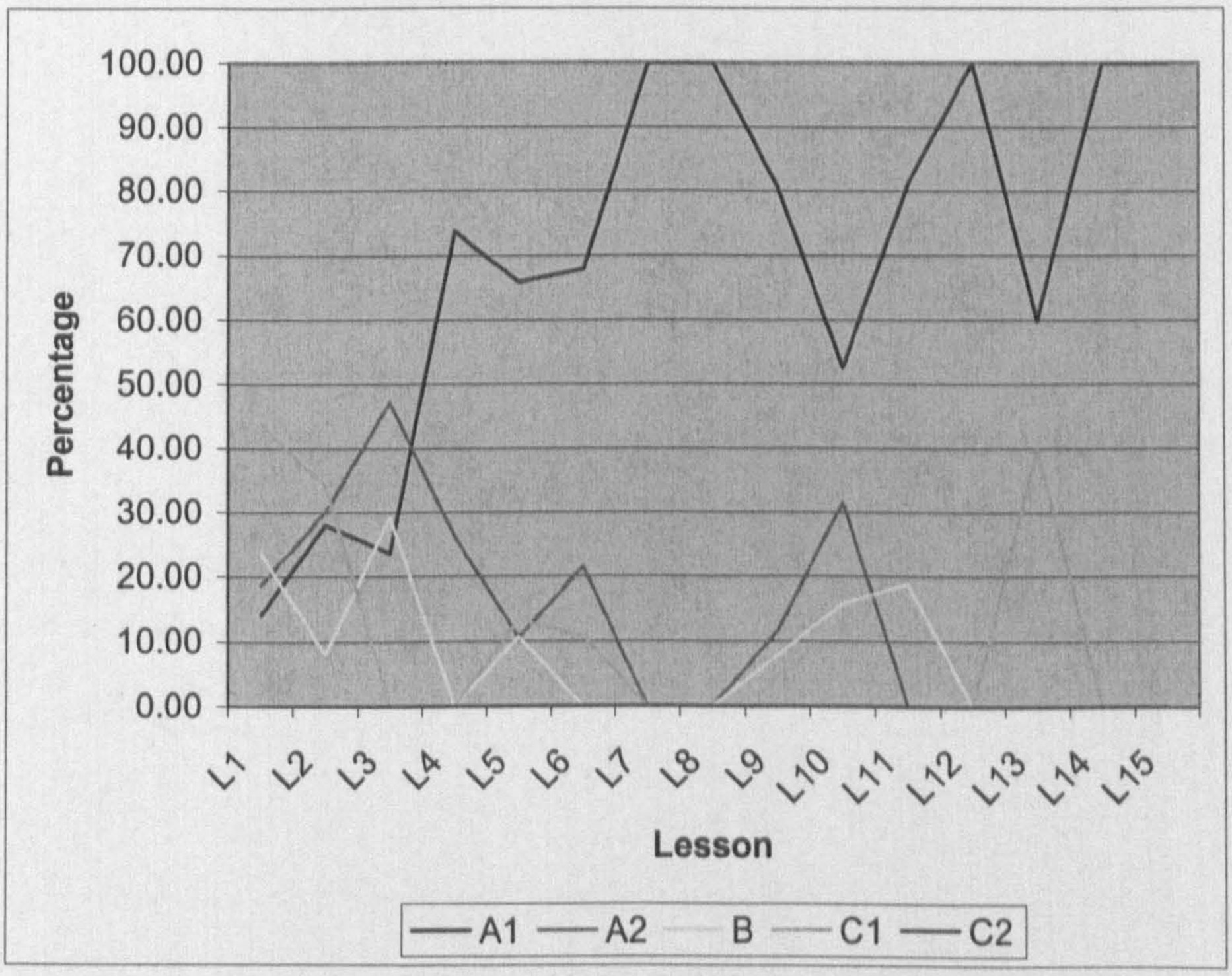


Figure 6.1: Evolution of participants per TRA category per Lesson (%)

6.2.2 Threads

Table 6.2 shows the number of threads for each TRA category. The highest number of conversation threads appeared in Lesson 1 with a total of 216 present. There were a total of 337 threads in the studied course with the majority belonging in the A1 category (118), followed by the A2 category (79) showing that most of the conversation threads were related to the course in hand. Furthermore, there have been 74 threads in category B (Technical/website related) and 66 threads in the socializing category.

Table 6.2: TRA results - Threads

	A1	A2	B	C1	C2	TOTAL
L1	36	58	61	61	0	216
L2	10	4	3	1	0	18
L3	4	7	5	0	0	16
L4	4	2	0	0	0	6
L5	10	2	2	2	0	16
L6	6	3	0	1	0	10
L7	12	0	0	0	0	12
L8	2	0	0	0	0	2
L9	6	1	1	0	0	8
L10	5	2	1	0	0	8
L11	4	0	1	0	0	5
L12	5	0	0	0	0	5
L13	4	0	0	1	0	5
L14	5	0	0	0	0	5
L15	5	0	0	0	0	5
TOTAL	118	79	74	66	0	337

Fig 6.2 shows the percentage of threads in each category for every lesson. For the first three lessons the distribution is more evenly spread out between the TRA categories and they are balanced until about lesson 3. After that, the majority of the threads become A1 related and in some instances (like Lessons 7 & 8) they are exclusively A1 threads with no other conversation topics involved.

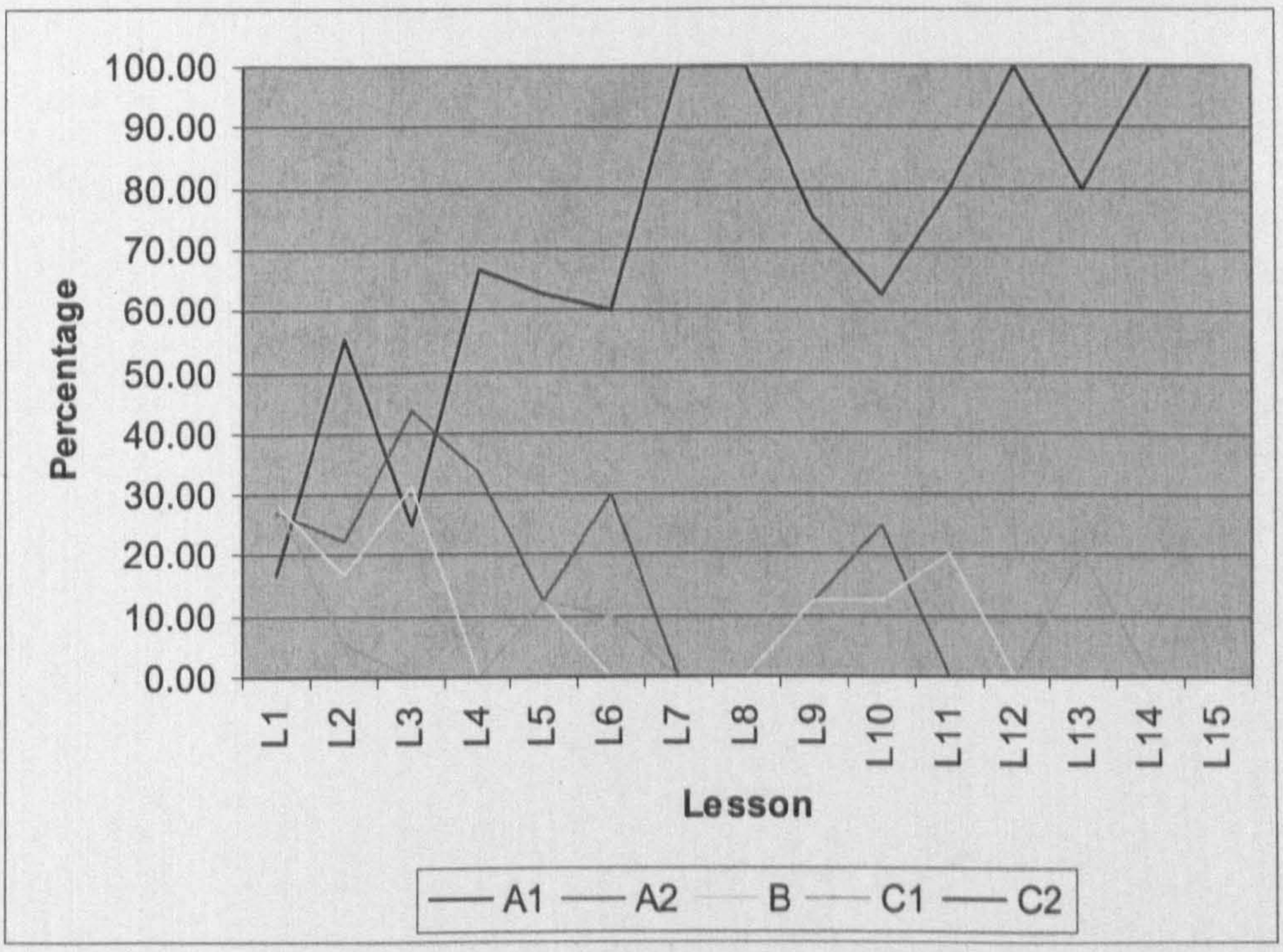


Figure 6.2: % threads per category by lesson

This indicates that although many of the conversations at the start of the course included peers socializing and having questions with how to use the website, as the course evolved these diminished and mostly conversation threads on the course material emerged.

6.2.3 Messages

In table 6.3 we can see the total number of messages posted by the students for each lesson. Most messages were posted in Lesson 1's discussion board (1230 of

the 1821). It is interesting to note that although the distribution of threads in the TRA categories of Lesson 1 did not vary much, the actual number of messages does since 515 of the 1230 messages (41%) were C1 related. This outcome portrays that the number of messages per thread is actually a lot more in the C1 category than in the rest of the TRA categories. As the course evolves however, once again there are more A1 related messages as a natural phenomenon since there were mostly A1 threads. In the last two lessons of the course all messages posted were in category A1.

Table 6.3: TRA results - Messages

	A1	A2	B	C1	C2	TOTAL
L1	166	280	269	515	0	1230
L2	43	37	9	41	0	130
L3	14	50	17	0	0	81
L4	19	9	0	0	0	28
L5	41	4	4	5	0	54
L6	28	7	0	5	0	40
L7	62	0	0	0	0	62
L8	7	0	0	0	0	7
L9	31	6	3	0	0	40
L10	13	6	3	0	0	22
L11	18	0	3	0	0	21
L12	24	0	0	0	0	24
L13	26	0	0	9	0	35
L14	21	0	0	0	0	21
L15	26	0	0	0	0	26
Total	539	399	308	575	0	1821

Furthermore, I have calculated the percentages per TRA category of all the messages posted in the LGO course. The highest two were A1 (Related to current lesson) and C1 (Peer socializing) with 30% and 31% respectively. However, course material related messages (categories A1 and A2) made up the bulk since they took up 52% of the total messages posted. Finally, 17% of the messages were category B (Course website/technical related), and there were no C2 messages showing that the discussions in LGO did not contain any spam or advertisements and that the discussions were in a friendly and helpful atmosphere.

Finally, fig 6.3 displays the evolution of the messages cumulatively. The messages were calculated into percentages per TRA category for each lesson making it easier to follow.

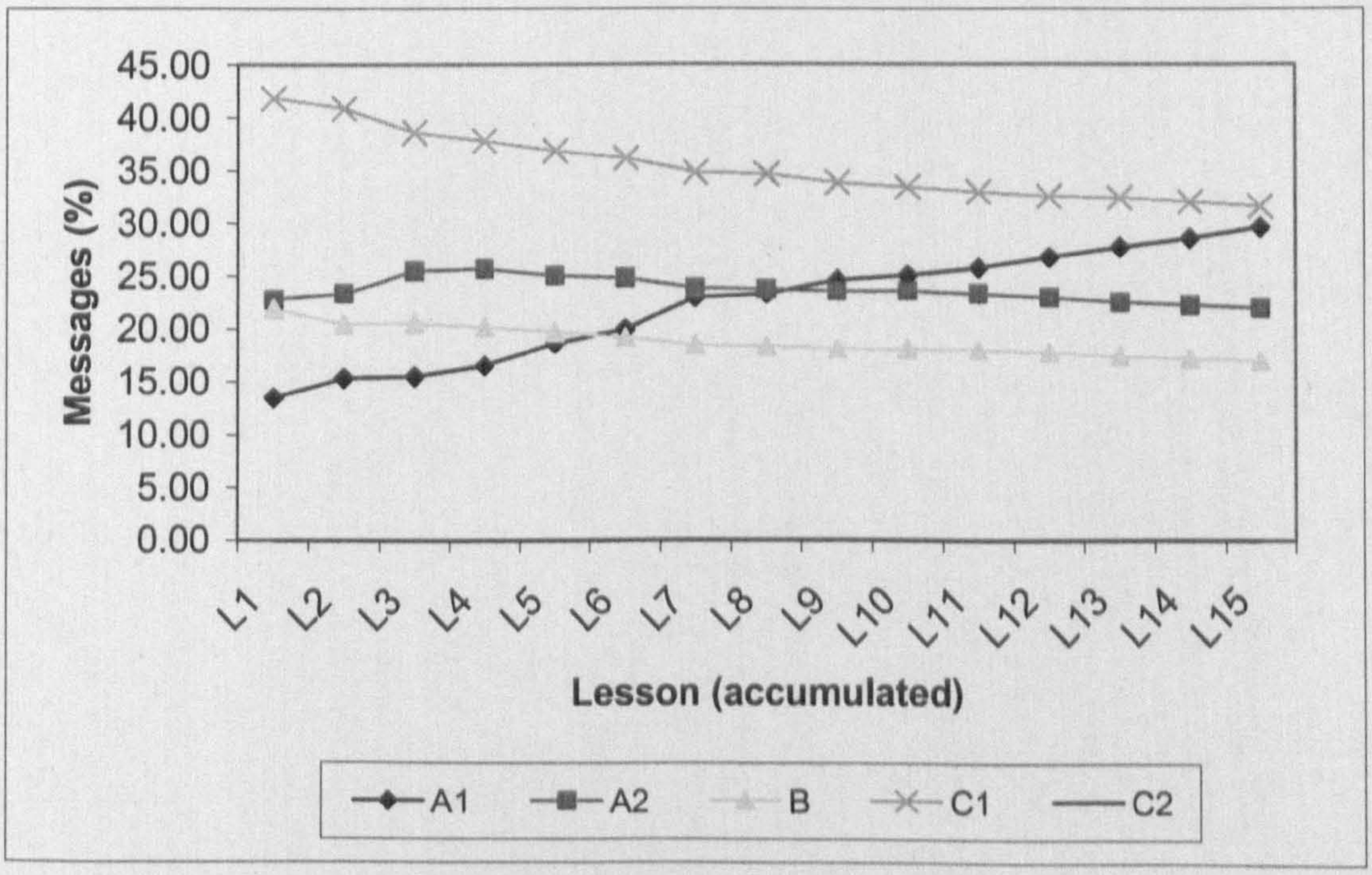


Figure 6.3: Cumulative Messages (by percentage)

The most important thing to note from here is that C1 starts high and is on a gradual decrease, while A1 starts low and is on a gradual increase. They meet

near the end of the course. Messages of categories B and A2 remained fairly constant over the course both ending with slightly lower percentages than at the beginning of LGO.

All these indications lead to the conclusion that when the course started the LGO students were more talkative and social with one another, but as the course progressed they became more relevant discussing topics and posting messages in the A1 category which was the one relating to the course material and indeed to the current lesson's material. It could also be the case that the students (irrespective of which lesson they were following) went back to lesson 1 to discuss social issues (i.e. perceived the discussion board of lesson 1 to be the social discussion board and the boards of the other lessons to be more 'serious' and focused on lesson material).

6.3 TRA of Role Groups

Following the TRA of the LGO discussions, I have looked in more detail into the conversations of the students in the four identified role groups (R1, R2, R3, R4). This analysis assisted in gaining more information about the characteristics of the role groups and more specifically about their conversation topics.

6.3.1 Role Group - R1

In this section I have carried out a content analysis on the topics the student in role group R1 has participated in and contributed to. To see the relevancy of what student S7 talked about, I analyzed his/her discussion board contributions using the Topic Relation Analysis (TRA) method.

Table 6.4: R1 TRA results.

Threads Participated In					Messages Posted				
A1	A2	B	C1	C2	A1	A2	B	C1	C2
42	39	25	21	0	56	48	27	42	0

Table 6.5: R1 contributions.

	Threads		Messages	
	#	%	#	%
A	81	63.78	104	60.12
B	25	19.69	27	15.61
C	21	16.54	42	24.28
Total	127	100	173	100

Table 6.4 shows R1's TRA results. While it is obvious from Table 6.5 that the majority (over 60%) of S7's postings had to do with the course in question. Also, it should be noted that in Lesson 1, S7 contributed many more messages in the Peer socializing category, than in the rest of the lessons, as a 'normal' teacher would when first meeting the students in a face-to-face classroom. I remind that contribution to the discussion board in this course is completely voluntary and thus S7 participated on his/her own will. Not only did he/she send the most messages, but was also the one who received the most messages.

This is exactly how a teacher would interact with the students in a classroom, where the vast majority of communication that takes places is directed as: teacher-students, students-teacher, but less as students-students, as was the case in LGO with student S7. In addition from a closer examination of S7's postings I have discovered that the majority of this student's contributions were answers to

his/hers peers' questions. Many of the other students are dependant on S7, thus making S7 the central figure in LGO. Thus I conclude that in this student-centred e-Learning community, one of the students' communication interactions resembled those of a teacher (Laghos and Zaphiris, 2006b).

Furthermore, from looking at S7's profile on the LGO course it has been established that the student is indeed a teacher in his/her occupation (but not of the Greek Language) and is learning Greek because he/she visits Greece for holidays.

6.3.2 Role Group – R2

Similarly to R1 above, the TRA contributions of S157 (the only student in role group R2) were obtained.

Table 6.6: R2 TRA results.

Threads Participated In					Messages Posted				
A1	A2	B	C1	C2	A1	A2	B	C1	C2
20	13	6	4	0	37	22	9	5	0

Table 6.7: R2 contributions.

	Threads		Messages	
	#	%	#	%
A	33	76.74	59	80.82
B	6	13.95	9	12.33
C	4	9.30	5	6.85
Total	43	100	73	100

His/her TRA results (Tables 6.6 & 6.7) show that the students discusses mainly issues that have to do with the course in hand, having over 80% of his/her messages posted relating to the course (category A).

In a deeper examination of R2's postings I have found that the student provides his own lecture notes and lesson transcripts for his peers. Although he doesn't answer many questions like the student in R1 previously, his fellow peers are still dependant on him for this material.

Garton et al (1997) point out that in role groups "those who share empirically-identified positions are likely to share similar access to informational resources". Given that student S157 is the only one in the R2 role group, one can understand that these informational resources provided by him are unique and the other students can only gain this information from student S157. He is a good motivated student who wants to share his gained Greek language knowledge with his peers. Thus student S157 is a key person in the LGO network.

6.3.3 Role Group – R3

In tables 6.8 and 6.9, we can see the contributions and TRA results of the average R3 student. These students mainly post messages that fall under the A1 TRA category, followed by social posts in category C1.

Table 6.8: R3 TRA results.

Threads Participated In					Messages Posted				
A1	A2	B	C1	C2	A1	A2	B	C1	C2
0.64	0.42	0.4	0.55	0	0.79	0.55	0.45	0.67	0

As can been seen, over 50% of their conversations were related to the course material (category A). This outcome shows that the students in this role group collaborate and cooperate with each other and discuss topics where they help their peers or they get help from their peers.

Table 6.9: R3 contributions.

	Threads		Messages	
	#	%	#	%
A	1.06	51.46	1.35	54.66
B	0.4	19.42	0.45	18.22
C	0.6	29.13	0.67	27.13
Total	2.06	100	2.47	100

6.3.4 Role Group – R4

Contrary to the R3 students above, the majority of the posts of the R4 students were in the social category of the TRA with over 60% of their messages and threads belonging in C1.

Table 6.10: R4 TRA results.

Threads Participated In					Messages Posted				
A1	A2	B	C1	C2	A1	A2	B	C1	C2
0.31	0.35	0.29	1.51	0	0.4	0.43	0.38	1.85	0

Furthermore as indicated from tables 6.10 and 6.11, the R4 students post messages that are mainly of a social nature, thus TRA category C comprises of above 60% of all of R3 students' messages. Thus it seems that the students in role group R4 prefer to contact their peers for friendly conversations unrelated to

the course material, and prefer to learn the actual material on their own and only ask for help, or help others themselves, when they really have to.

Table 6.11: R4 contributions.

	Threads		Messages	
	#	%	#	%
A	0.66	26.83	0.83	27.12
B	0.29	11.79	0.38	12.42
C	1.51	61.38	1.85	60.46
Total	2.46	100	3.06	100

6.3.5 Comparison of Role Groups' TRA

Table 6.12 is a comparison of the TRA scores of the role groups. The messages per thread for each category for each of the role groups ranges from 1.08 to 2 with the student in R1 having the highest rate (2 messages per thread) in category C. For the messages and threads in categories A1, A2 and B, R1 post the most messages, followed by R2 and R3 and the students in R4. The only case where this is not so, is in the C category where the students in role group R4 are more vocal then those in R3.

In addition, the table displays the contributions of the specific student role groups with their postings in the TRA categories. As can be seen from table 6.12, the highest percentage of messages for R1, R2 and R3 are all in Category A (course related). The exception is R4 where the highest posting percentage is that in category C (social discussions).

Table 6.12: Comparison of Role Groups TRA

	R1	R2	R3	R4
Messages A1	56	37	0.8	0.4
Threads A1	42	20	0.64	0.31
Messages per Thread A1	1.33	1.85	1.25	1.29
Messages A2	48	22	0.55	0.43
Threads A2	39	13	0.42	0.35
Messages per Thread A2	1.23	1.69	1.31	1.23
Messages B	27	9	0.45	0.38
Threads B	25	6	0.4	0.29
Messages per Thread B	1.08	1.5	1.13	1.31
Messages C	42	5	0.67	1.85
Threads C	21	4	0.55	1.51
Messages per Thread C	2	1.25	1.22	1.23
% of messages in A	60.12	80.82	54.66	27.12
% of threads in A	63.78	76.74	51.46	26.83
% of messages in B	15.61	12.33	18.21	12.42
% of threads in B	19.69	13.95	19.42	11.79
% of messages in C	24.28	6.85	27.13	60.46
% of threads in C	16.54	9.3	29.13	61.38

My findings - based on the roles undertaken by the course participants - are inline with O Murchu (2005) and McGhee and Kozma (2001). Their studies investigated the roles that students take on as a result of computer based

technologies and they have identified three student roles, namely, the self-learner, the team member and the knowledge manager.

These roles can be matched with the student roles identified in LGO as follows:

- *Self Learner:* These students need to see their own goals, organize their own work and manage their own time (O Murchu, 2005). Based on my SNA and TRA findings, this role matches best with the LGO students in role group R4 since although these students make connections with a large number of their peers, their discussions are mainly on social topics and not course related. They prefer to learn on their own and were mainly using the discussion boards to make friends and socialize with their peers.

- *Team Member:* These students work collaboratively, their social interaction is in teams, and they are actively involved in their projects (O Murch, 2005). This student role is matched by the LGO students who were in role group R3. The R3 students interacted with a lesser number of their peers (than the R4 students), but more often, thus working more in small teams. In addition, the TRA results show that the majority of their usage of the LGO discussion boards was in Category A, that is, discussing the course material and helping out their peers.

- *Knowledge Manager:* The focus of the knowledge manager role is on the development of knowledge products and these can be in the form of reports and newspapers, while their activities include searching for information, collecting and analyzing data, and designing reports (O Murchu, 2005). The roles group matches perfectly with the behavior of student S157 in role group R2 of LGO. The student in R2 would provide his own lectures notes and transcripts for each and every lesson of the 15

in the LGO course. He is connected with a large number of his peer students who depend on him for this material, is part of a high number of cliques and his contributions in the discussion boards are mainly on course related material.

Therefore in the LGO network, the four role groups identified are as follows:

- **R1:** Teacher (Laghos and Zaphiris, 2005)
- **R2:** Knowledge Manager
- **R3**: Team Member
- **R4:** Self Learner

6.4 COLLES results

In this section my goal was to analyse the students' feedback on online learning using the Constructivist On-Line Learning Environment Survey (COLLES). Furthermore the COLLES results for the four previously identified roles groups are also examined. After the analysis, these results were correlated with SNA and TRA results to investigate whether or not the students' opinions are reflected in their actual communication in the LGO course.

104 students answered each of the questionnaires giving a response rate of 18.83%. A modified version of the COLLES was used omitting the tutor support section since there was no tutor in the LGO course. Table 6.13 shows the average rating per individual COLLES question.

Table 6.13: COLLES results

Section	Question		Mean (St.d)
Relevance	**Q1**	My learning focuses on issues that interest me	4.33 (0.89)
	Q2	What I learn is important for my professional practice	2.74 (1.38)
	Q3	I learn how to improve my professional practice	2.78 (1.36)
	Q4	What I learn connects well with my professional practice	2.67 (1.34)
Reflective Thinking	**Q5**	I think critically about how I learn	4.08 (0.91)
	Q6	I think critically about my own ideas	3.80 (1.10)
	Q7	I think critically about other students' ideas	3.01 (1.36)
	Q8	I think critically about ideas in the readings	3.74 (1.27)
Interactivity	**Q9**	I explain my ideas to other students	2.28 (1.20)
	Q10	I ask other students to explain their ideas	2.33 (1.19)
	Q11	Other students ask me to explain my ideas	2.13 (1.20)
	Q12	Other students respond to my ideas	2.43 (1.29)
Tutor Support	**Q13**	The tutor stimulates my thinking	n/a
	Q14	The tutor encourages me to participate	n/a
	Q15	The tutor models good discourse	n/a
	Q16	The tutor models critical self-reflection	n/a
Peer Support	**Q17**	Other students encourage my participation	2.45 (1.34)
	Q18	Other students praise my contribution	2.24 (1.29)
	Q19	Other students value my contribution	2.37 (1.37)
	Q20	Other students empathise with my struggle to learn	2.54 (1.48)
Interpretation	**Q21**	I make good sense of other students' messages	2.85 (1.39)
	Q22	Other students make good sense of my messages	2.69 (1.44)
	Q23	I make good sense of the tutor's messages	n/a
	Q24	The tutor makes good sense of my messages	n/a

The first four questionnes of the COLLES deal with the relevance of the course to the students' professional practises. Questionnes 5 to 8 examined whether the course stimulates the students' critical reflective thinking. Questions 9 to 12 measure to what extent the students engage in online in rich educative dialogue.

In addition questions 9 and 10 ask about the students outgoing interactivity while questions 11 and 12 ask about their incoming interactivity. The next section of

the COLLES is about Tutor Support, but this is not avaliable in this case since LGO does not have a tutor.

Following this are the four questions for peer support which examines whether fellow students provide sensitive and encouraging support. Finally, the last four questions in the COLLES ask whether the students and tutor make good sense of each others messages. However since there is no tutor involved, the focus was only on the first 2 questions of this section which ask about interpretation of the students' messages.

Table 6.14 shows the average respodent rate for each of the sections and subsections of the COLLES.

Table 6.14: Results of COLLES by section

COLLES Section	Mean (St.d)
Relevance (Q1-Q4):	3.13 (1.43)
Reflective Thinking (Q5-Q8):	3.66 (1.23)
Interactivity1 (Q9-Q12):	2.29 (1.22)
Interactivity2 (Q9-Q10)	2.30 (1.20)
Interactivity3 (Q11-Q12)	2.24 (1.25)
Tutor Support (Q13-Q16)	N/A
Peer Support (Q17-Q20)	2.40 (1.37)
Interpretation (Q21-Q22)	2.77 (1.44)

The scale used on the questionnaire was 1 meaning 'almost never' to 5 meaning 'almost always'. Relevance scored an average rating of approximately 3.13 indicating that the students found the course material relevant.

Reflective thinking scored the highest with a score of approx. 3.66 meaning that the course highly stimulates the students' critical reflective thinking. Furthermore Interactivity scored around 2.29. This section was further broken down into

Interactivity2 and Interactivity3 since the questions refer to outgoing and ingoing communication respectively and average at 2.30 and 2.24.

Tutor Support was not available and the student ratings for peer support averaged at about 2.40 indicating that fellow students provide support sometimes.

Finally, Interpretation (only the questions related to the students) ranked at 2.77 showing that the student's interpretation of each others messages was above average.

6.4.1 COLLES of Role Groups

A key player of LGO, student S157, who was the only representative of Role Group R2 did not answer the COLLES survey therefore his results could not be obtained. Table 6.15 shows the results per COLLES category for each of the role groups.

Table 6.15 – COLLES roles groups' results

Role Group	R1	R2	R3	R4
Relevance	1	n/a	3.25	2.5
Reflective Thinking	5	n/a	3.75	3.5
Interactivity1	2.5	n/a	2.28	2
Interactivity2	2.5	n/a	2.2	2
Interactivity3	2.5	n/a	2.35	2
Peer Support	3	n/a	2.45	2.15
Interpretation	3	n/a	2.95	2.5

As can be seen from Figure 6.4, the student in R1 has the lowest relevance rating but also the highest reflective thinking rating. This shows that although online learning is not very relevant to the student's professional practices, he still

believes that it highly stimulates his critical reflective thinking. For all other COLLES sections, the highest scores are from role group R1, followed by the mean rating from students in R3, and finally R4 students with the lowest scores. These results illustrate that R1 students are more interactive (both with in-coming and out-going messaged), and believe more in peer support than their fellow students in R3 and R4. Furthermore, R1 and R3 students make better sense of their peers messages in comparison to the students in R4.

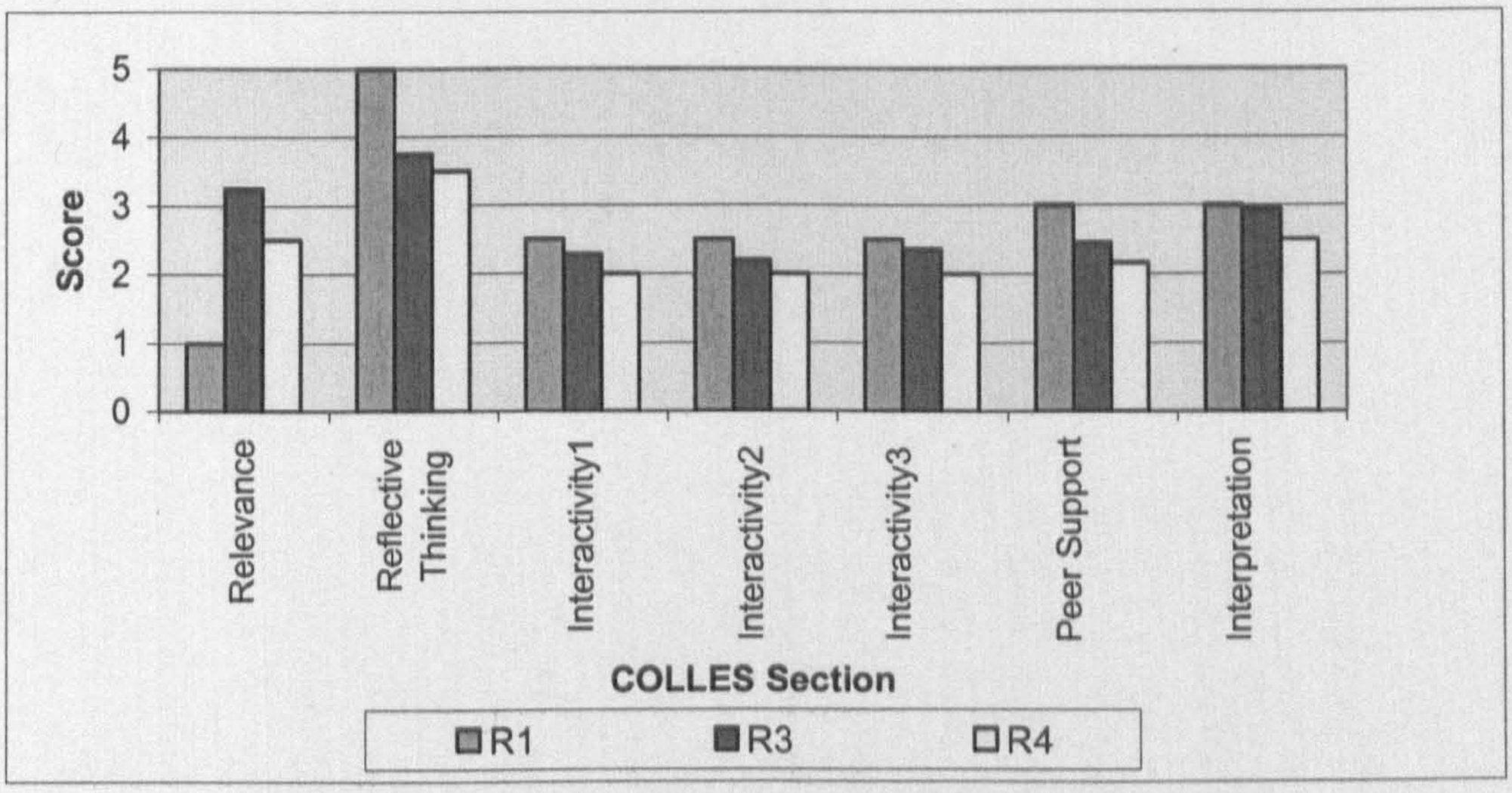


Figure 6.4: COLLES scores of the Role Groups

In comparison to the results obtained by the authors of the COLLES survey (Taylor and Maor, 2002) on a case study they conducted themselves, the mean ratings provided by the LGO students were lower in all of the COLLES categories. This outcome shows that different online learning environments indeed produce different COLLES ratings and behaviours.

6.5 ATTLS results

In this section I used the results of the students' replies to the Attitudes towards Thinking and Learning Survey (ATTLS) to identify their learning styles, whether

they are connection knowers, separate knowers or both. In addition a comparison was made between the ATTLS scores of the role groups.

The 20 questions in the ATTLS are displayed in the questionnaire in random order as not to reveal which questions are Connected Knowing (CK) related and which are Separate Knowing (SK) related. The questionnaire can be found in Appendix B. 104 students answered the ATTLS. Tables 6.16 and 6.17 show the average ratings the students gave per question as well as the average CK and SK scores of LGO.

Table 6.16: ATTLS CK results

	Question	Mean (St.d)
CK01	When I encounter people whose opinions seem alien to me, I make a deliberate effort to 'extend' myself into that person, to try to see how they could have those opinions.	3.43 (1.21)
CK02	I can obtain insight into opinions that differ from mine through empathy.	4.46 (0.89)
CK03	I tend to put myself in other people's shoes when discussing controversial issues, to see why they think the way they do.	4.14 (0.98)
CK04	I'm more likely to try to understand someone else's opinion than to try to evaluate it.	2.92 (1.30)
CK05	I try to think with people instead of against them.	3.84 (1.03)
CK06	I feel that the best way for me to achieve my own identity is to interact with a variety of other people.	3.79 (1.05)
CK07	I am always interested in knowing why people say and believe the things they do.	3.63 (1.09)
CK08	I enjoy hearing the opinions of people who come from backgrounds different to mine - it helps me to understand how the same things can be seen in such different ways.	4.03 (1.11)
CK09	The most important part of my education has been learning to understand people who are very different to me.	3.95 (0.98)
CK10	I like to understand where other people are 'coming from', what experiences have led them to feel the way they do.	3.97 (0.99)
	Mean CK Score	**3.82**

Like the COLLES the range for the responses of the ATTLS is from 1 to 5 for each question with 1 meaning 'Strongly Disagree' and 5 meaning 'Strongly Agree'. The higher the CK and SK scores, the higher the students' connected and separate knowing. As mentioned earlier, these two knowing modes are not mutually exclusive as the same student may be both a separate knower and a connected knower. In the LGO case, the mean CK score was 3.82 out of 5 and the mean SK score was 3.75 out of 5. This means that the the average student in the course was both a Connected Knower (looks for what is wrong with other peoples' ideas) and Seprate Knower (looks for why other peoples' ideas make sence) with mean CK scores being averaged slightly higher than the SK scores.

Table 6.17: ATTLS SK results

	Question	Mean (St.d)
SK01	I like playing devil's advocate - arguing the opposite of what someone is saying.	3.79 (1.14)
SK02	It's important for me to remain as objective as possible when I analyze something.	3.92 (0.89)
SK03	In evaluating what someone says, I focus on the quality of their argument, not on the person who's presenting it.	4.03 (1.08)
SK04	I find that I can strengthen my own position through arguing with someone who disagrees with me.	3.54 (1.08)
SK05	One could call my way of analysing things 'putting them on trial' because I am careful to consider all the evidence.	3.64 (1.15)
SK06	I often find myself arguing with the authors of books that I read, trying to logically figure out why they're wrong.	3.55 (1.05)
SK07	I have certain criteria I use in evaluating arguments.	4.12 (0.93)
SK08	I try to point out weaknesses in other people's thinking to help them clarify their arguments.	2.93 (1.32)
SK09	I value the use of logic and reason over the incorporation of my own concerns when solving problems.	3.89 (1.11)
SK10	I spend time figuring out what's 'wrong' with things. For example, I'll look for something in a literary interpretation that isn't argued well enough.	4.06 (0.96)
	Mean SK score	**3.75**

6.5.1 ATTLS of Role Groups

The only student in role group R2 did not answer the ATTLS survey so his results are not available. Table 6.18 shows the connected knower and separate knower results for each of the role groups.

Table 6.18 – ATTLS roles groups' results

Role Group	R1	R2	R3	R4
Connected Knower	4.3	n/a	3.81	3.81
Separate Knower	4.3	n/a	3.70	3.87

As can bee seen from Figure 6.5 the student in role group R1 has both a high Connected Knowing score as well as a high Separate Knowing score. As mentioned earlier these two learning modes are not mutually exclusive and a student may be both a connected knower and separate knower as it is in this case. The students in R3 are more of Connected Knowers (CK) than Separate Knowers (SK), while the opposite stands for the students in role group R4 which have higher Separate knowing scores. CK students are often more cooperative and willing to build on the ideas of others whereas SK students take a more critical and argumentative stance to learning. So the outcome from this analysis is that the student in R1 is both a CK and SK, the students in R3 are more CK and the students in R4 are SK.

The findings of this section are in-line with the results found on a case study carried out by the authors of the ATTLS survey. Galotti et al (2001) reported that the mean CK scores of their studied course were higher than the mean SK scores. This is also the case in the LGO case study as the mean CK score (3.82) is higher than the mean SK score (3.75).

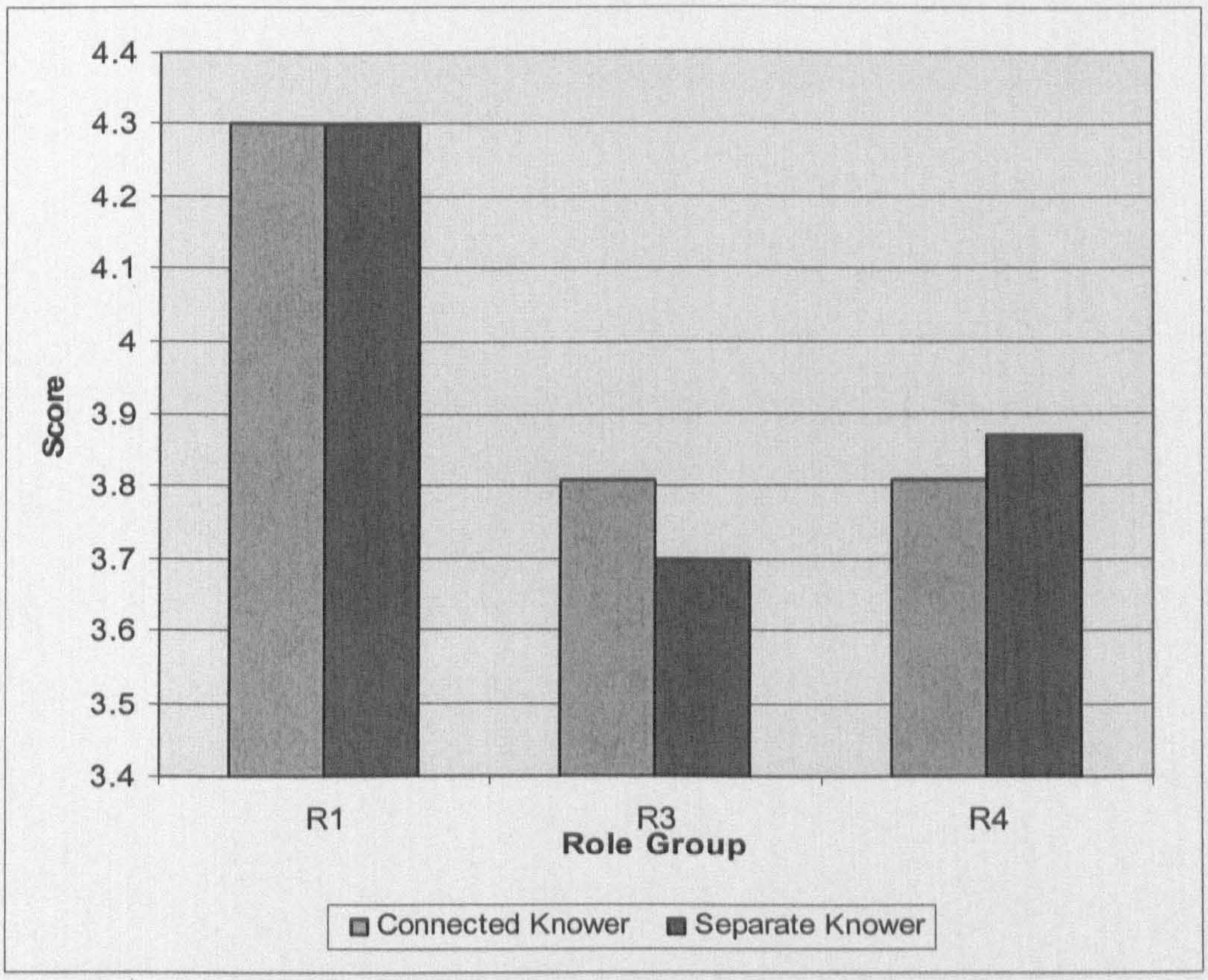


Figure 6.5: Connected and Separate Knowing Scores of the Role Groups

6.6 Hypothesis Testing

Hypothesis 1, "*Students consider CMC tools to be important when learning online*" was tested and proved correct in Chapter 4. In order to answer the remaining characteristic hypothesis stated in chapter 1, correlations have been carried out between the 4 elements of FESNeL: COLLES questionnaire, ATTLS questionnaire, SNA and TRA. The data used here was the questionnaire answers from the 104 students that replied, along with their individual SNA and TRA scores.

6.6.1 COLLES with SNA

Hypothesis 2: *We cannot predict how students will communicate based on their views about online learning.*

In order to test this hypothesis, a correlation was carried out between the students' COLLES responses and their individual SNA results. No significant correlations existed between the SNA results with the following COLLES sections: Interactivity, Interactivity2, Interactivity3, Interpretation, Peer Support and Reflective Thinking. However there were a number of significant correlations between Relevance and the SNA results. Table 6.19 shows these correlations.

The most significant correlation found was -0.288 and existed between the COLLES relevance and the Centrality Out-degree of the SNA, which means that the more relevant the student felt the course was the less the student's outgoing messages. Furthermore, -0.287 was found between Relevance with Centrality In-degree and Egonet size in SNA once again indicating that the more relevant the student felt the course was the less number of connections the student has and a lower number of incoming messages.

Finally correlations of -0.259 and twice -0.258 were found between Relevance and SNA cliques of a minimum of 5, 3 and 10 students respectively. Less significant correlations of -0.248, -0.199 and -0.199 existed between Relevance and cliques with 20+ members, cliques with 100+ members and cliques with 50+ members.

Table 6.19: Significant Correlations between COLLES and SNA

		COLLES: Relevance
SNA: CENTRALITY- In-Degree	Pearson Correlation	-.287(**)
	Sig. (2-tailed)	0.003
	N	104
SNA: CENTRALITY- Out-Degree	Pearson Correlation	-.288(**)
	Sig. (2-tailed)	0.003
	N	104
SNA: COHESION- cliques n>=10	Pearson Correlation	-.238(*)
	Sig. (2-tailed)	0.015
	N	104
SNA: COHESION- cliques n>=100	Pearson Correlation	-.199(*)
	Sig. (2-tailed)	0.043
	N	104
SNA: COHESION- cliques n>=20	Pearson Correlation	-.248(*)
	Sig. (2-tailed)	0.011
	N	104
SNA: COHESION- cliques n>=3	Pearson Correlation	-.258(**)
	Sig. (2-tailed)	0.008
	N	104
SNA: COHESION- cliques n>=5	Pearson Correlation	-.259(**)
	Sig. (2-tailed)	0.008
	N	104
SNA: COHESION- cliques n>=50	Pearson Correlation	-.199(*)
	Sig. (2-tailed)	0.043
	N	104
SNA: CONNECTION/NEIGHBOUR- Egonet Size	Pearson Correlation	-.287(**)
	Sig. (2-tailed)	0.003
	N	104
** Correlation is significant at the 0.01 level (2-tailed).		
* Correlation is significant at the 0.05 level (2-tailed).		

All these lead me to conclude that yes we can predict how students will communicate based on their views on the course and online learning. There is a negative relationship between the students' perceived course relevance and the students' participation and connection with other students in the learning environment.

6.6.2 ATTLS with SNA

Hypothesis 3: *The students' 'way of knowing' learning style cannot predict their online CMC participation.*

In order to test this hypothesis, correlations were carried out between the students' ATTLS responses and their individual SNA results. As can be seen in Table 6.20, there was only 1 significant correlation and this existed between Connected Knowing and Egonet Density with a value of -0.195.

Table 6.20: Significant Correlation between ATTLS and SNA

		ATTLS: Connected Knowing
SNA: CONNECTION/NEIGHBOUR-Egonet Density	Pearson Correlation	-.195(*)
	Sig. (2-tailed)	0.047
	N	104
** Correlation is significant at the 0.01 level (2-tailed).		
* Correlation is significant at the 0.05 level (2-tailed).		

This result tells us that the more of a connected knower a student is, the less is his egonet density meaning that the ratio of connections he/she has to the total possible connections he/she could have is less. Although this is a relative small value these results suggest that there is still a reverse relation between connected knowers and their egonet density.

This outcome portrays that the higher the connected knowing score of the students, the less connections they have with their peers. This is an unexpected result as one would have expected that connected knowers will be more active in the online communication around the course. One explanation of this result might be that the connected knowers prefer to engage in communication with few of their peers but at a higher frequency. Therefore, yes, we can predict the

students' online CMC participation from their 'way of knowing' learning style as there is a negative relationship between the students' connected knowing scores and their egonet densities.

6.6.3 COLLES with TRA

Hypothesis 4: *The students' opinions of online learning do not suggest what topics they will talk about during their online course studies.*

Correlations between the students' COLLES responses and the percentage of their individual postings per TRA category were carried out to test this hypothesis. There were no significant correlations found between any of the COLLES categories and the TRA results.

This outcome leads me to the conclusion that, no, the students' opinions on the course and online learning does not suggest what they will be talking about. This may be because the students' perceptions (their feedback provided on the COLLES survey) of their communication behavior (in the online discussion boards of LGO) is not accurately matched with their actual interactions with their peers in the course.

6.6.4 ATTLS with TRA

Hypothesis 5: *The students' learning style does not suggest what they will talk about in the e-Learning discussion boards.*

Once again to test this hypothesis, correlations were carried out between the students' responses to the ATTLS questionnaire and their TRA results. As can be

seen in Table 6.21, there were no significant correlations found and thus, no, the students' learning styles do not suggest what they will be discussing in the lesson's forums.

Table 6.21: No significant correlations between ATTLS and TRA

		ATTLS: Connected Knowing	ATTLS: Separate Knowing
TRA: % of A1 Messages	Pearson Correlation	-0.028	-0.035
	Sig. (2-tailed)	0.776	0.721
	N	104	104
TRA: % of A2 Messages	Pearson Correlation	-0.051	-0.029
	Sig. (2-tailed)	0.605	0.767
	N	104	104
TRA: % of B Messages	Pearson Correlation	0.037	0.033
	Sig. (2-tailed)	0.711	0.741
	N	104	104
TRA: % of C1 Messages	Pearson Correlation	0.169	0.169
	Sig. (2-tailed)	0.087	0.086
	N	104	104
** Correlation is significant at the 0.01 level (2-tailed).			
* Correlation is significant at the 0.05 level (2-tailed).			

This (like the COLLES correlation with the TRA) is an important outcome since it has been established that the surveys cannot be used to predict the students' conversation topics. Predicting their discussions seems to depend on some of their other characteristics like possibly their background, ethnicity, their experience with CMC, and perhaps more importantly, their reasons for taking the online course.

6.7 Conclusion

In this chapter FESNeL was applied to a case study to test its overall validity. Following the SNA (see previous chapter), the remaining three attributes of the framework were used and the results from the TRA, COLLES and ATTLS

questionnaires were discussed. Based on these outcomes, more characteristics of the role groups were obtained.

My results showed that one of the students (role group R1) had communication patterns that resembled that of a teacher in classroom settings. The next group (R2) consisted of 1 student who was very vocal, however less than R1. This student was the "knowledge manager" providing his peers with course related information that only he had access to, while the majority of his conversations were course material related. Students in R3 were the least participative, preferred to work more in small teams (they were part of very few large member cliques) and talked mainly about issues concerning the course. Their behavior can be described as "team members" and lastly the students in R4 were more communicative than those in R3 but had most of their conversations in the social category which makes them "self learners".

In addition, correlation analyses were carried out between the results of the four elements of FESNeL in order to answer some characteristic hypothesis. The results showed significant correlations between some aspects of SNA with the 2 questionnaires and no significant correlations between TRA and the questionnaires. Furthermore, these results prove that all elements of FESNeL are necessary to be included in the framework since the correlations found between some its aspects were not very high, but only provided some indications as to relationships between several factors (Laghos and Zaphiris, 2006a).

Chapter 7: Discussion & Conclusions

7.1 Introduction

In this chapter a summary of the thesis is provided along with a discussion of the research carried out (section 7.2). In section 7.3 the scope of the thesis is presented and there is a discussion of the outcomes against the objectives set out in Chapter 1. The project's contributions and limitations are discussed in sections 7.4 and 7.5, respectively. This chapter ends with an overall conclusion of the thesis and a discussion for future research (section 7.6).

7.2 Summary of Thesis

In this section the thesis summary is presented. In Chapter 1 the thesis was introduced and the aim and hypotheses of the study were outlined.

In Chapter 2, I discussed the background and previous research of Computer Mediated Communication in Online Computer Based Learning environments. By utilizing the Internet and the communication technologies of the World-Wide-Web, e-Learning has evolved into a state where students from around the globe become members of online communities where they can work collaboratively and cooperatively with their peers to learn and share knowledge.

The literature review of this chapter provided insights into how the software and technology are being used and what the benefits and limitations that arise from their useage are. This was important in order to get an understanding of the functioning of e-Learning systems and the capabilities that are available for the students.

In Chapter 3, I presented the currently available methods for analyzing CMC activity concentrating on three areas:

- Human-Human Interaction Analysis
- Human-Computer Interaction Analysis
- Content Analysis

The benefits and limitations of these methods were identified, and the need for the development of a new methodological framework was explained. The deliverable of the chapter was FESNeL (Framework for assessing the Evolution of Social Networks in e-Learning) and was developed on the theoretical foundations of these methods. FESNeL is comprised of 4 attributes: Social Network Analysis (Human-Human Interaction), COLLES and ATTLS questionnaires (Human-Computer Interaction) and the Topic Relation Analysis (Content Analysis).

Prior to the data collection and analysis with the case study, chapter 4 tested hypothesis 1 whereby the current state of 32 CALL websites was examined (in terms of the CMC and other tools/features they provided) in conjunction with a questionnaire which identified which features current and potential CALL students deemed important to be included in these sort of websites. The results showed that the average current state of these websites lacks the support the students wanted in the terms of CMC tools like discussion boards as well as language related features like spell checkers.

Furthermore, through their responses it was highlighted that they find that the asynchronous communication of discussion boards are important when learning online. This is also backed up by the literature review in chapter 2, where research has shown that asynchoronous discussion is important for collaboration and learning in online environments.

In chapters 5 and 6, FESNeL was used on a case study, namely the Begginers Greek course of Learn Greek Online. After the data was collected and analyzed hypothesis 2 to hypothesis 5 were tested. More specifically:

Chapter 5 (Analysis of the Social Network): Partial use of the framework to investigate the environment/context of the case study and the dynamics of the Social Network that lived within this environment. Results for SNA were presented here. Student role groups were identified and discussed

Chapter 6 (Hypotheses Testing): Here the whole framework was used and the results for the TRA, COLLES and ATTLS were presented. Furthermore, more characteristics about the role groups identified in the previous chapter were obtained. In addition, a number of correlations were carried out in order to justify the necessity of the attributes in the framework and to test the remaining hypothesis of the thesis.

Finally in this chapter (chapter 7), a summary of the thesis is provided along with the scope of experimental findings, key and secondary contributions, limitations of the research, and future research directions.

7.3 Scope of Experimental Findings

In this section, the scope of the research and the experimental findings are described in relation to the aim and objectives set out in section 1.2. Starting from Hypothesis 1 to Hypothesis 5 I have summarized the methods used to test the hypothesis and their relevant outcomes.

- ***Hypothesis 1:*** *Students consider CMC tools to be important when learning online.*

To test this hypothesis an online questionnaire was solicited whereby students gave their views and feedback on which features and tools they thought are important to be included in e-Learning websites. The results showed that the respondents rated the CMC tools, like discussion boards, to be important when learning online thus proving hypothesis 1 to be correct.

- ***Hypothesis 2:*** *We cannot predict how students will communicate based on their views about online learning.*

Hypothesis 2 was tested by carrying out a correlation analysis between the students 'Constructivist On-Line Learning Environment Survey' (COLLES) scores and 'Social Network Analysis' (SNA) results to see if their opinions are actually reflected by their actions. A number of significant correlations were found between Relevance and the SNA results leading me to the conclusion that yes we can indeed predict how students will communicate based on their views on the course and online learning. A negative relationship exists between "the course's relevance with the students' professional practice" and "the students' participation and connection with other students" in the learning environment. This means that the more relevant the course to the students, the less they actually contribute to the discussions. One would have expected the opposite to be the case, however these findings suggest otherwise. This maybe because if the course is relevant to the students' professional practice they know exactly what it is they want to learn from it, and thus

only participate and contribute to fewer and more focused areas that are important to them.

- ***Hypothesis 3:*** *The students' 'way of knowing' learning style cannot predict their online CMC participation.*

This time a correlation analysis was carried out between the students 'Attitudes Towards Thinking and Learning' (ATTLS) scores and SNA results to investigate whether their participation is related to their individual learning style. The results showed that there is a reverse relationship between connected knowers and their egonet density. This means the more of a connected knower the student is, the smaller the student's egonet density (ratio of connections the student has to the total possible connections he/she could have). In this case again one could have expected the opposite to occur, that is, for the connected knowers to have many connections with their peers. However it seems that they prefer to interact more often with a small but consistent number of their peers rather than with more of them.

- ***Hypothesis 4:*** *The students' opinions of online learning do not suggest what topics they will talk about during their online course studies.*

To test hypothesis 4, a further correlation was carried out between the students COLLES scores and their 'Topic Relation Analysis' (TRA) results to determine if what they think actually determines what topics they will be talking about. No significant correlations were found thus hypothesis 4 is correct: the students opinions do not determine what they will talk about.

- ***Hypothesis 5:*** *The students' learning style does not suggest what they will talk about in the e-Learning discussion boards.*

Finally, hypothesis 5 was tested in a similar manner to hypothesis 4, this time by a correlation of the students' ATTLS scores with their TRA results to investigate if their learning styles determine what they will talk about. Again, no significant correlations found and thus, no, the students' learning styles do not suggest what they will be discussing in the lesson's forums. This proves hypothesis 5.

7.4 Contributions

The disciplines spanned in this research included Computer Based Learning (e-Learning and CALL), Online Communities and Computer-Mediated Communication (CMC) and Human-Computer Interaction (HCI). Key contributions are discussed in section 7.4.1 and secondary contributions in section 7.4.2.

7.4.1 Key contributions

The most important contribution of the thesis was the development of FESNeL – a methodological framework for assessing the evolution of social networks in e-Learning. FESNeL was designed after an extensive literature review in the areas of e-Learning and Computer Mediated communication revealed limitations in the overall assessment of CMC activity in e-Learning environments. The FESNeL approach combines qualitative and quantitative methods, thus allowing for a

more in-depth analysis of the communication that takes place between the students.

Below are the contributions with relevance to the following fields of study:

- Computer Based Learning (e-Learning and CALL), Online Communities and Computer-Mediated Communication (CMC)

The findings from the literature review showed that most existing frameworks make either a qualitative or quantitative analysis of CMC, but rarely do we see a mixture of these techniques, thus there is a lack of a complete evaluation of all aspects of online communication in e-Learning environments. New teaching and learning methods require new types of evaluation. My proposed framework synthesized a number of analysis frameworks with the aim of filling in some gaps on research, and testing hypothesis that could not be tested through the use of the individual models. Other studies in this domain focus on particular time stamps of the community of e-Learning courses (usually the end of the course), but my project has studied the evolution of these communities throughout the duration of a course. The proposed framework was applied at various stages (per lesson) from the beginning of the course until the end, thus documenting and chronologically mapping the changes of the structure of the social network over time and the duration of the course. Furthermore, the FESNeL framework can be used by e-Learning course maintainers and creators to monitor and receive feedback from their students' social networks over the duration of the online course they are offering.

Unlike current CMC analysis methods, the main advantage of FESNeL is that it assesses the social networks over the duration of a course. Current methods analyze the end state of a social network omitting the changes

and growth that these people networks have gone through before reaching their current state. On the other hand, FESNeL is useful for keeping track of the network changes, while investigating how specific conversation topics, or course amendments positively or negatively influenced the dynamics of their online community. This way, people who use FESNeL to asses their online communities benefit in the ability to predict how certain actions will affect their network, and to incorporate various methodologies to alter the state of their network.

- Human-Computer Interaction (HCI)

  HCI is an important discipline which is quite often omitted when planning and designing online learning environments. However, HCI issues must be addressed in order to be able to implement more user-friendly systems that are more usable, accessible and take interface issues into consideration, since these ultimately play a role in the usage of the system by the students, and can affect their communication, motivation and learning outcomes. In Chapter 4, I have examined the tools and multimedia features that CALL students regard as important to be included in such e-Learning websites. This information is a valuable HCI resource for developers to keep in mind when creating online CALL courses.

By applying FESNeL on a case study, I was able to test the hypotheses listed in section 1.2 (answered in section 7.3). Furthermore during the analysis I have come across several other important findings that can also be considered valuable research contributions and these are discussed in the next section.

7.4.2 Secondary Contributions and Outcomes

In this section the secondary contributions of the particular research are outlined. They were not in the initial scope of this research project, however, they are still important outcomes which can be helpful with similar studies:

- In this student centered online learning environment one student's communication patterns imitated those of a teacher in classroom settings. In addition three more role groups were identified (knowledge manager, self-learner and team member) and these were in line with the findings of O Murchu (2005) and McGhee and Kozma (2001).

- Centrality in-degree was approximately equal to centrality out-degree. This outcome suggests that if you participate and post messages in the discussion boards, you are more likely to get replies and in-coming messages from other students yourself.

- The role groups identified from the SNA analysis did not only have in common their pair relations with other actors, but also their conversation topics. For example, students in the role group R3 were the least participative and their discussions focused mainly on issues related to the course material, whereas R4 students were more communicative and had most of their conversations in the social category.

- The central students in the course took their powerful status from the beginning of the course. Although less powerful students gained more status during the duration of the course, the most powerful ones had already gained and maintained their status from the beginning.

- The various cliques that formed at the beginning of the course usually remained until the end. This is similar to real classes in schools where many times the friends that students make at the beginning of the school year are usually the ones that they have until the end of the course.

- At the initial lessons of LGO, the students posted more general course questions and social topics. As they progressed through the course lessons however, their discussion topics become more focused to the applicable lesson material.

- Lastly, it has been observed that the students seem to be more excited and chat/contribute more at the start of the course, but their overall participation rates are on a decrease during the duration of the course.

7.5 Limitations of Research

In order to be able carry out this research and get meaningful results a number of limitations had to be addressed. These referred to the methodological constraints met and are listed below:

- Questionnaire response rate: the COLLES and ATTLS questionnaires were made available in LGO for the 618 students of the course. However only 104 of the students answered both questionnaires giving a response rate of 16.83%. Responding to the questionnaires (like participating in the forums) was completely up to the students and was not a requirement of the course. Thus this limitation was balanced on the accuracy of the responses since the students that did respond, did so at their own will to give their own opinions and suggestions. The main limitation however of the questionnaire responses was that a key player in LGO (student S157)

who was the only member in role group R2 did not respond, so the COLLES and ATTLS results of the specific role group could not be obtained.

- Student participation in the discussion boards: a log analysis would have been beneficial to identify the lurkers in the courses (ie. Those who observe silently in the discussion boards but do not contribute messages themselves). However this was outside the scope of the project since the main investigation of the thesis was student Communication in the e-Learning environments.

- Course pace: The LGO course was self-paced whereby the students could access the material and contribute to the forums at their own time and calendar schedule. However this imposed a limitation as not all the students were following the lessons at the same time and so there were some delayed posts in earlier forums. (Eg. A student would post in lesson's 1 forum, while some of the other students were already in lesson 2). This was however compensated with the TRA category A2 whereby course-related messages that were posted in the wrong lessons forums were identified and documented.

- Qualitative research limitations: in the TRA component of the FESNeL framework the students' postings had to be put in the TRA categories. This can be considered a limitation since it is up to the discretion of the analyst to decide which message belongs in which category. However, through my analysis I can say that I had no problems with this since the way the categories are, the messages could easily be identified to belong to only a single TRA category. Furthermore, once sorted into the TRA categories, quantitative analysis could be carried out.

7.6 Conclusions

This thesis has provided insights into the use of Computer Mediated Communication by students in online computer based learning environments. The project's primary aim was to develop FESNeL, a methodological framework for assessing the Evolution of CMC social networks in e-Learning courses.

FENSeL was designed following a literature review which identified limitations in current methods of analysis of CMC activity (especially the lack to follow the evolution and changes of a social network). Social networks are networks of people in online communities and they continually evolve and change over time thus following their evolution (and not just analyzing their end state) is significant. FESNeL was tested by applying it to an e-Learning course of the Modern Greek Language which consisted of 15 lessons and provided the students with CMC tools to interact with each other.

The findings from the case study highlighted important communication patterns, role groups and characteristics of the students taking part in the e-Learning course that could not be otherwise investigated with existing methods. Thus FESNeL is an important and useful tool for researchers, practitioners and educators to study and analyze online learning communities and follow the evolution of the social networks that form within them.

Recommendations for Researchers

This study showed the use of FESNeL as a mechanism for better exploring the dynamics and following the evolution of online learning communities, while also identifying student role groups and their characteristics. Future research directions could include comparisons of SNA and TRA results with other forms of standardized questionnaires, applications of FESNeL to different e-Learning domains and investigations of student communication and role groups in relation

to learning outcomes, and student retention. It is also recommended that specialist software be written to collect the students' interactions automatically thus making the data collection stage faster and more efficient.

Some of these future research directions are explained in more detail below:

- Extending the scope of the case study experiments: in this thesis the case study was a course for learning a language (Greek). It would be beneficial to use FESNeL to study the evolution of social networks in areas different to this (like for example history, math, economics, music and so on) to see the differences and similarities between such courses and also to investigate any relation of the course topic with student communication and roles in the online learning environment.

- Investigate communication and role groups in relation to learning outcomes: Although this was outside the scope of this thesis, it would be beneficial in future research to use the results from the FESNeL analysis (SNA, TRA, COLLES, ATTLS) and correlate these with the student's exam results. Exams can be incorporated into the e-Learning environments and the results of such correlations will be important in determining if participation in the discussion boards of the online courses plays a positive, negative or neutral role in learning online.

- Student Retention: Another future direction of this thesis is an investigation of CMC usage and student retention in online courses. Does increased use of CMC actually motivate students to remain in and finish an online course? or is it irrelevant? This could be answered using a mixture of Log Analysis (to determine the students' attendance and drop-outs) and FESNeL (to follow the students online communication activities).

- Student-centred vs Teacher-centred e-Learning environments: In this thesis a self sustainable student centred online learning environment was examined. The course did not have a teacher present (only facilitators to help out with general enquiries). It would be interesting to compare the results and role groups identified in this study with those of a teacher-centred e-Learning environment, to realise the possible differences and similarities in the roles and communication patterns the students undertake in different online settings.

- Course related discussions vs. Social discussions: In this case study the students' overall communication was analyzed irrespective of whether their conversations had to do with the course or whether they were just socializing with each other. A future direction could include applying SNA to each of the TRA categories separately and comparing these to each other to investigate whether there are any relation with the conversations topics and the students communication interactions.

Recommendations for Practitioners

The approach provided in this thesis can be a useful methodology for developers and maintainers of online communities as it can provide insights about the nature and dynamics of their community and will enable them to develop strategies for altering the state of their student social networks. It is recommended that designers incorporate feedback from various studies and evaluations to make their systems more usable and user-friendly. From my findings in this study I can suggest the inclusion of certain features in e-Learning systems, like the facilities of chat-rooms and discussion boards as these promote the synchronous and asynchronous communication between the learners. I can also recommend providing a pre-set recommended schedule to assist the students in their progress and time-planning.

Some of these practical insights are explained in more detail below:

- My thesis showed that communication is an important element of the e-learning experience. E-educators and course designers should make sure to include CMC facilities and CMC support so that their students can engage in communication with each other.

- Students seem to group into specific roles early on in the course. This is important for lectures as they can identify these student roles and their characteristics at the start of the course and make the e-Learning environment and context more personalized to their students.

- The TRA component of FESNeL was helpful in identifying what the students of the course were talking about. For course designers it is recommended to implement scripts which can filter these conversations by topic and present them to the lectures in a user-friendly way. Thus lecturers will be able to easily see what their students are talking about. A benefit of this, is that if the lecturer wants to increase the course related conversations, then he/she can intervene and begin new discussions on topics that they find will be more beneficial to the students.

- By using the ATTLS questionnaire from the start of the course, lecturers will be able to identify which of their students are connected knowers and which are separate knowers. Knowing your students learning styles is important as you can amend the CMC around the course in a way that best fits their learning style. Similarly, when using the COLLES at the start of the course, lecturers will be able to learn what their students opinions, preferences and previous CMC experience is and may include guidance on how their students can learn to feel comfortable in these environments fast.

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Appendices

Appendix A – Questionnaire for Online Language Courses

1. Apart from your mother language, do you speak any other languages?

- ☐ Yes
- ☐ No

2. If yes, which ones?

3. Have you ever taken part in an online course?

- ☐ Yes
- ☐ No

4. Have you ever taken part in an online language course?

- ☐ Yes
- ☐ No

5. What were the things you liked about the online course?

6. What were the things you disliked about the online course?

7. Would you consider learning a foreign language from the internet?

- ☐ Yes
- ☐ No

8. Would you be willing to pay for an online foreign language course?

- ☐ Yes
- ☐ Probably Not
- ☐ No

9. Would you prefer to follow an online foreign language course on:

- ☐ Your own pace
- ☐ Pre-set Schedule

10. How many hours a week, would you be willing to spend on an online foreign language course?

11. Do you have any accessibility problems?

12. Is your computer equipted with audio support (eg spearkers, etc)?

- ☐ Yes
- ☐ No
- ☐ Dont Know

13. Is your computer equipted with video support (can you watch videos)?

- ☐ Yes
- ☐ No
- ☐ Dont Know

14. What kind of internet connection do you have?

- ☐ Dial-up
- ☐ Broadband/Cable
- ☐ LAN
- ☐ dont know

15. Which is more important to you in websites

- ☐ Speed
- ☐ Appearance/Look
- ☐ Content

16. In the next few questions, how would you rate the importance of the specific features for online language courses?

17. Audio (sound clips for pronounciations etc)

- ☐ 1 - Least Important
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 - Very Important

18. Dictionary/Translator

- ☐ 1 - Least Important
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 - Very Important

19. Links to other useful resources

- ☐ 1 - Least Important
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 - Very Important

20. Quizes/Tests

- ☐ 1 - Least Important
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 - Very Important

21. Discussion Boards

- ☐ 1 - Least Important
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 - Very Important

22. Games

- ☐ 1 - Least Important
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 - Very Impotant

23. Chatrooms

- ☐ 1 - Least Important
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 - Very Important

24. Thesaurus

- ☐ 1 - Least Important
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 - Very Important

25. Penfriends finder

- ☐ 1 - Least Important
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5 - Very Important

26. Frequently Asked Questions/IIelp

- ☐ 1 - Least Important
- ☐ 2
- ☐ 3

☐ 4

☐ 5 - Very Important

27. Video (eg short videos in the target language)

☐ 1 - Least Important

☐ 2

☐ 3

☐ 4

☐ 5 - Very Important

28. Horoscopes

☐ 1 - Least Important

☐ 2

☐ 3

☐ 4

☐ 5 - Very Important

29. News (website news, not world news)

☐ 1 - Least Important

☐ 2

☐ 3

☐ 4

☐ 5 - Very Important

30. Spell-Checker

☐ 1 - Least Important

☐ 2

☐ 3

☐ 4

☐ 5 - Very Important

31. List two other features (not listed previously) that you think are important to be included in online language courses?

32. Please feel free to make any other comments or suggestions

Appendix B – ATTLS Survey

The purpose of this questionnaire is to help us evaluate your attitudes towards thinking and learning.

		Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
1	I spend time figuring out what's 'wrong' with things. For example, I'll look for something in a literary interpretation that isn't argued well enough.					
2	I try to point out weaknesses in other people's thinking to help them clarify their arguments.					
3	I tend to put myself in other people's shoes when discussing controversial issues, to see why they think the way they do.					
4	One could call my way of analysing things 'putting them on trial' because I am careful to consider all the evidence.					
5	I value the use of logic and reason over the incorporation of my own concerns when solving problems.					
6	I can obtain insight into opinions that differ from mine through empathy.					
7	When I encounter people whose opinions seem alien to me, I make a deliberate effort to 'extend' myself into that person, to try to see how they could have those opinions.					
8	I have certain criteria I use in evaluating arguments.					
9	I'm more likely to try to understand someone else's opinion than to try to evaluate it.					
10	I try to think with people instead of against them.					
11	It's important for me to remain as objective as possible when I analyze something.					
12	I often find myself arguing with the authors of books that I read, trying to logically figure out why they're wrong.					
13	I am always interested in knowing why people say and believe the things they do.					
14	I find that I can strengthen my own position through arguing with someone who disagrees with me.					
15	I enjoy hearing the opinions of people who come from backgrounds different to mine - it helps me to understand how the same things can be seen in such different ways.					

16	I feel that the best way for me to achieve my own identity is to interact with a variety of other people.					
17	The most important part of my education has been learning to understand people who are very different to me.					
18	I like to understand where other people are 'coming from', what experiences have led them to feel the way they do.					
19	In evaluating what someone says, I focus on the quality of their argument, not on the person who's presenting it.					
20	I like playing devil's advocate - arguing the opposite of what someone is saying.					

Appendix C - COLLES Survey

The purpose of this questionnaire is to help us understand what you value in an online learning experience.

		Almost never	seldom	some-times	often	Almost always
Relevance						
1	My learning focuses on issues that interest me					
2	What I learn is important for my professional practice					
3	I learn how to improve my professional practice					
4	What I learn connects well with my professional practice					
Reflection						
5	I think critically about what I learn					
6	I think critically about my own ideas					
7	O think critically about other students' ideas					
8	I think critically about ideas in the readings					
Interactivity						
9	I explain my ideas to other students					
10	I ask other students to explain their ideas					
11	Other students ask me to explain my ideas					
12	Other students respond to my ideas					
Tutor Support						
13	The tutor stimulates my thinking					
14	The tutor encourages me to participate					
15	The tutor models good discourse					
16	The tutor models critical self-reflection					
Peer Support						
17	Other students encourage my participation					
18	Other students praise my contribution					
19	Other students value my contribution					
20	Other students empathise with my struggle to learn					
Interpretation						
21	I make good sense of other students' messages					
22	Other students make good sense of my messages					
23	I make good sense of the tutor's messages					
24	The tutor makes good sense of my messages					

Appendix D – SNA Ego-net Results

	In-Degree	*Out-Degree*	*Size*	*Density*	*Str. Equivalence*
S1	0.006	0.006	4	0.5	1
S2	0.096	0.096	59	0.119	615
S3	0.011	0.011	7	0.571	250
S4	0.11	0.11	68	0.536	459
S5	0.002	0.002	1	0	2
S6	0.005	0.005	3	1	3
S7	0.548	0.548	338	0.118	618
S8	0.164	0.164	101	0.962	512
S9	0.003	0.005	3	0.667	38
S10	0.002	0.003	2	1	39
S11	0.011	0.013	8	1	240
S12	0.107	0.109	67	0.137	616
S13	0.018	0.019	12	0.576	242
S14	0.086	0.086	53	0.168	611
S15	0.024	0.026	16	0.4	243
S16	0.041	0.042	26	0.323	492
S17	0.011	0.013	8	1	241
S18	0.002	0.003	2	1	4
S19	0.169	0.169	104	0.91	514
S20	0.006	0.008	5	0.9	113
S21	0.006	0.006	4	1	114
S22	0.019	0.019	12	1	298
S23	0.055	0.055	34	0.301	607
S24	0.019	0.019	12	1	299
S25	0.019	0.019	12	1	300
S26	0.042	0.042	26	0.622	406
S27	0.019	0.019	12	1	301
S28	0.146	0.146	90	0.359	610
S29	0.217	0.217	134	0.582	604
S30	0.062	0.062	38	0.44	506
S31	0.091	0.091	56	0.734	480
S32	0.194	0.178	120	0.703	568
S33	0.193	0.193	119	0.709	594
S34	0.16	0.16	99	1	515
S35	0.16	0.16	99	1	516
S36	0.17	0.17	105	0.897	603
S37	0.165	0.165	102	0.944	513
S38	0.16	0.16	99	1	517
S39	0.16	0.16	99	1	518
S40	0.253	0.253	156	0.498	608
S41	0.222	0.17	137	0.634	580
S42	0.172	0.172	106	0.881	587
S43	0.172	0.172	106	0.878	564

S44	0.16	0.16	99	1	588
S45	0.232	0.232	143	0.589	510
S46	0.162	0.162	100	0.981	559
S47	0.16	0.16	99	1	519
S48	0.16	0.16	99	1	520
S49	0.243	0.246	152	0.487	597
S50	0.185	0.185	114	0.784	571
S51	0.16	0.16	99	1	521
S52	0.185	0.185	114	0.784	572
S53	0.16	0.16	99	1	522
S54	0.16	0.16	99	1	523
S55	0.22	0.22	136	0.644	581
S56	0.17	0.17	105	0.897	601
S57	0.16	0.16	99	1	524
S58	0.16	0.16	99	1	525
S59	0.173	0.173	107	0.864	593
S60	0.198	0.198	122	0.679	598
S61	0.227	0.227	140	0.565	614
S62	0.164	0.164	101	0.968	563
S63	0.16	0.16	99	1	526
S64	0.17	0.17	105	0.9	596
S65	0.16	0.16	99	1	527
S66	0.165	0.165	102	0.945	591
S67	0.16	0.16	99	1	589
S68	0.173	0.173	107	0.865	602
S69	0.182	0.182	112	0.791	511
S70	0.16	0.16	99	1	528
S71	0.164	0.164	101	0.961	561
S72	0.162	0.162	100	0.98	556
S73	0.162	0.162	100	0.981	555
S74	0.248	0.248	153	0.483	599
S75	0.16	0.16	99	1	529
S76	0.16	0.16	99	1	530
S77	0.186	0.186	115	0.768	574
S78	0.16	0.16	99	1	531
S79	0.186	0.186	115	0.769	578
S80	0.16	0.16	99	1	532
S81	0.16	0.16	99	1	533
S82	0.209	0.207	129	0.619	600
S83	0.16	0.16	99	1	534
S84	0.18	0.18	111	0.813	573
S85	0.178	0.178	110	0.819	567
S86	0.16	0.16	99	1	535
S87	0.16	0.16	99	1	536
S88	0.167	0.167	103	0.926	560
S89	0.16	0.16	99	1	537
S90	0.16	0.16	99	1	538

S91	0.16	0.16	99	1	590
S92	0.259	0.259	160	0.485	585
S93	0.16	0.16	99	1	539
S94	0.169	0.169	104	0.915	562
S95	0.193	0.193	119	0.723	576
S96	0.162	0.162	100	0.98	557
S97	0.178	0.175	110	0.818	569
S98	0.18	0.18	111	0.804	595
S99	0.229	0.229	141	0.604	584
S100	0.237	0.237	146	0.567	579
S101	0.16	0.16	99	1	540
S102	0.193	0.193	119	0.729	570
S103	0.16	0.16	99	1	541
S104	0.182	0.182	112	0.809	575
S105	0.16	0.16	99	1	542
S106	0.219	0.219	135	0.653	582
S107	0.219	0.219	135	0.653	583
S108	0.177	0.177	109	0.839	566
S109	0.16	0.16	99	1	543
S110	0.16	0.16	99	1	544
S111	0.243	0.243	150	0.541	508
S112	0.17	0.17	105	0.898	565
S113	0.16	0.16	99	1	545
S114	0.185	0.185	114	0.772	577
S115	0.16	0.16	99	1	546
S116	0.16	0.16	99	1	547
S117	0.16	0.16	99	1	548
S118	0.193	0.193	119	0.723	586
S119	0.16	0.16	99	1	549
S120	0.164	0.164	101	0.961	558
S121	0.16	0.16	99	1	550
S122	0.167	0.167	103	0.93	592
S123	0.16	0.16	99	1	551
S124	0.219	0.219	135	0.653	509
S125	0.16	0.16	99	1	552
S126	0.16	0.16	99	1	553
S127	0.16	0.16	99	1	554
S128	0.005	0.005	3	1	46
S129	0.032	0.032	20	0.358	422
S130	0.005	0.005	3	1	47
S131	0.066	0.066	41	0.143	613
S132	0.024	0.024	15	0.6	310
S133	0.006	0.006	4	1	130
S134	0.037	0.037	23	0.478	337
S135	0.019	0.019	12	1	317
S136	0.05	0.05	31	0.292	418
S137	0.019	0.019	12	1	318

S138	0.019	0.019	12	1	319
S139	0.019	0.019	12	1	320
S140	0.029	0.029	18	0.516	356
S141	0.019	0.019	12	1	321
S142	0.019	0.019	12	1	322
S143	0.019	0.019	12	1	323
S144	0.019	0.019	12	1	324
S145	0.019	0.019	12	1	325
S146	0.021	0.021	13	0.846	326
S147	0.003	0.003	2	1	104
S148	0.003	0.003	2	1	49
S149	0.011	0.011	7	0.857	260
S150	0.01	0.01	6	0.667	217
S151	0.008	0.008	5	1	218
S152	0.008	0.008	5	1	219
S153	0.008	0.008	5	1	220
S154	0.057	0.057	35	0.43	458
S155	0.028	0.028	17	0.544	419
S156	0.011	0.011	7	0.714	328
S157	0.233	0.233	144	0.193	617
S158	0.058	0.044	36	0.429	457
S159	0.088	0.089	55	0.22	609
S160	0.026	0.028	17	0.949	407
S161	0.026	0.028	17	0.949	412
S162	0.026	0.028	17	0.949	408
S163	0.026	0.028	17	0.949	409
S164	0.063	0.066	41	0.317	497
S165	0.026	0.028	17	0.949	410
S166	0.047	0.049	30	0.46	490
S167	0.026	0.028	17	0.949	411
S168	0.002	0.002	1	0	43
S169	0.018	0.018	11	0.782	376
S170	0.011	0.011	7	0.714	404
S171	0.003	0.003	2	1	19
S172	0.006	0.006	4	0.333	56
S173	0.01	0.01	6	0.4	150
S174	0.024	0.024	15	0.571	336
S175	0.003	0.003	2	1	51
S176	0.003	0.003	2	1	52
S177	0.019	0.019	12	0.515	499
S178	0.011	0.011	7	1	222
S179	0.047	0.047	29	0.369	605
S180	0.011	0.011	7	1	223
S181	0.002	0.002	1	0	58
S182	0.002	0.002	1	0	59
S183	0.005	0.005	3	1	288
S184	0.015	0.015	9	0.667	265

S185	0.003	0.003	2	1	20
S186	0.011	0.011	7	1	237
S187	0.018	0.018	11	0.491	239
S188	0.011	0.011	7	1	238
S189	0.003	0.003	2	1	133
S190	0.003	0.003	2	1	134
S191	0.013	0.013	8	0.571	196
S192	0.01	0.01	6	0.733	154
S193	0.01	0.01	6	0.733	193
S194	0.039	0.039	24	0.279	426
S195	0.008	0.008	5	1	155
S196	0.049	0.049	30	0.529	385
S197	0.003	0.003	2	1	110
S198	0.073	0.075	46	1	463
S199	0.083	0.084	52	0.826	485
S200	0.126	0.128	79	0.534	489
S201	0.076	0.078	48	0.918	474
S202	0.073	0.075	46	1	464
S203	0.073	0.075	46	1	465
S204	0.1	0.102	63	0.592	486
S205	0.115	0.117	72	0.478	507
S206	0.075	0.076	47	0.959	482
S207	0.078	0.079	49	0.911	479
S208	0.081	0.083	51	0.85	488
S209	0.073	0.075	46	1	466
S210	0.073	0.075	46	1	483
S211	0.073	0.075	46	1	467
S212	0.079	0.081	50	0.878	481
S213	0.147	0.149	92	0.359	612
S214	0.073	0.075	46	1	468
S215	0.073	0.075	46	1	484
S216	0.086	0.088	54	0.766	462
S217	0.073	0.075	46	1	469
S218	0.073	0.075	46	1	470
S219	0.073	0.075	46	1	471
S220	0.097	0.099	61	0.631	487
S221	0.073	0.075	46	1	472
S222	0.089	0.091	56	0.712	491
S223	0.075	0.076	47	0.981	475
S224	0.099	0.1	62	0.595	460
S225	0.078	0.079	49	0.897	476
S226	0.084	0.086	53	0.792	461
S227	0.073	0.075	46	1	473
S228	0.081	0.083	51	0.842	478
S229	0.078	0.079	49	0.894	477
S230	0.008	0.008	5	0.3	136
S231	0.003	0.003	2	1	36

S232	0.015	0.015	9	0.444	177
S233	0.034	0.034	21	0.333	415
S234	0.002	0.002	1	0	66
S235	0.021	0.021	13	0.244	297
S236	0.002	0.002	1	0	7
S237	0.016	0.016	10	1	294
S238	0.016	0.016	10	1	295
S239	0.036	0.036	22	0.532	414
S240	0.028	0.028	17	0.588	316
S241	0.003	0.003	2	1	139
S242	0.023	0.023	14	0.462	402
S243	0.01	0.01	6	0.867	421
S244	0.018	0.018	11	0.473	420
S245	0.002	0.002	1	0	53
S246	0.002	0.002	1	0	8
S247	0.016	0.016	10	0.6	187
S248	0.008	0.008	5	1	178
S249	0.002	0.002	1	0	9
S250	0.006	0.006	4	1	143
S251	0.006	0.006	4	1	144
S252	0.024	0.024	15	0.448	370
S253	0.021	0.021	13	0.846	364
S254	0.003	0.003	2	1	31
S255	0.028	0.028	17	0.5	363
S256	0.091	0.091	56	0.445	456
S257	0.037	0.037	23	0.506	425
S258	0.019	0.019	12	1	365
S259	0.019	0.019	12	1	366
S260	0.041	0.041	25	0.437	397
S261	0.019	0.019	12	1	367
S262	0.019	0.019	12	1	368
S263	0.019	0.019	12	1	369
S264	0.029	0.029	18	0.353	403
S265	0.016	0.016	10	0.756	354
S266	0.015	0.015	9	0.861	314
S267	0.013	0.013	8	1	315
S268	0.011	0.011	7	0.81	163
S269	0.018	0.018	11	1	306
S270	0.055	0.055	34	0.326	424
S271	0.023	0.023	14	0.659	309
S272	0.018	0.018	11	1	307
S273	0.018	0.018	11	1	308
S274	0.018	0.018	11	1	311
S275	0.028	0.028	17	0.566	313
S276	0.023	0.023	14	0.67	312
S277	0.003	0.003	2	1	24
S278	0.005	0.005	3	1	74

S279	0.023	0.023	14	0.505	413
S280	0.013	0.013	8	1	423
S281	0.023	0.023	14	0.527	374
S282	0.013	0.013	8	1	371
S283	0.013	0.013	8	1	372
S284	0.013	0.013	8	1	373
S285	0.002	0.002	1	0	76
S286	0.013	0.013	8	1	269
S287	0.013	0.013	8	1	270
S288	0.013	0.013	8	1	271
S289	0.013	0.013	8	1	272
S290	0.013	0.013	8	1	273
S291	0.01	0.01	6	0.533	304
S292	0.026	0.026	16	0.383	496
S293	0.002	0.002	1	0	77
S294	0.008	0.008	5	1	256
S295	0.037	0.037	23	0.277	493
S296	0.006	0.006	4	0.667	157
S297	0.002	0.002	1	0	78
S298	0.006	0.008	5	1	202
S299	0.006	0.008	5	1	203
S300	0.011	0.011	7	0.857	221
S301	0.076	0.076	47	0.181	606
S302	0.005	0.005	3	1	296
S303	0.005	0.005	3	1	112
S304	0.013	0.013	8	0.5	302
S305	0.005	0.005	3	1	160
S306	0.002	0.002	1	0	79
S307	0.002	0.002	1	0	80
S308	0.008	0.008	5	1	277
S309	0.008	0.008	5	1	278
S310	0.008	0.008	5	1	279
S311	0.008	0.008	5	1	495
S312	0.002	0.002	1	0	84
S313	0.005	0.005	3	1	85
S314	0.002	0.002	1	0	10
S315	0.003	0.003	2	1	26
S316	0.037	0.037	23	0.423	500
S317	0.002	0.002	1	0	86
S318	0.005	0.005	3	1	29
S319	0.003	0.003	2	1	27
S320	0.015	0.015	9	0.694	286
S321	0.021	0.021	13	1	358
S322	0.105	0.105	65	0.347	494
S323	0.021	0.021	13	1	359
S324	0.021	0.021	13	1	360
S325	0.024	0.024	15	0.81	361

S326	0.021	0.024	15	0.81	357
S327	0.026	0.023	16	0.733	362
S328	0.003	0.003	2	1	28
S329	0.011	0.011	7	1	428
S330	0.002	0.002	1	0	11
S331	0.013	0.013	8	0.607	173
S332	0.008	0.008	5	1	171
S333	0.008	0.008	5	1	172
S334	0.005	0.005	3	1	89
S335	0.013	0.013	8	0.464	327
S336	0.008	0.008	5	1	148
S337	0.021	0.021	13	0.333	290
S338	0.008	0.008	5	1	149
S339	0.029	0.029	18	0.386	498
S340	0.005	0.005	3	1	90
S341	0.002	0.002	1	0	91
S342	0.003	0.003	2	1	30
S343	0.008	0.008	6	0.667	305
S344	0.006	0.006	5	1	355
S345	0.002	0.002	1	0	41
S346	0.003	0.003	2	1	92
S347	0.008	0.008	5	0.3	161
S348	0.019	0.019	12	0.864	503
S349	0.018	0.018	11	1	504
S350	0.018	0.018	11	1	501
S351	0.028	0.029	18	0.497	505
S352	0.018	0.018	11	1	502
S353	0.015	0.016	10	1	347
S354	0.023	0.023	14	0.582	353
S355	0.016	0.016	10	1	348
S356	0.016	0.016	10	1	349
S357	0.016	0.016	10	1	350
S358	0.016	0.016	10	1	351
S359	0.016	0.016	10	1	352
S360	0.003	0.003	2	1	32
S361	0.005	0.005	3	1	124
S362	0.008	0.008	5	0.4	159
S363	0.002	0.002	1	0	12
S364	0.029	0.029	18	0.464	388
S365	0.006	0.006	4	0.5	145
S366	0.006	0.006	4	1	233
S367	0.006	0.006	4	1	234
S368	0.006	0.006	4	1	230
S369	0.006	0.006	4	1	231
S370	0.003	0.003	2	1	140
S371	0.003	0.003	2	1	141
S372	0.003	0.003	2	1	142

S373	0.003	0.003	2	1	37
S374	0.003	0.002	2	1	106
S375	0.002	0.002	1	0	13
S376	0.013	0.013	8	0.857	400
S377	0.002	0.002	1	0	60
S378	0.002	0.002	1	0	61
S379	0.063	0.063	39	0.76	455
S380	0.011	0.011	7	1	399
S381	0.015	0.015	9	0.694	398
S382	0.021	0.021	13	0.731	335
S383	0.015	0.015	9	0.167	289
S384	0.005	0.005	3	1	125
S385	0.005	0.005	3	1	126
S386	0.01	0.01	6	1	283
S387	0.01	0.01	6	1	275
S388	0.024	0.024	15	0.524	417
S389	0.01	0.01	6	1	276
S390	0.003	0.003	2	1	135
S391	0.002	0.002	1	0	70
S392	0.002	0.002	1	0	71
S393	0.003	0.003	2	1	33
S394	0.018	0.018	11	1	391
S395	0.026	0.026	16	0.542	395
S396	0.019	0.019	12	0.848	390
S397	0.018	0.018	11	1	392
S398	0.018	0.018	11	1	393
S399	0.018	0.018	11	1	394
S400	0.018	0.018	11	1	389
S401	0.005	0.005	3	1	158
S402	0.005	0.005	3	1	87
S403	0.005	0.005	3	1	88
S404	0.002	0.002	1	0	16
S405	0.002	0.002	1	0	93
S406	0.003	0.003	2	1	101
S407	0.002	0.002	1	0	57
S408	0.003	0.003	2	1	34
S409	0.002	0.002	1	0	99
S410	0.002	0.002	1	0	14
S411	0.008	0.008	5	1	206
S412	0.008	0.008	5	1	205
S413	0.011	0.011	7	0.476	209
S414	0.008	0.008	5	1	207
S415	0.008	0.008	5	1	208
S416	0.018	0.018	11	1	396
S417	0.019	0.019	12	0.833	333
S418	0.021	0.021	13	0.718	334
S419	0.018	0.018	11	1	329

S420	0.031	0.031	19	0.497	387
S421	0.018	0.018	11	1	330
S422	0.018	0.018	11	1	331
S423	0.018	0.018	11	1	332
S424	0.002	0.002	1	0	192
S425	0.002	0.002	1	0	153
S426	0.002	0.002	1	0	15
S427	0.062	0.062	38	0.778	429
S428	0.006	0.006	4	1	191
S429	0.006	0.006	4	0.333	293
S430	0.006	0.006	4	0.333	244
S431	0.003	0.003	2	1	245
S432	0.003	0.003	2	1	25
S433	0.002	0.002	1	0	63
S434	0.011	0.011	7	1	212
S435	0.015	0.015	9	0.611	211
S436	0.011	0.011	7	1	213
S437	0.011	0.011	7	1	214
S438	0.011	0.011	7	1	215
S439	0.011	0.011	7	1	216
S440	0.006	0.005	4	1	108
S441	0.006	0.005	4	1	109
S442	0.066	0.066	41	0.691	450
S443	0.008	0.008	5	1	116
S444	0.008	0.008	5	1	117
S445	0.008	0.008	5	1	115
S446	0.015	0.015	9	0.333	280
S447	0.019	0.019	12	0.394	386
S448	0.008	0.008	5	0.6	162
S449	0.002	0.002	1	0	73
S450	0.026	0.026	16	0.333	405
S451	0.01	0.01	6	0.667	200
S452	0.002	0.002	1	0	83
S453	0.002	0.002	1	0	67
S454	0.002	0.002	1	0	72
S455	0.002	0.002	1	0	55
S456	0.003	0.003	2	1	167
S457	0.003	0.003	2	1	168
S458	0.003	0.003	2	1	166
S459	0.002	0.002	1	0	69
S460	0.002	0.002	1	0	68
S461	0.002	0.002	1	0	156
S462	0.018	0.018	11	0.309	255
S463	0.003	0.003	2	1	132
S464	0.003	0.003	2	1	131
S465	0.002	0.002	1	0	128
S466	0.008	0.008	5	1	201

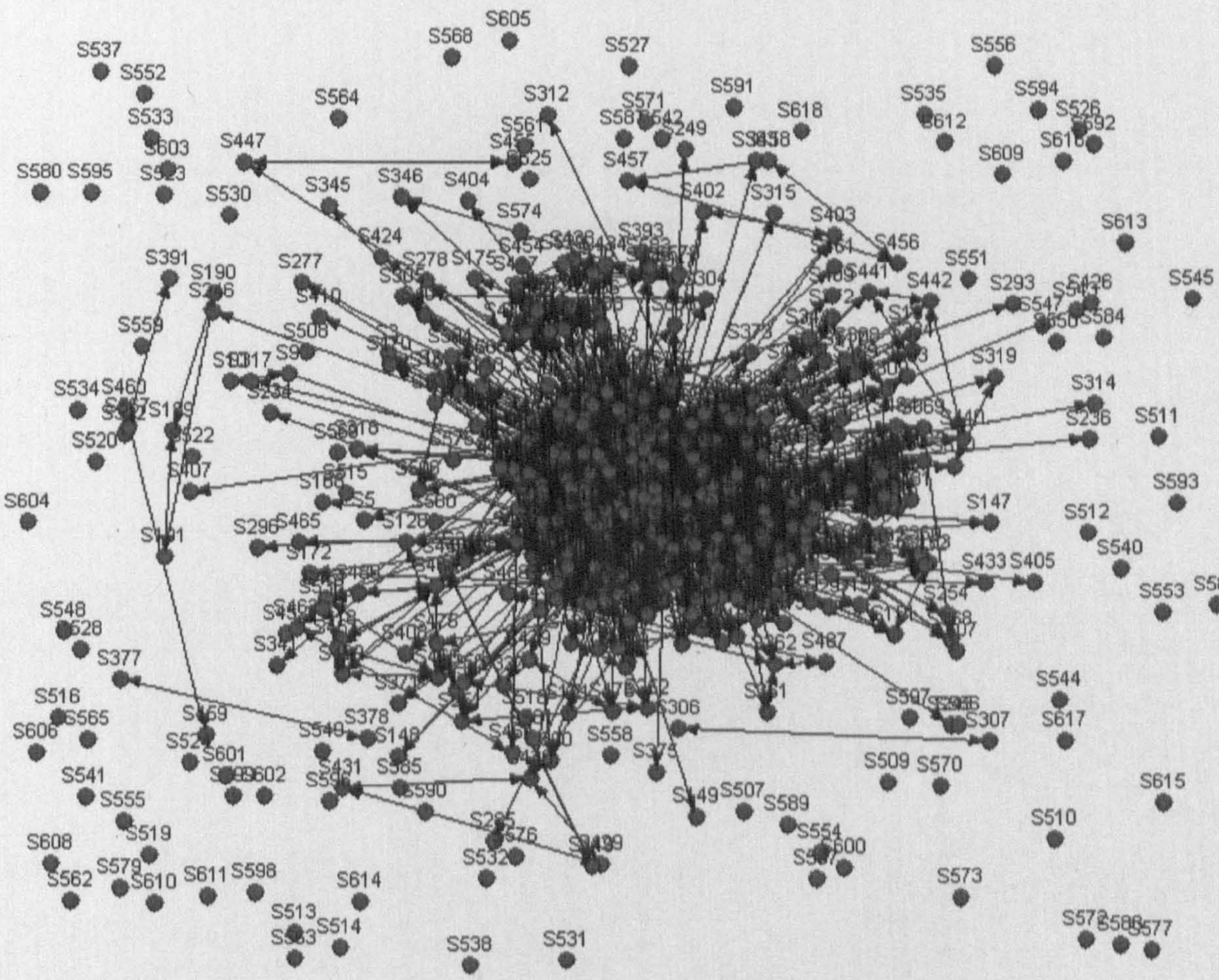
S467	0.008	0.008	5	1	199
S468	0.013	0.013	8	0.464	198
S469	0.039	0.039	24	0.659	377
S470	0.003	0.003	2	1	257
S471	0.024	0.024	15	0.248	416
S472	0.044	0.044	27	0.516	384
S473	0.005	0.005	3	1	151
S474	0.011	0.011	7	0.524	287
S475	0.002	0.002	1	0	82
S476	0.005	0.005	3	0.333	138
S477	0.002	0.002	1	0	81
S478	0.058	0.058	36	0.849	430
S479	0.003	0.003	2	1	137
S480	0.021	0.021	13	0.526	375
S481	0.008	0.008	5	1	264
S482	0.008	0.008	5	1	263
S483	0.008	0.008	5	1	262
S484	0.011	0.011	7	0.524	261
S485	0.018	0.018	11	0.818	344
S486	0.002	0.002	1	0	75
S487	0.003	0.003	2	1	170
S488	0.003	0.003	2	1	169
S489	0.058	0.058	36	0.844	451
S490	0.013	0.013	8	0.464	266
S491	0.029	0.029	18	0.503	346
S492	0.013	0.013	8	1	268
S493	0.013	0.013	8	1	267
S494	0.006	0.006	4	1	281
S495	0.021	0.021	13	0.654	345
S496	0.016	0.016	10	1	339
S497	0.016	0.016	10	1	343
S498	0.016	0.016	10	1	342
S499	0.016	0.016	10	1	341
S500	0.016	0.016	10	1	340
S501	0.016	0.016	10	1	338
S502	0.006	0.006	4	1	236
S503	0.006	0.006	4	1	235
S504	0.008	0.008	5	1	229
S505	0.008	0.008	5	1	228
S506	0.008	0.008	5	1	227
S507	0.008	0.008	5	1	251
S508	0.008	0.008	5	1	253
S509	0.008	0.008	5	1	252
S510	0.013	0.013	8	0.5	427
S511	0.008	0.008	5	1	254
S512	0.003	0.003	2	1	111
S513	0.002	0.002	1	0	50

S514	0.006	0.006	4	1	175
S515	0.006	0.006	4	1	176
S516	0.006	0.006	4	1	174
S517	0.005	0.005	3	1	65
S518	0.003	0.003	2	1	23
S519	0.005	0.005	3	1	64
S520	0.002	0.002	1	0	62
S521	0.008	0.008	5	1	303
S522	0.005	0.005	3	1	226
S523	0.002	0.002	1	0	152
S524	0.003	0.003	2	1	18
S525	0.055	0.055	34	0.943	441
S526	0.031	0.031	19	1	379
S527	0.031	0.031	19	1	381
S528	0.036	0.036	22	0.771	383
S529	0.031	0.031	19	1	382
S530	0.081	0.081	50	0.594	454
S531	0.081	0.081	50	0.594	453
S532	0.031	0.031	19	1	380
S533	0.081	0.081	50	0.594	452
S534	0.031	0.031	19	1	378
S535	0.053	0.053	33	1	447
S536	0.053	0.053	33	1	449
S537	0.053	0.053	33	1	434
S538	0.053	0.053	33	1	448
S539	0.053	0.053	33	1	440
S540	0.053	0.053	33	1	439
S541	0.053	0.053	33	1	438
S542	0.053	0.053	33	1	437
S543	0.053	0.053	33	1	436
S544	0.053	0.053	33	1	435
S545	0.058	0.058	36	0.852	444
S546	0.053	0.053	33	1	433
S547	0.053	0.053	33	1	432
S548	0.053	0.053	33	1	446
S549	0.057	0.057	35	0.896	442
S550	0.058	0.058	36	0.849	443
S551	0.053	0.053	33	1	431
S552	0.053	0.053	33	1	445
S553	0.003	0.003	2	1	48
S554	0.013	0.013	8	1	232
S555	0.018	0.018	11	0.655	401
S556	0.005	0.005	3	1	190
S557	0.003	0.003	2	1	102
S558	0.008	0.008	5	1	186
S559	0.008	0.008	5	1	185
S560	0.006	0.006	4	0.667	100

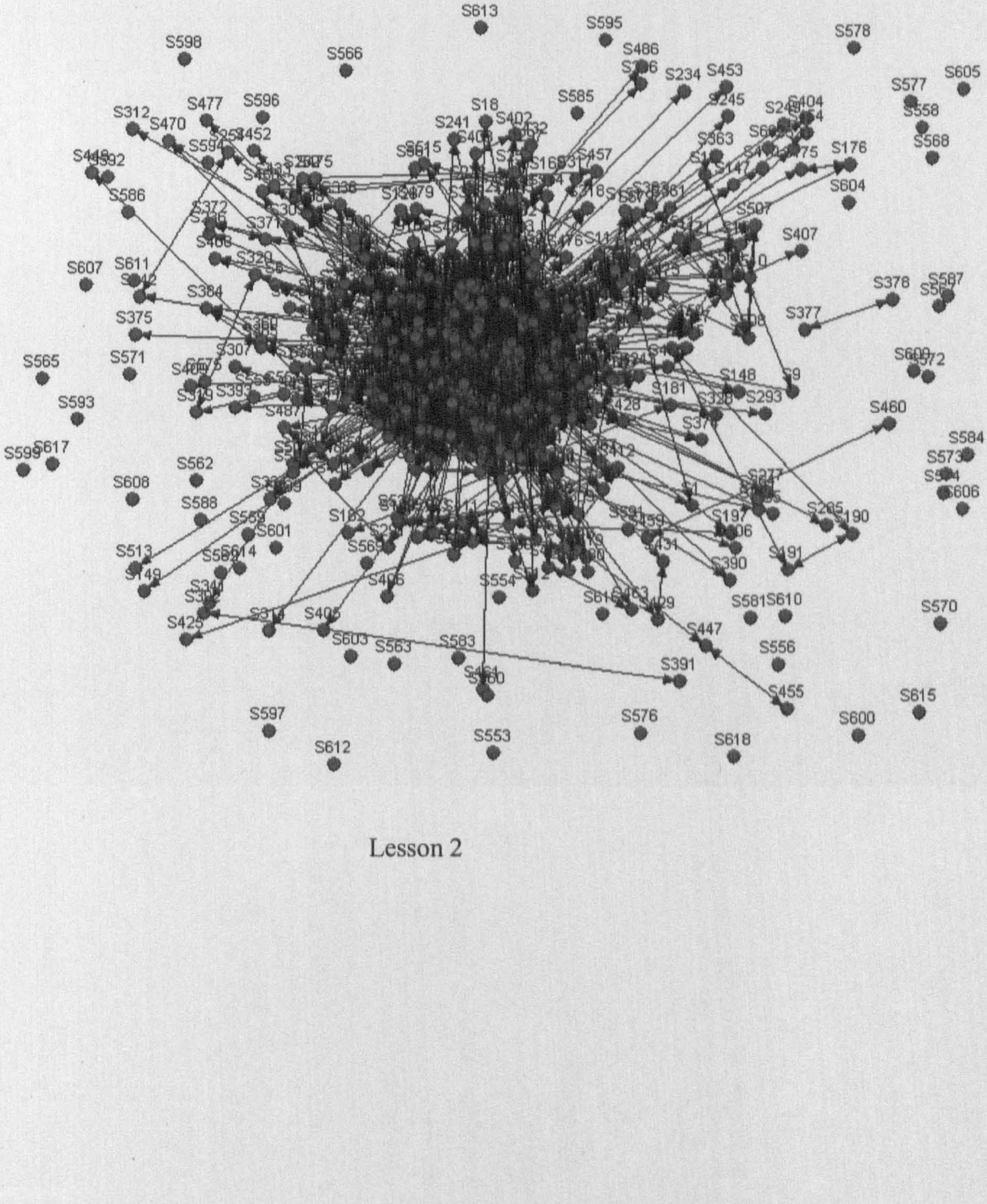
S561	0.003	0.003	2	1	97
S562	0.005	0.005	3	1	107
S563	0.006	0.006	4	1	184
S564	0.006	0.006	4	1	183
S565	0.002	0.002	1	0	21
S566	0.003	0.003	2	1	105
S567	0.003	0.003	2	1	54
S568	0.003	0.003	2	1	147
S569	0.003	0.003	2	1	146
S570	0.018	0.018	11	0.545	194
S571	0.008	0.008	5	1	224
S572	0.008	0.008	5	1	181
S573	0.008	0.008	5	1	180
S574	0.008	0.008	5	1	179
S575	0.015	0.015	9	0.583	282
S576	0.015	0.015	9	1	292
S577	0.003	0.003	2	1	40
S578	0.005	0.005	3	1	35
S579	0.005	0.005	3	1	249
S580	0.003	0.003	2	1	17
S581	0.002	0.002	1	0	6
S582	0.002	0.002	1	0	129
S583	0.003	0.003	2	1	127
S584	0.006	0.006	4	1	189
S585	0.006	0.006	4	1	188
S586	0.003	0.003	2	1	42
S587	0.005	0.005	3	1	165
S588	0.003	0.003	2	1	103
S589	0.006	0.008	5	0.4	164
S590	0.01	0.01	6	1	248
S591	0.01	0.01	6	1	247
S592	0.013	0.013	8	0.679	274
S593	0.01	0.01	6	1	246
S594	0.003	0.003	2	1	98
S595	0.005	0.005	3	1	45
S596	0.005	0.005	3	1	44
S597	0.011	0.011	7	1	285
S598	0.021	0.021	13	0.59	284
S599	0.003	0.003	2	1	210
S600	0.019	0.019	12	0.5	291
S601	0.002	0.002	1	0	22
S602	0.01	0.008	6	0.8	123
S603	0.008	0.008	5	1	122
S604	0.008	0.008	5	1	121
S605	0.006	0.006	4	1	204
S606	0.011	0.011	7	0.905	259
S607	0.006	0.006	4	1	120

S608	0.006	0.006	4	1	119
S609	0.006	0.006	4	1	118
S610	0.003	0.003	2	1	96
S611	0.003	0.002	2	1	95
S612	0.002	0.002	1	0	5
S613	0.01	0.01	6	1	182
S614	0.013	0.013	8	0.75	197
S615	0.011	0.011	7	1	225
S616	0.006	0.006	4	1	258
S617	0.003	0.003	2	1	94
S618	0.01	0.01	6	1	195

Appendix E – Neighbour Connection Lessons 1-15 Sociograms



Lesson 1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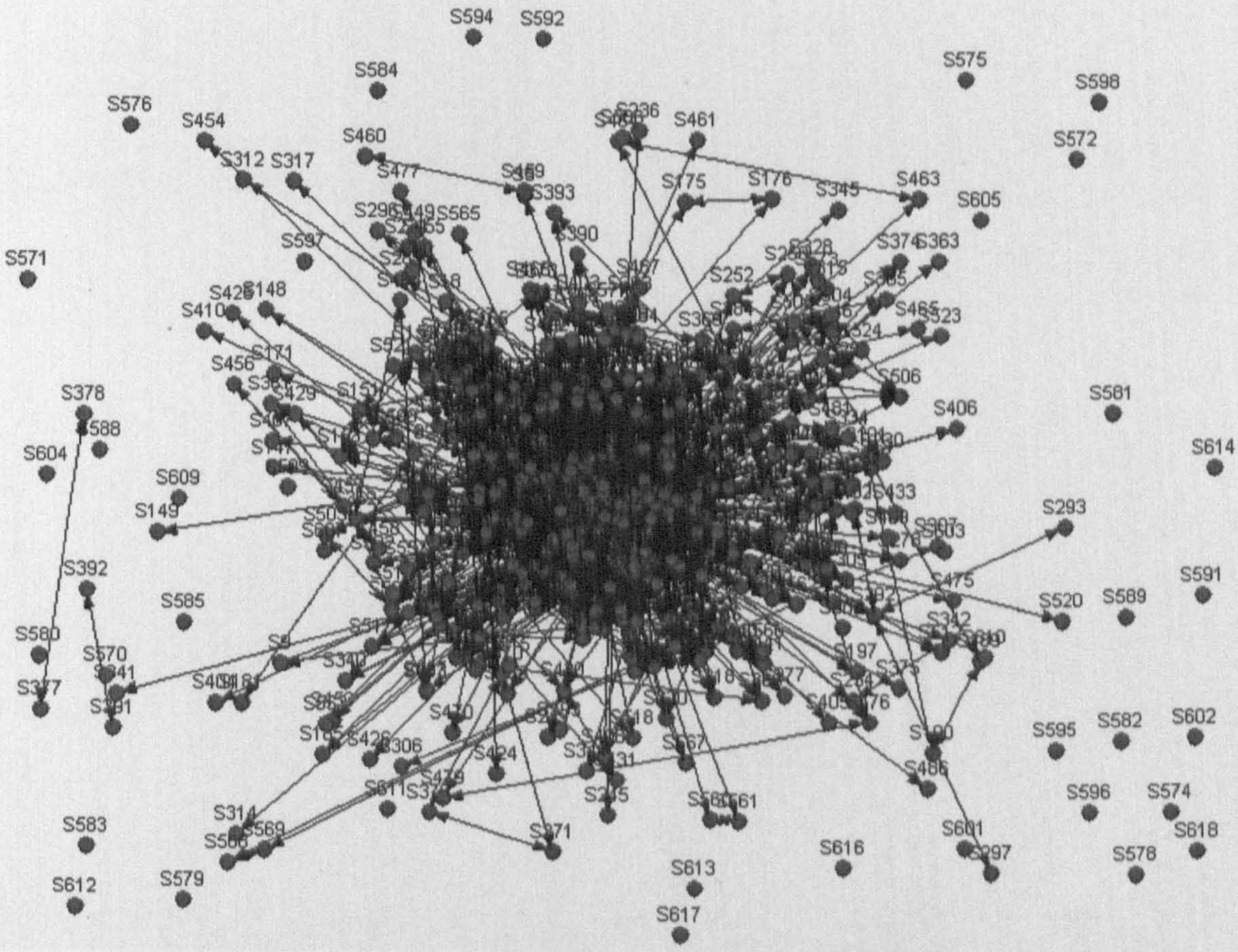
Lesson 2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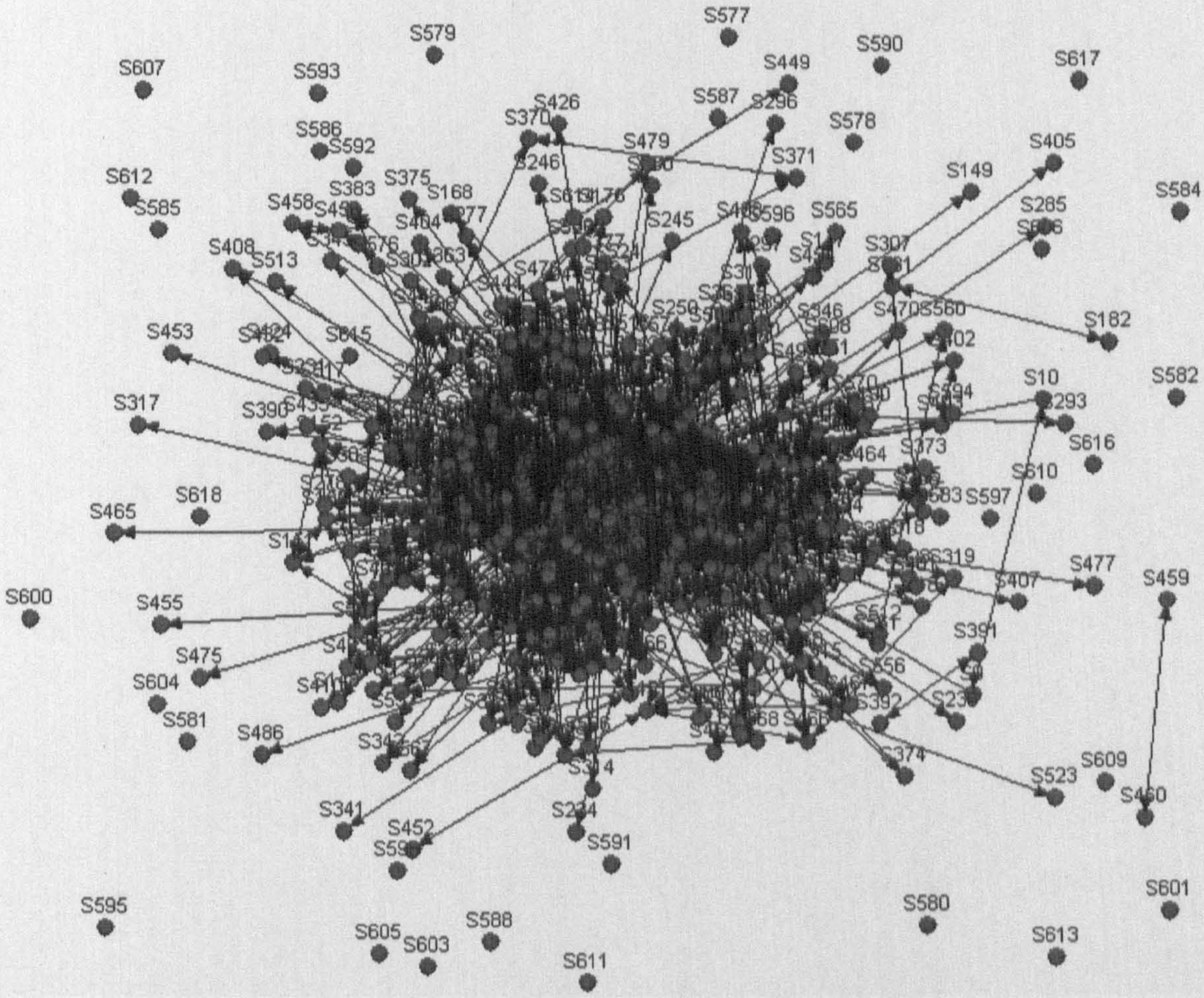
Lesson 3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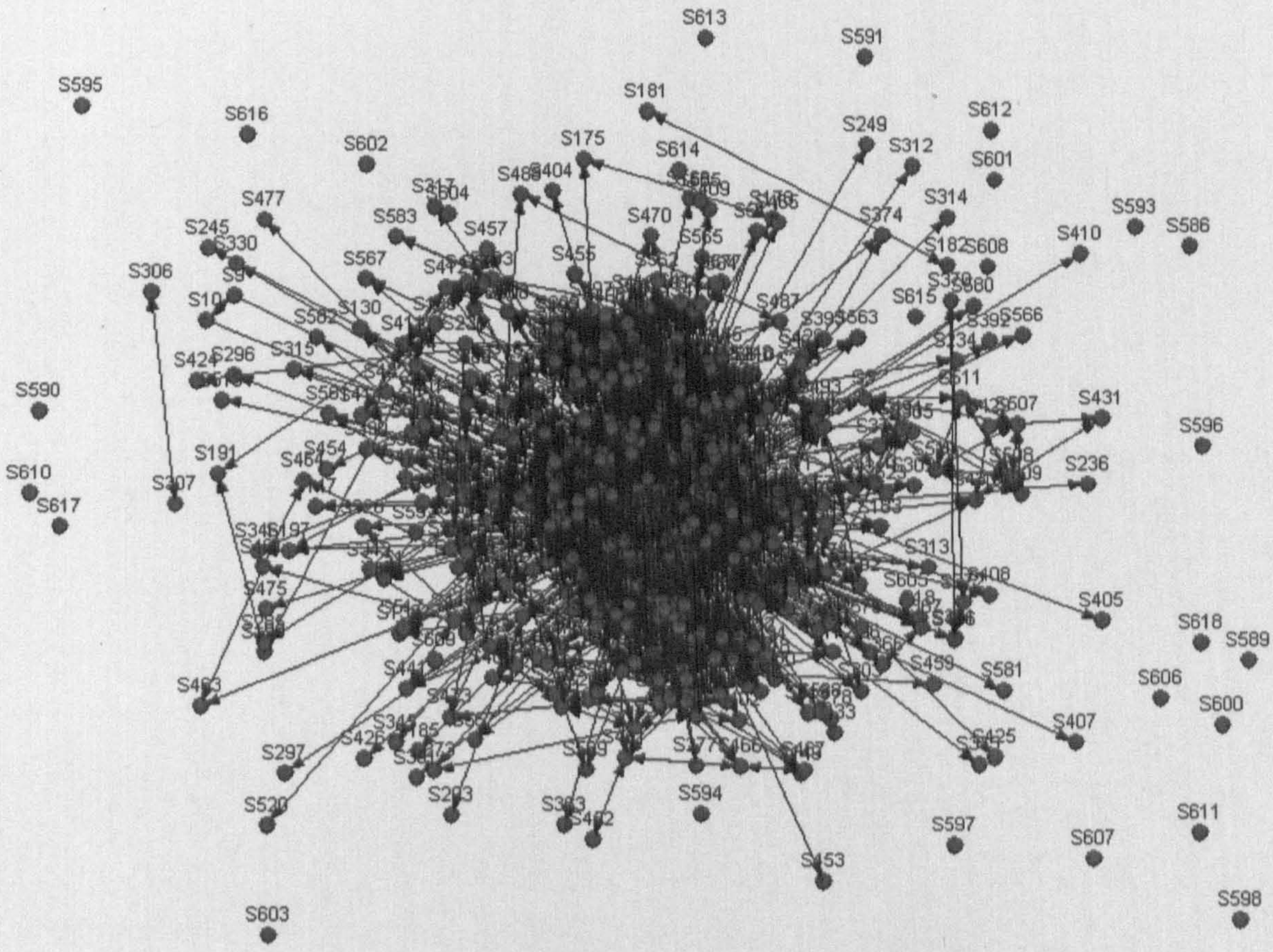
Lesson 4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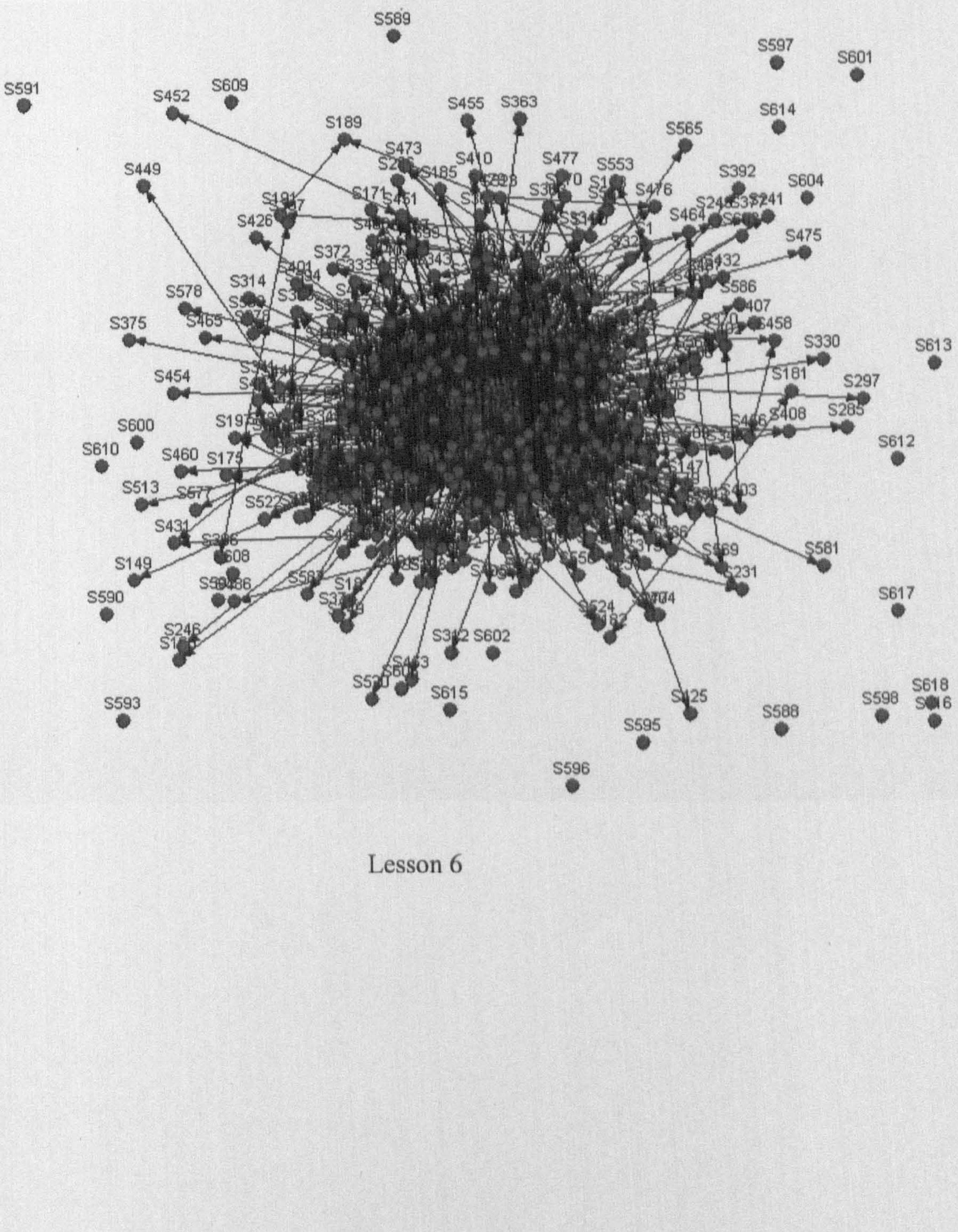
Lesson 5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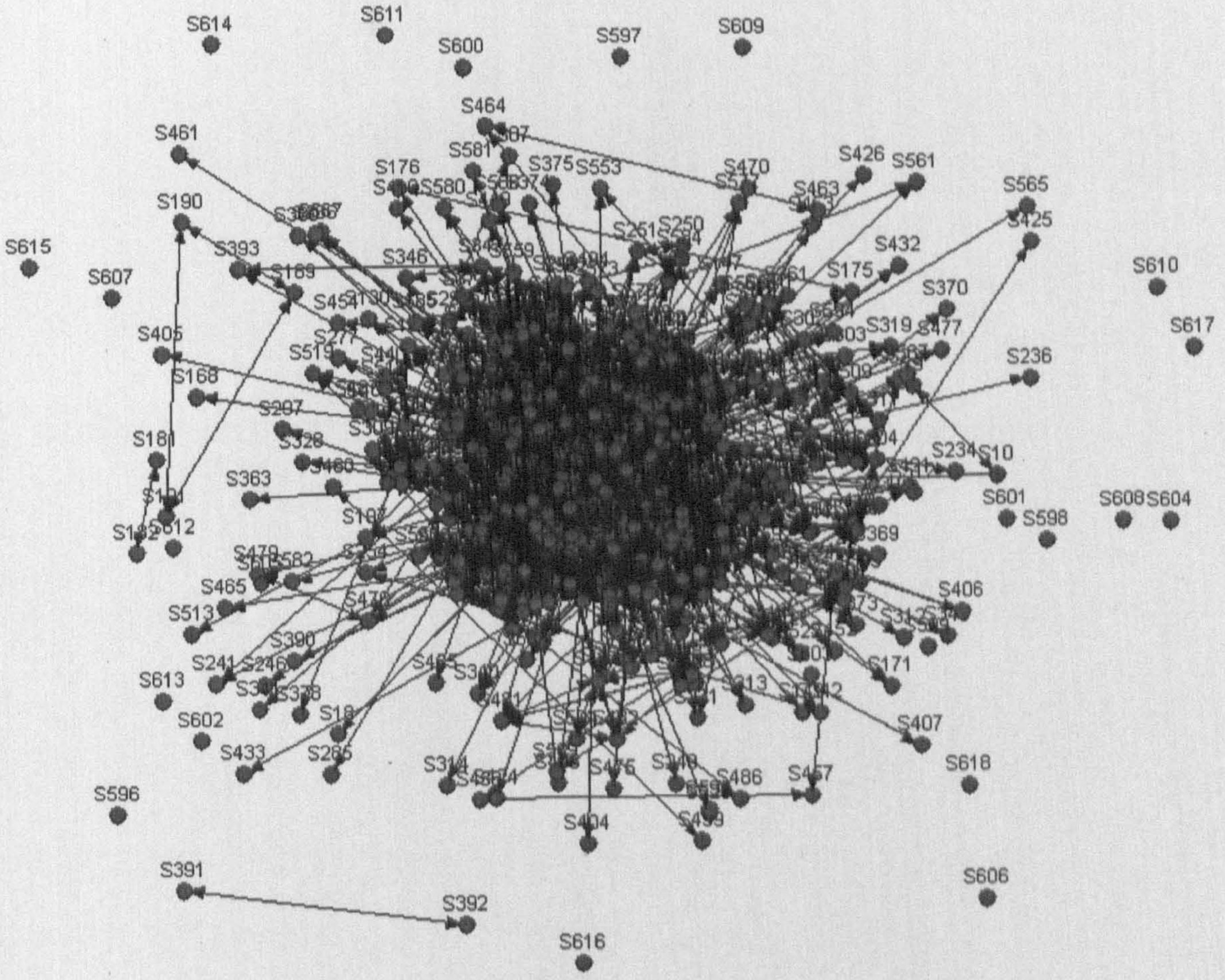
Lesson 6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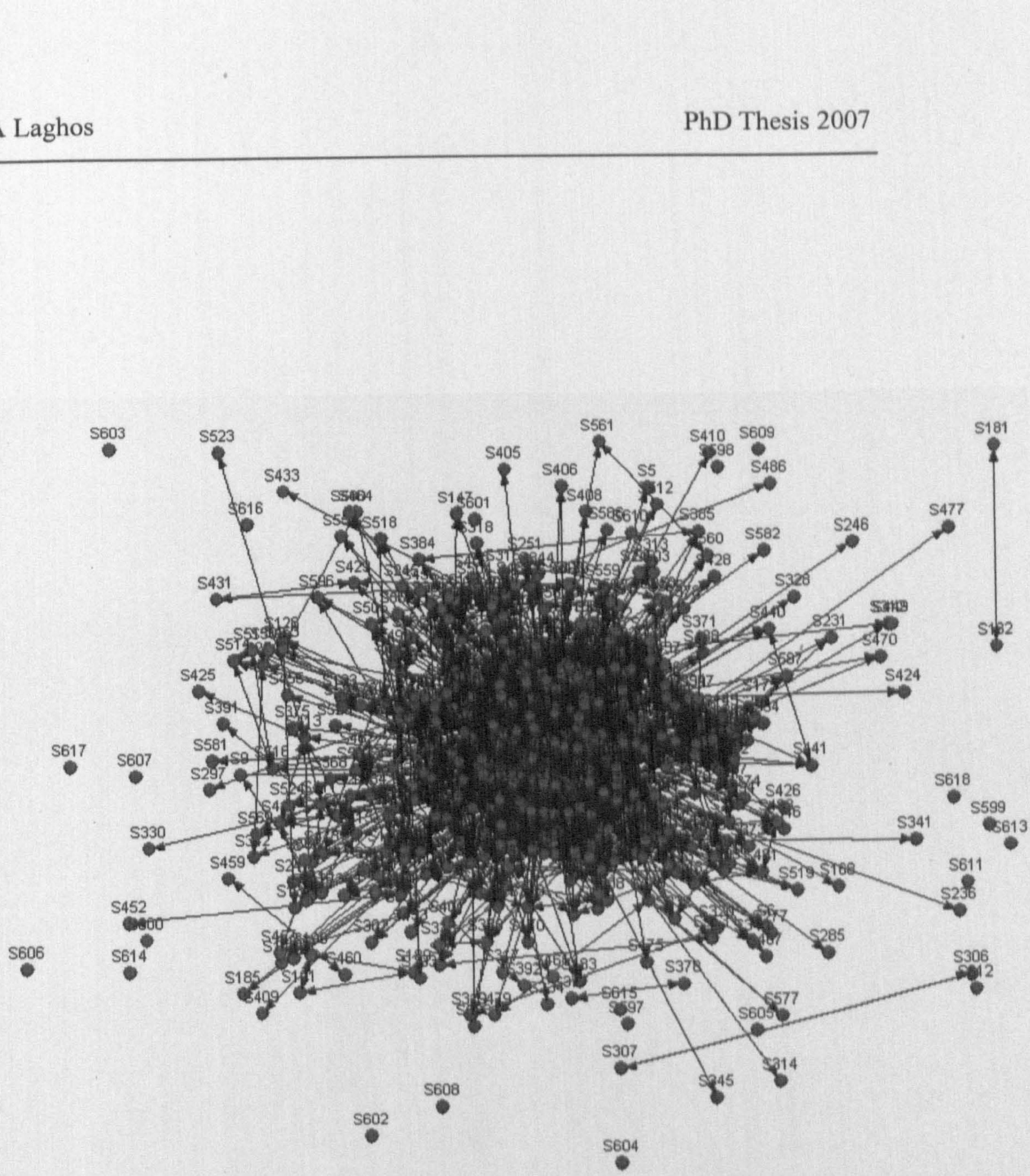
Lesson 7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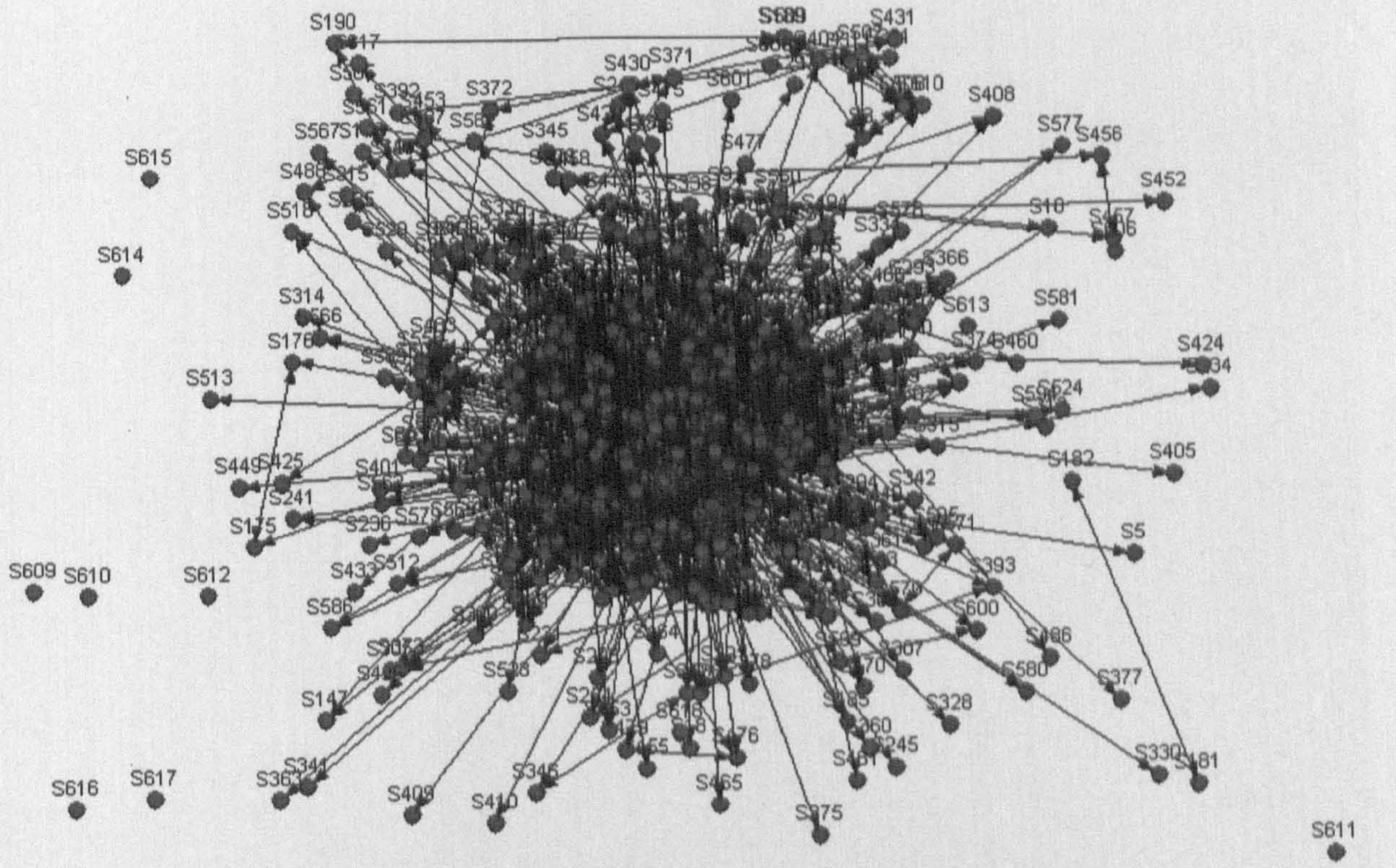
Lesson 8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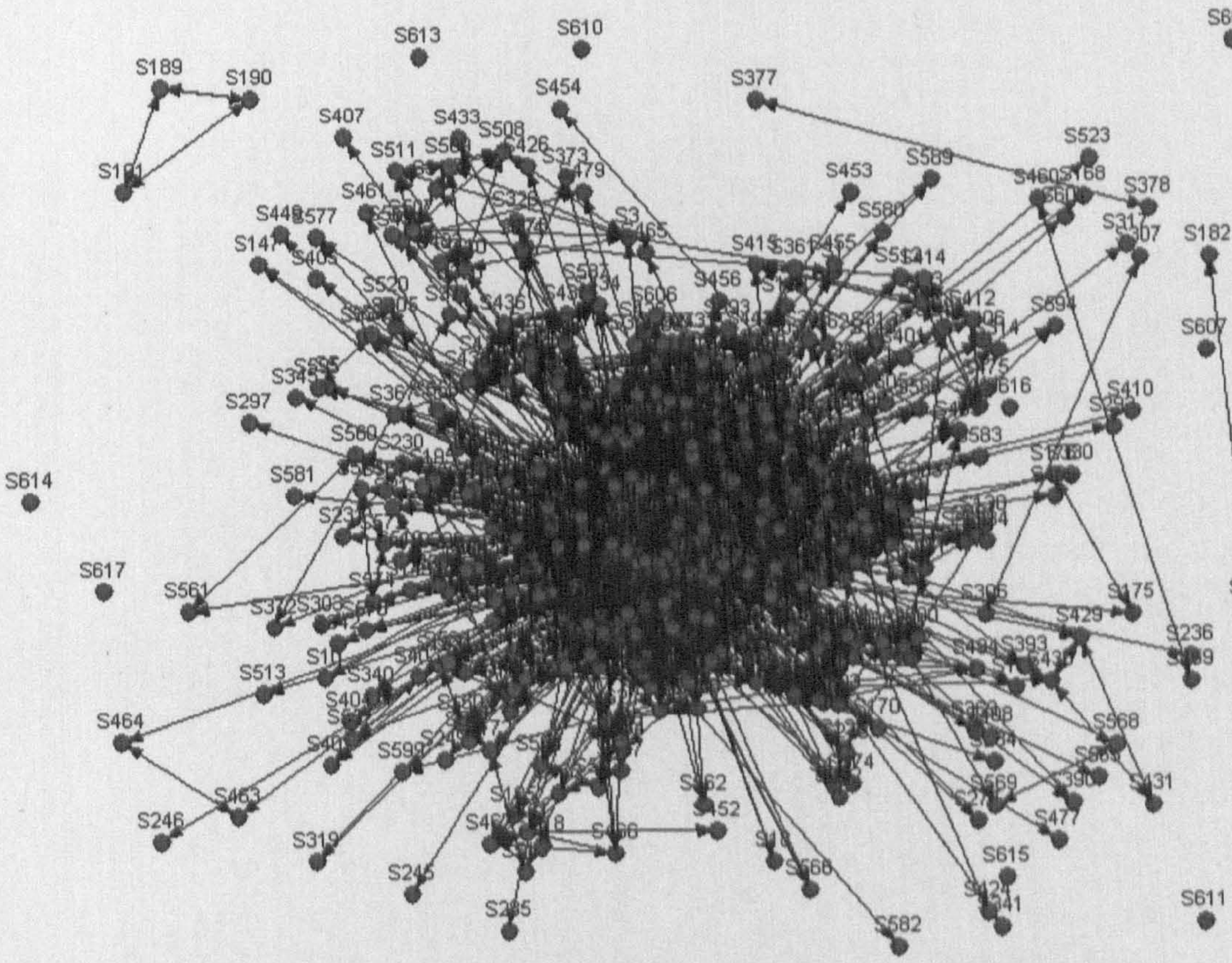
Lesson 9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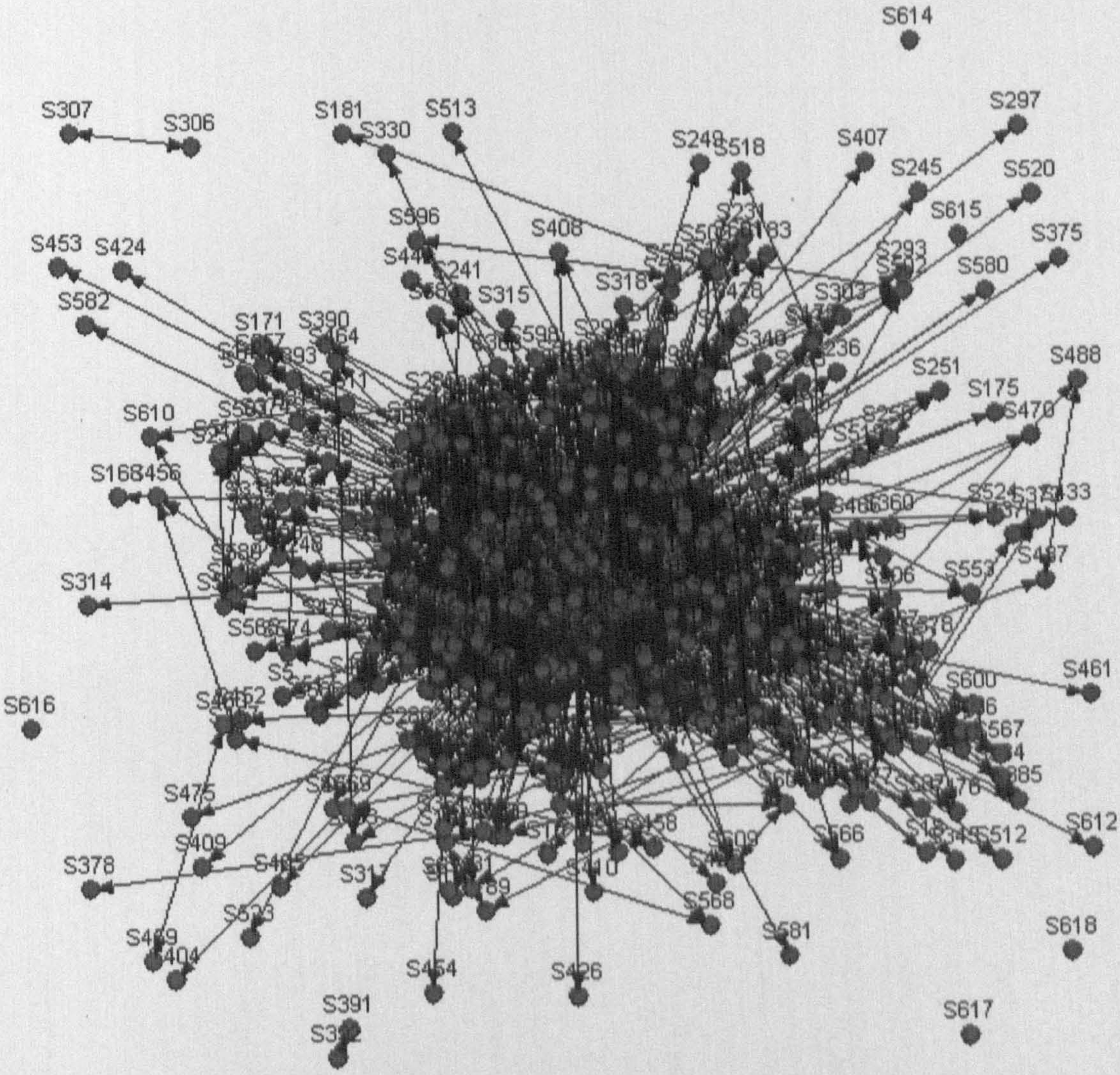
Lesson 10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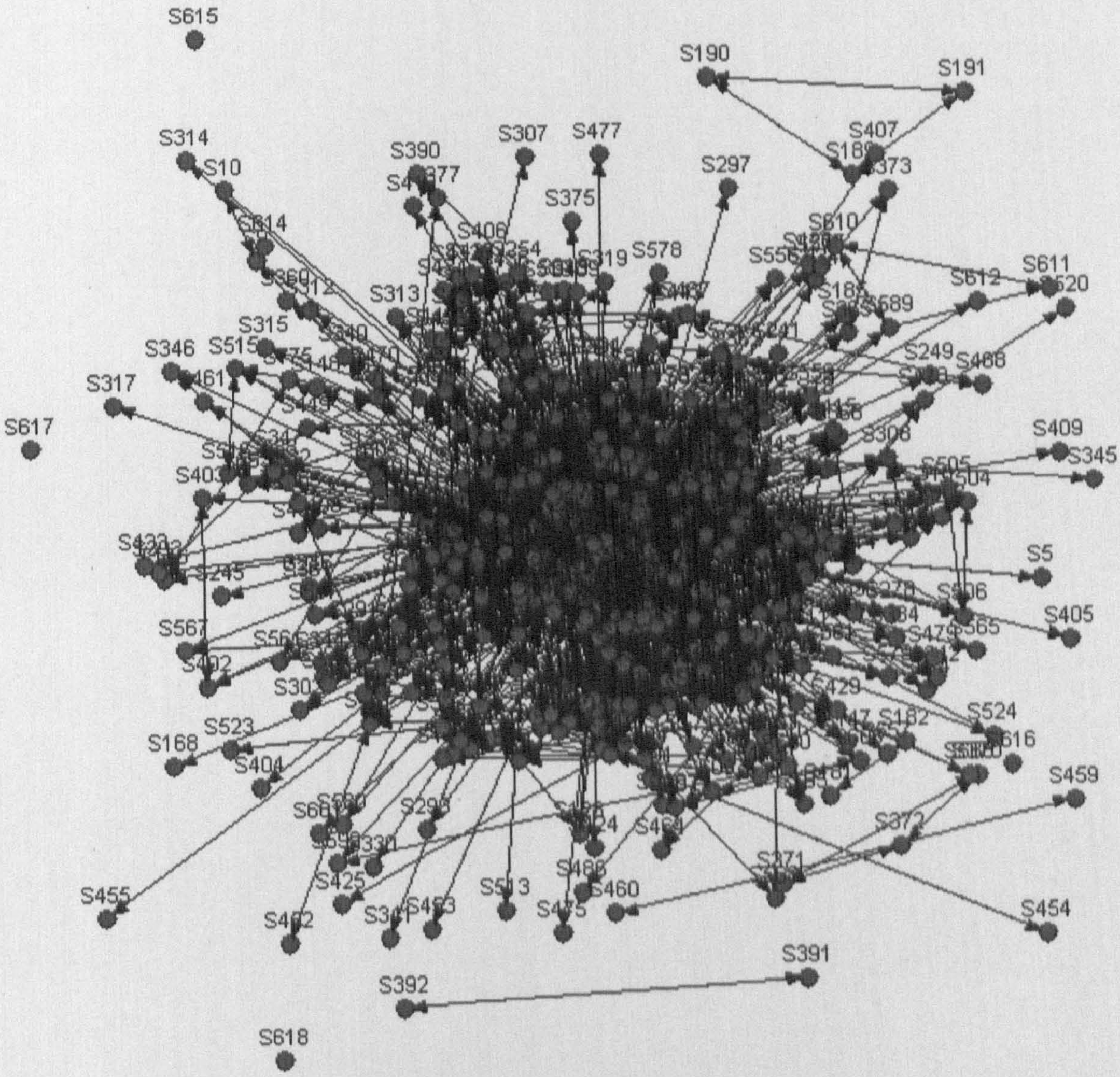
Lesson 11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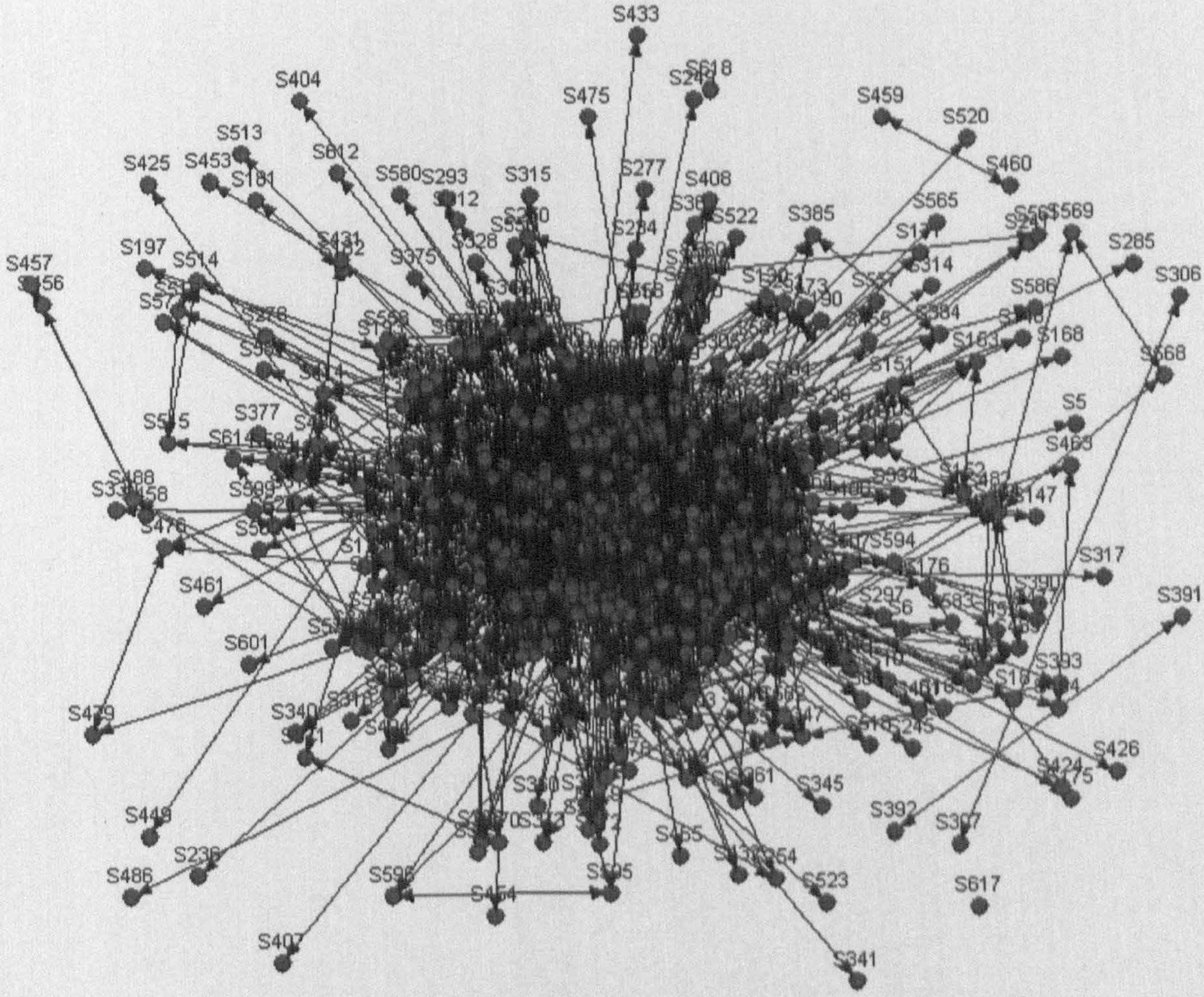
Lesson 12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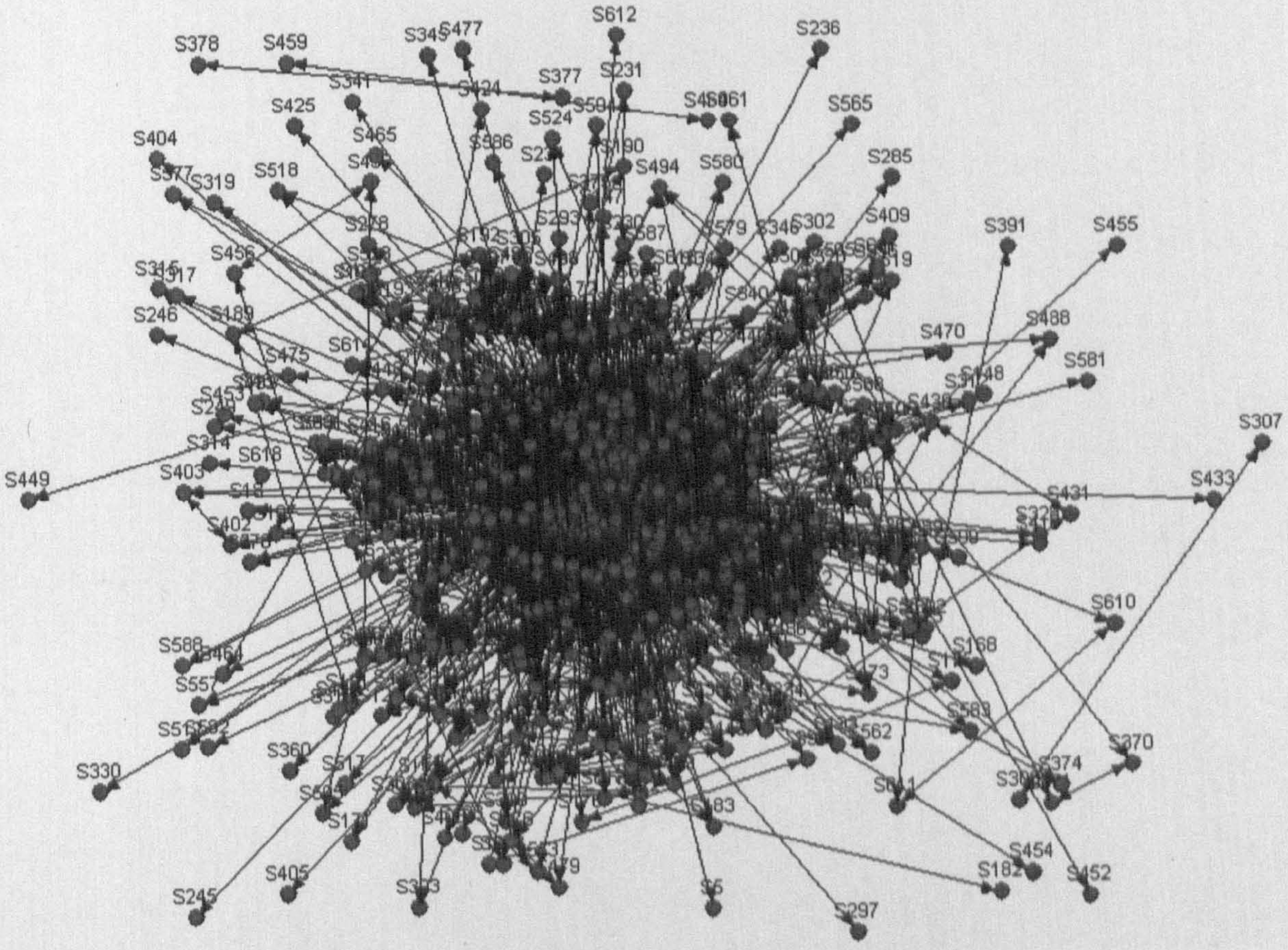
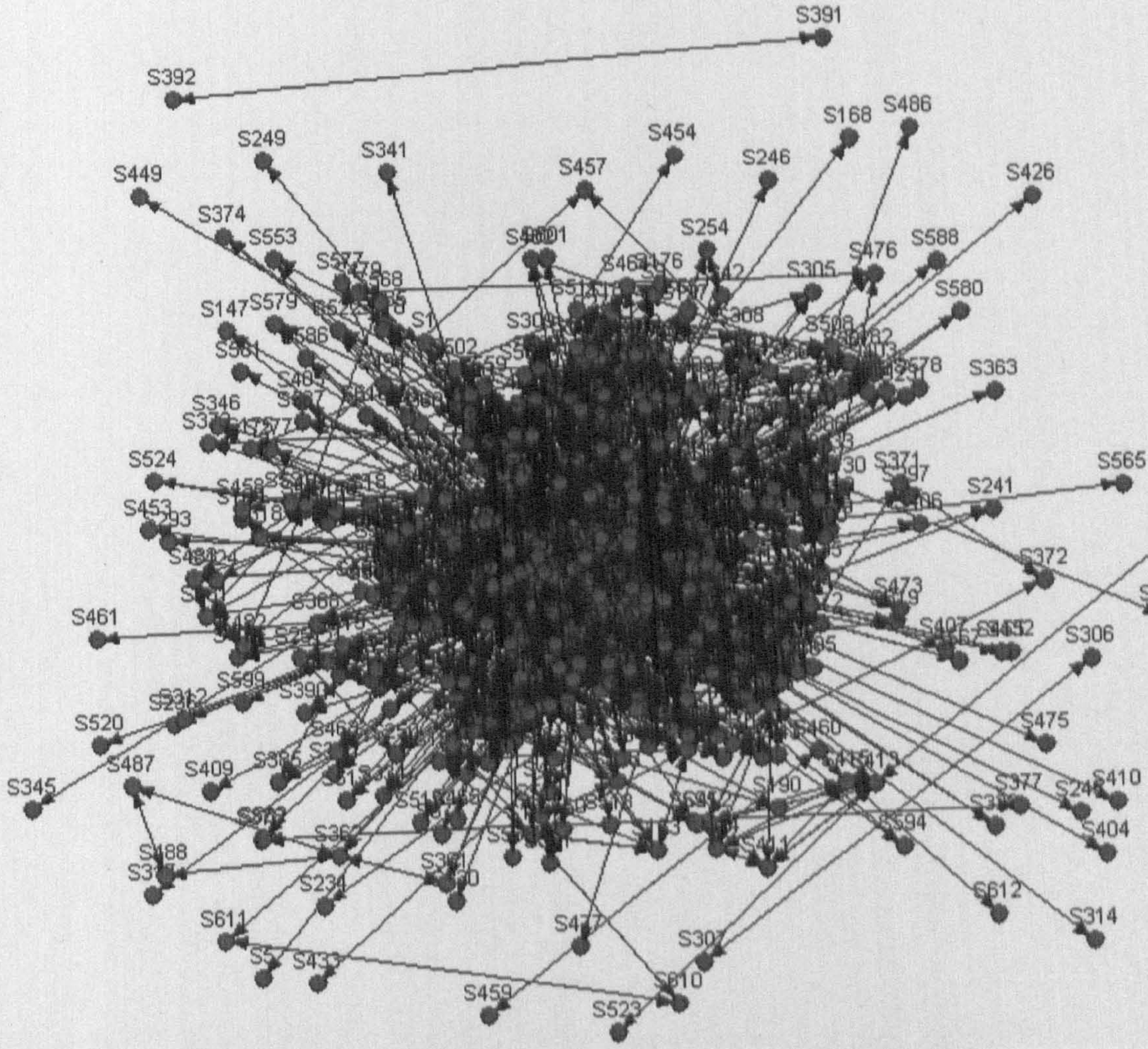
S522
S197
S514
S457
S285
S306
S586
S168
S668
S5
S377
S463
S147
S317
S391
S601
S393
S479
S340
S426
S345
S392
S307
S449
S238
S486
S596
S454
S523
S617
S407
S341

Lesson 13

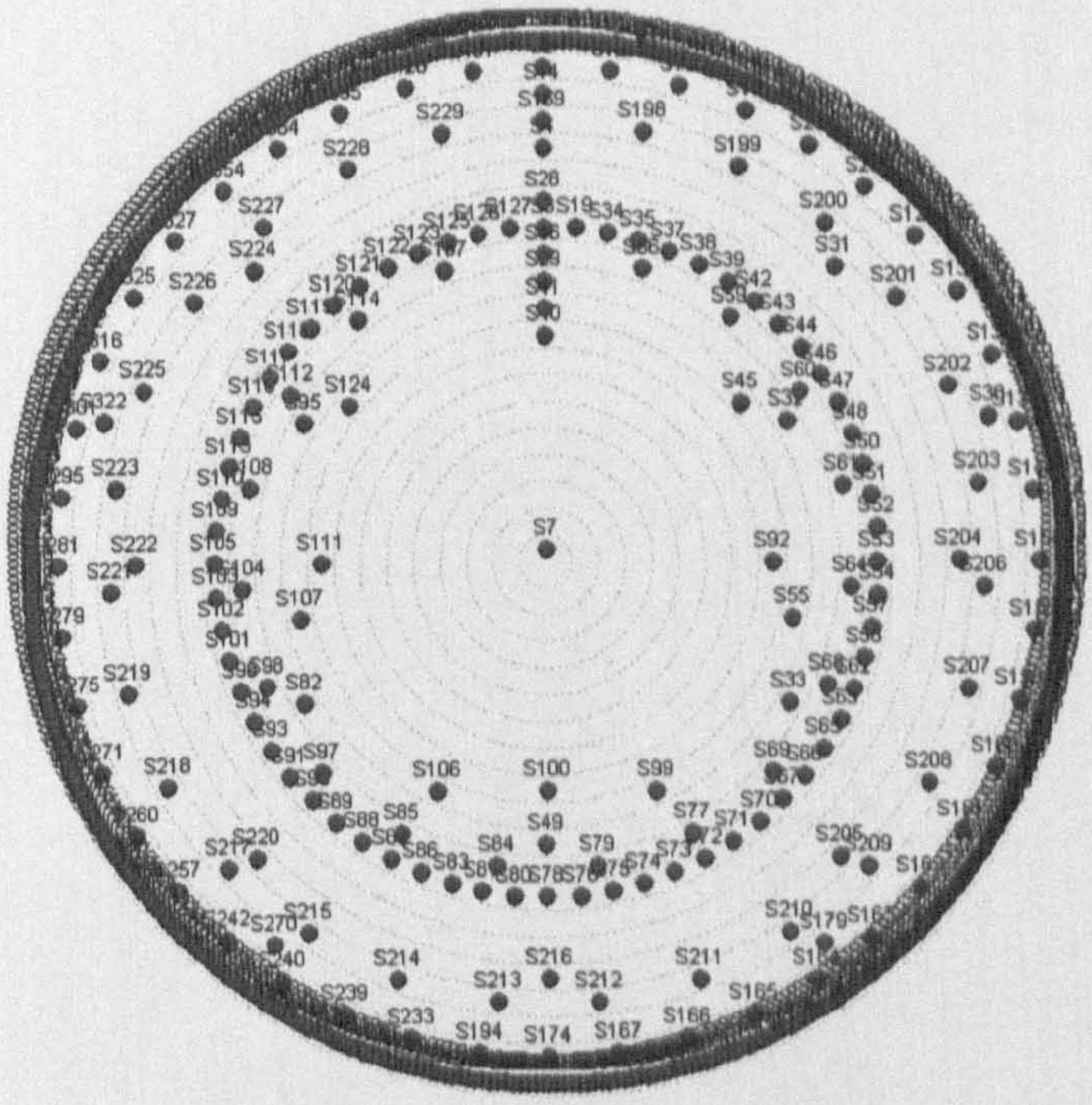

S612
S236
S378
S459
S345
S477
S377
S231
S341
S424
S565
S425
S524
S465
S404
S190
S494
S580
S285
S518
S319
S409
S391
S455
S456
S246
S189
S470
S488
S475
S581
S307
S449
S403
S618
S433
S431
S610
S588
S168
S557
S562
S360
S330
S370
S374
S405
S454
S182
S452
S245
S297

Lesson 14

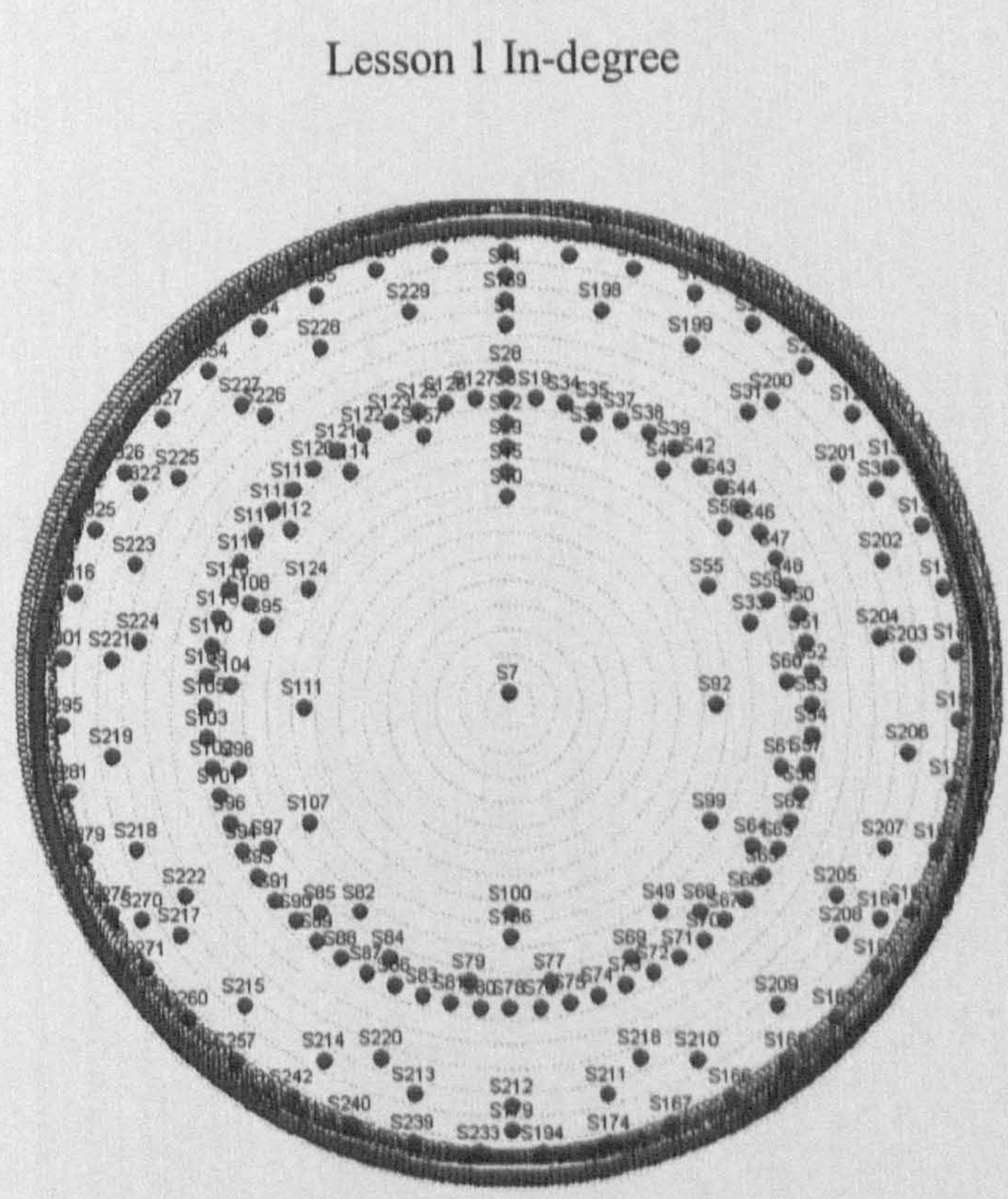

S391
S392
S168
S486
S249
S454
S341
S246
S457
S449
S426
S374
S553
S254
S588
S476
S305
S580
S147
S579
S363
S346
S524
S565
S241
S453
S425
S372
S473
S452
S461
S306
S599
S520
S475
S487
S409
S345
S410
S377
S404
S188
S612
S611
S314
S307
S459
S523

Lesson 15

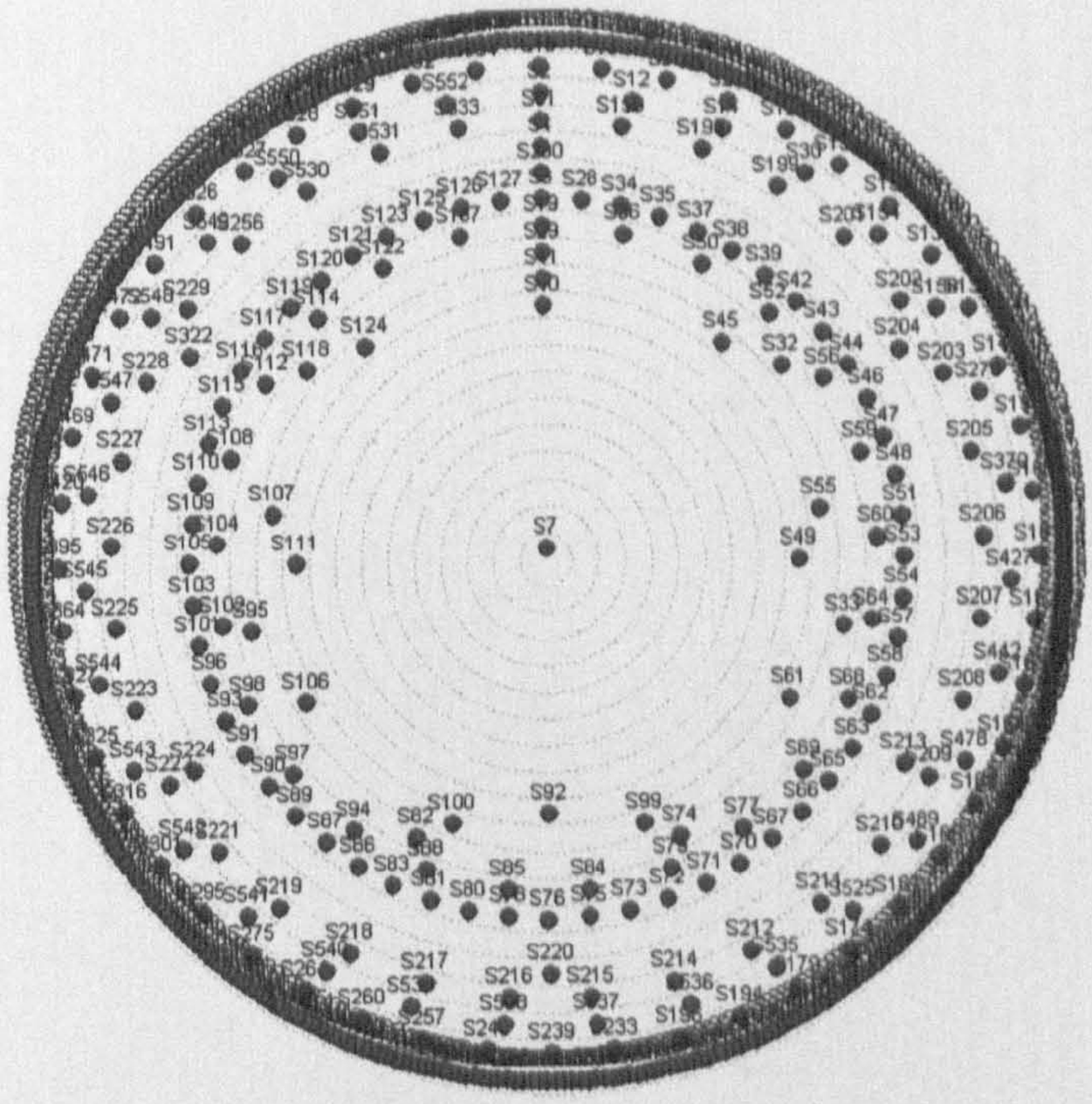
Appendix F – Centrality In/Out Degree Lessons 1-15 Sociograms



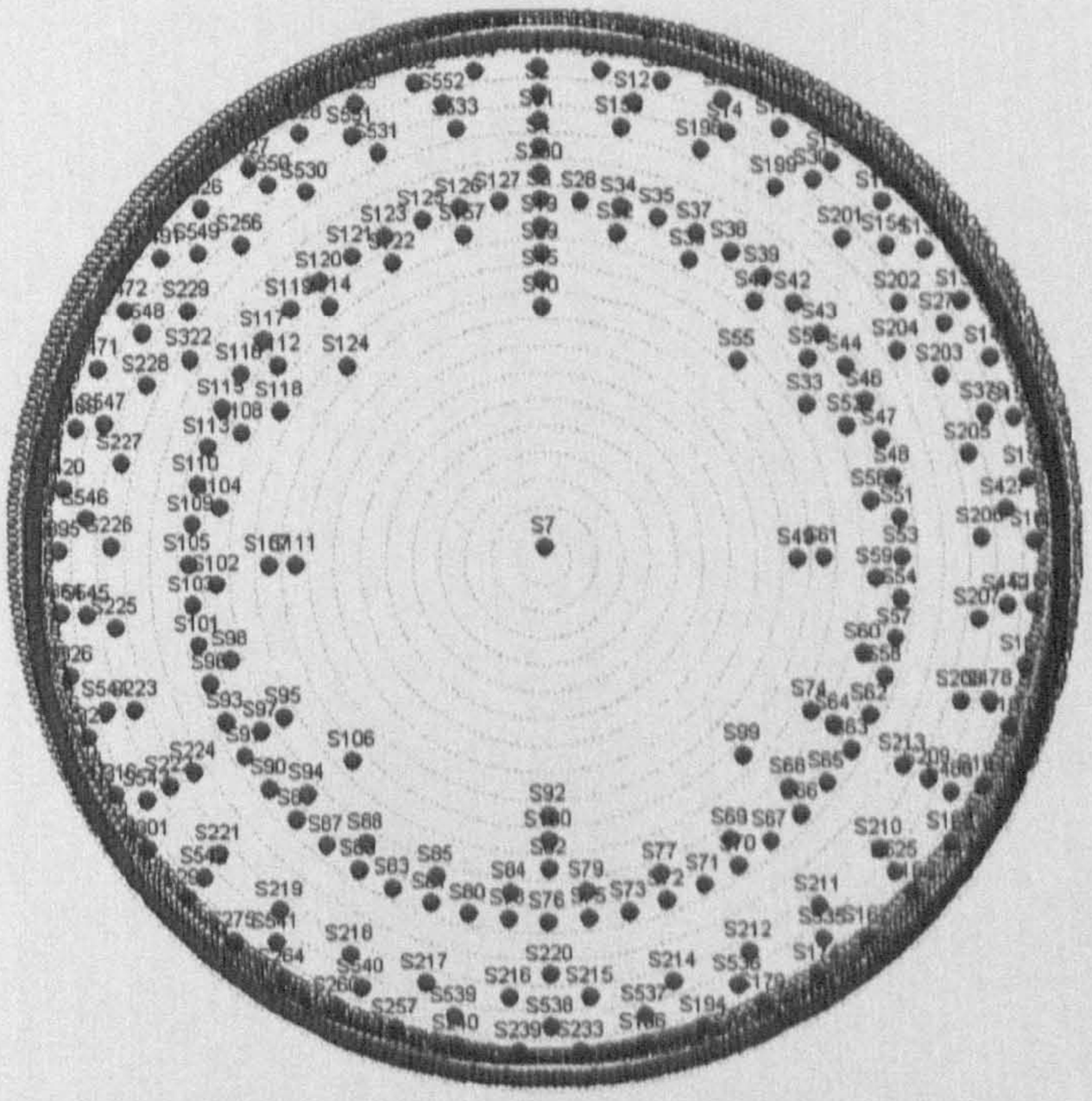
Lesson 1 In-degree



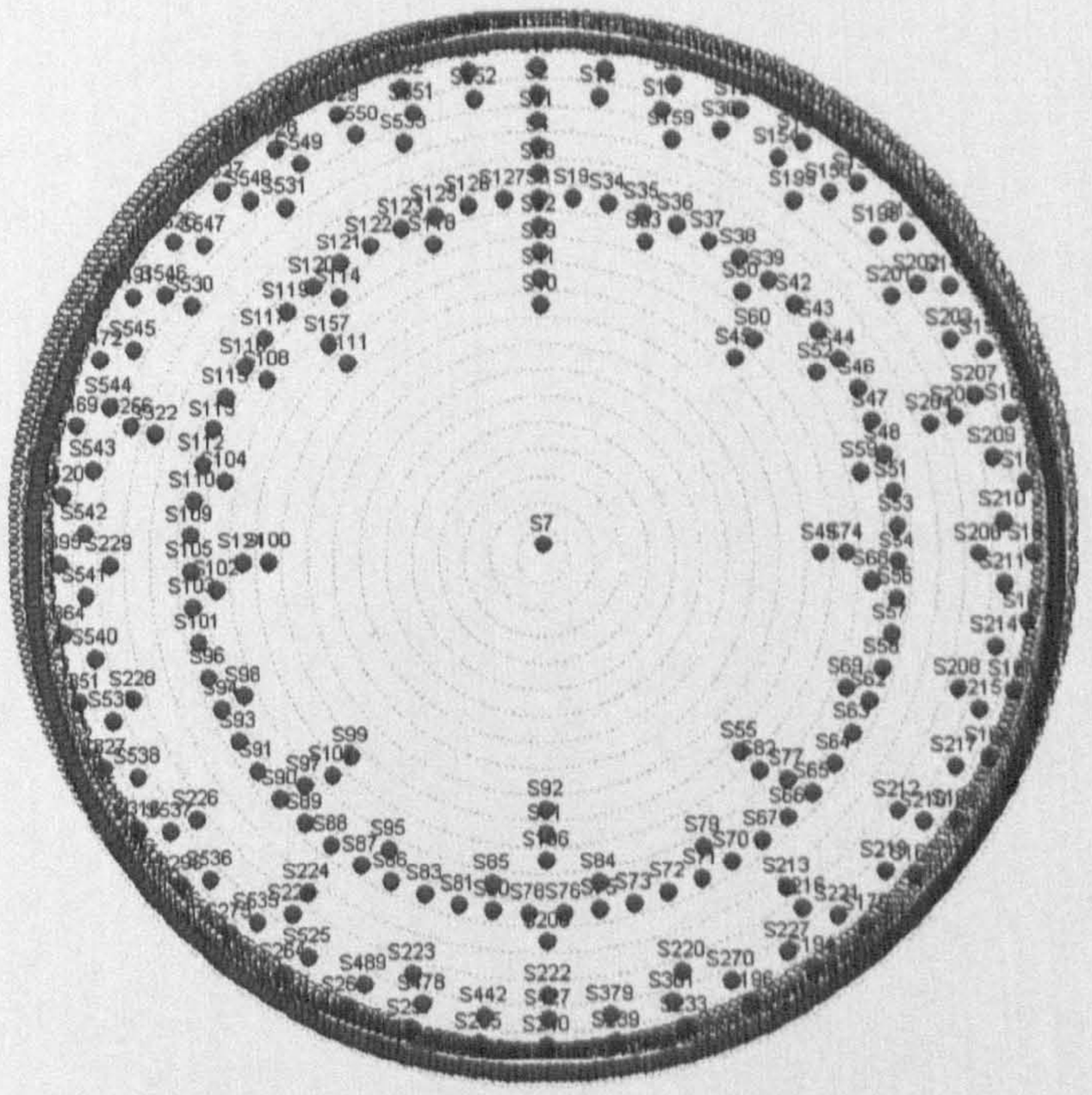
Lesson 1 Out-degree



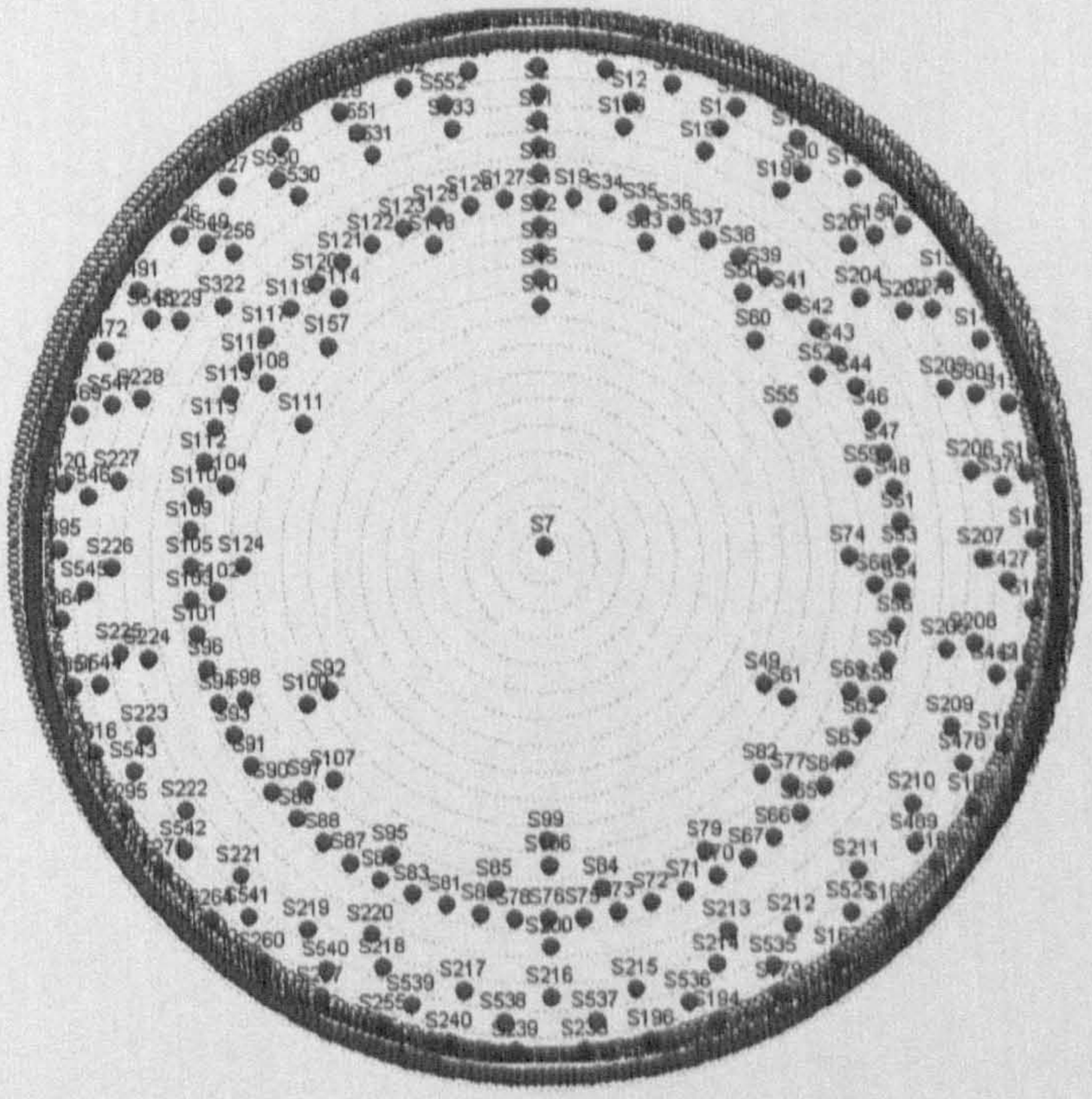
Lesson 2 In-degree



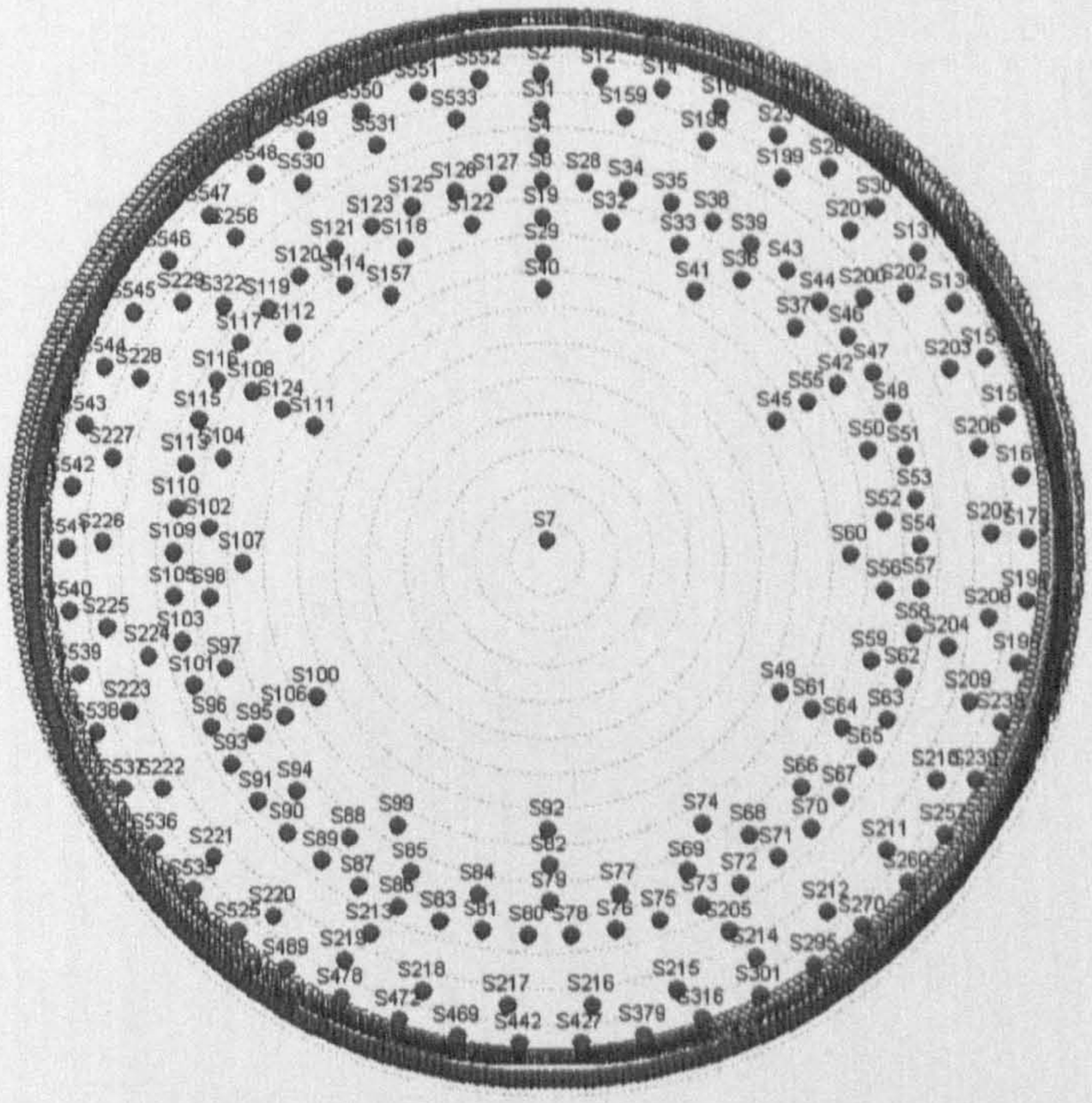
Lesson 2 Out-degree



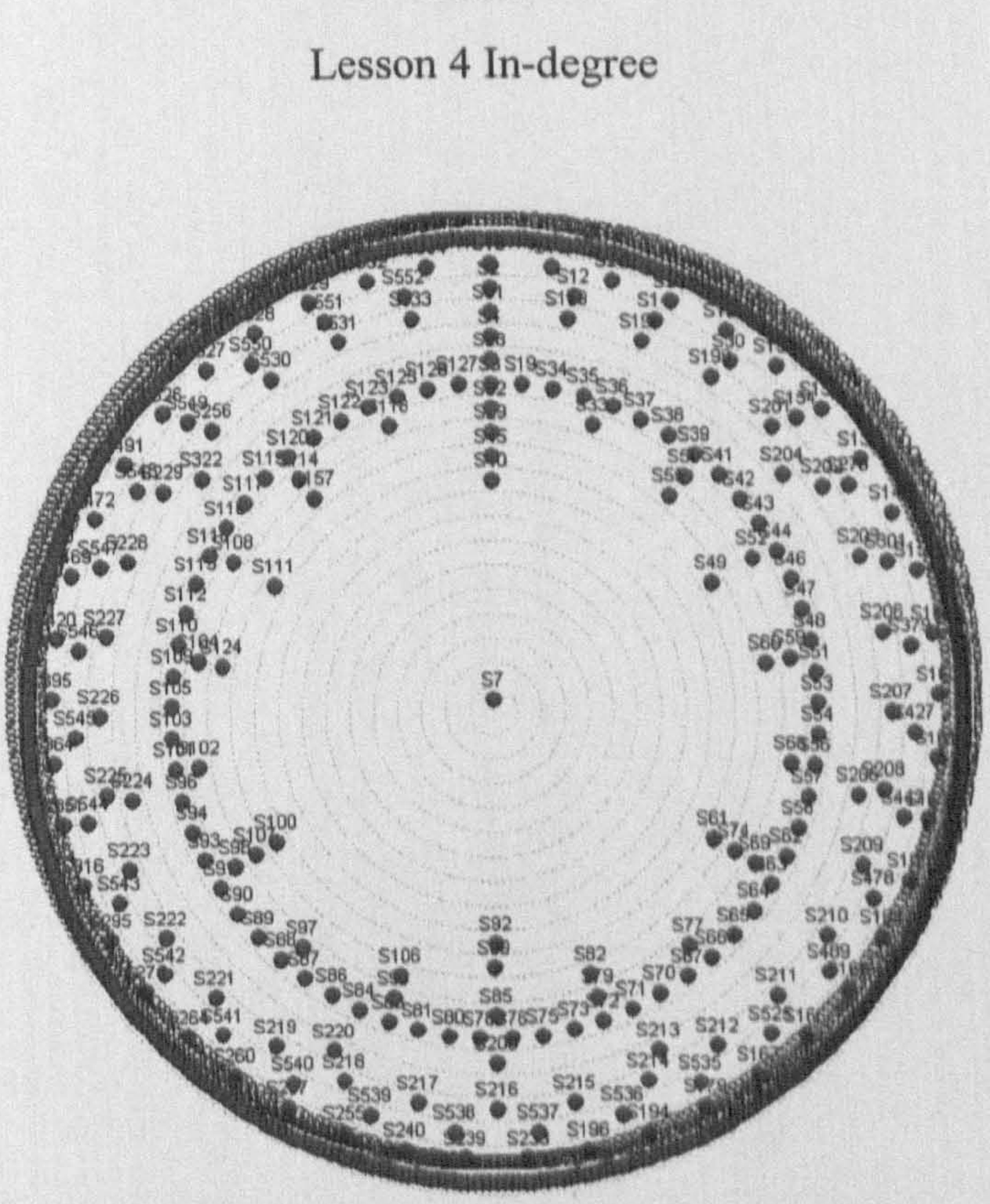
Lesson 3 In-degree



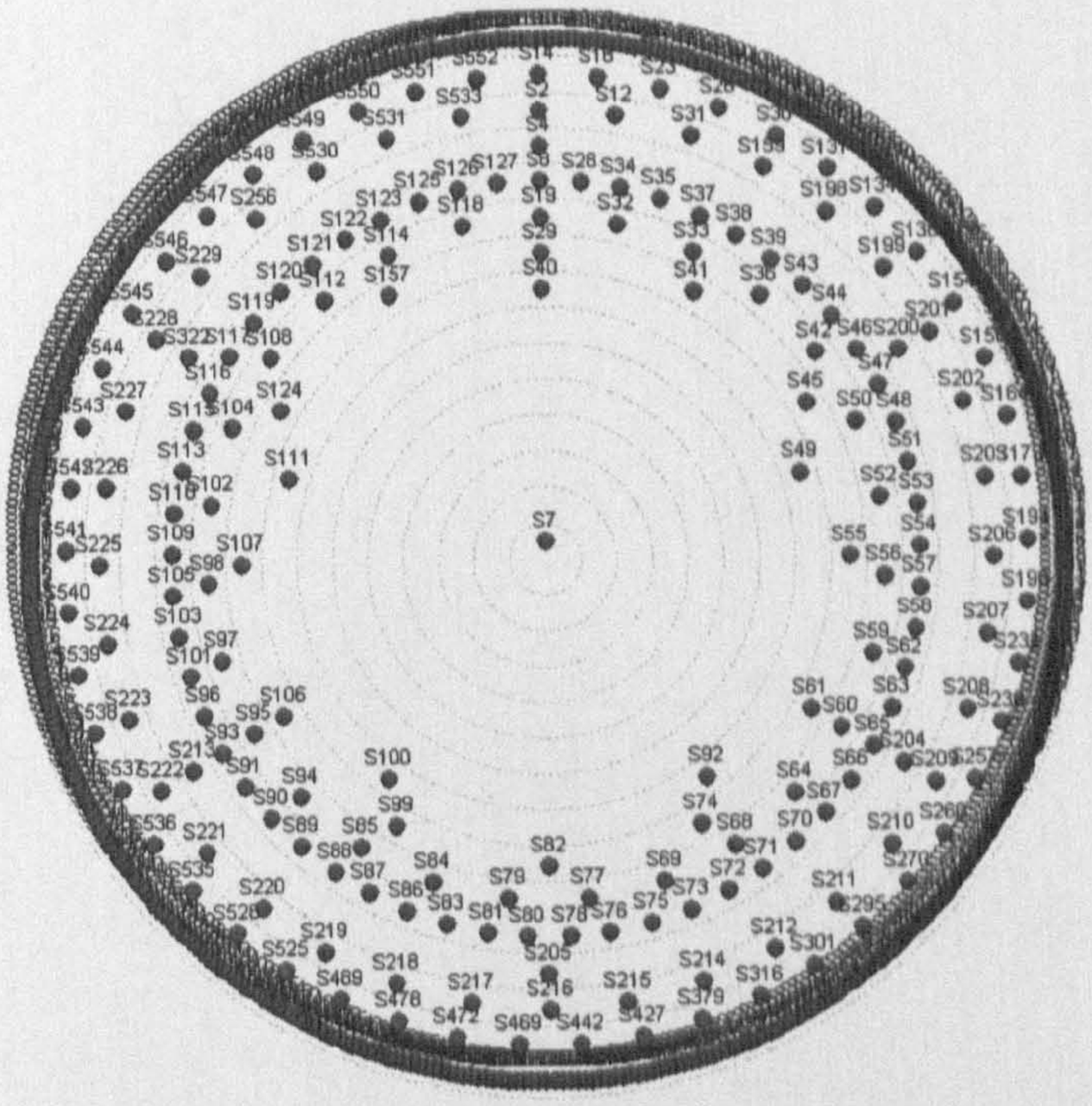
Lesson 3 Out-degree



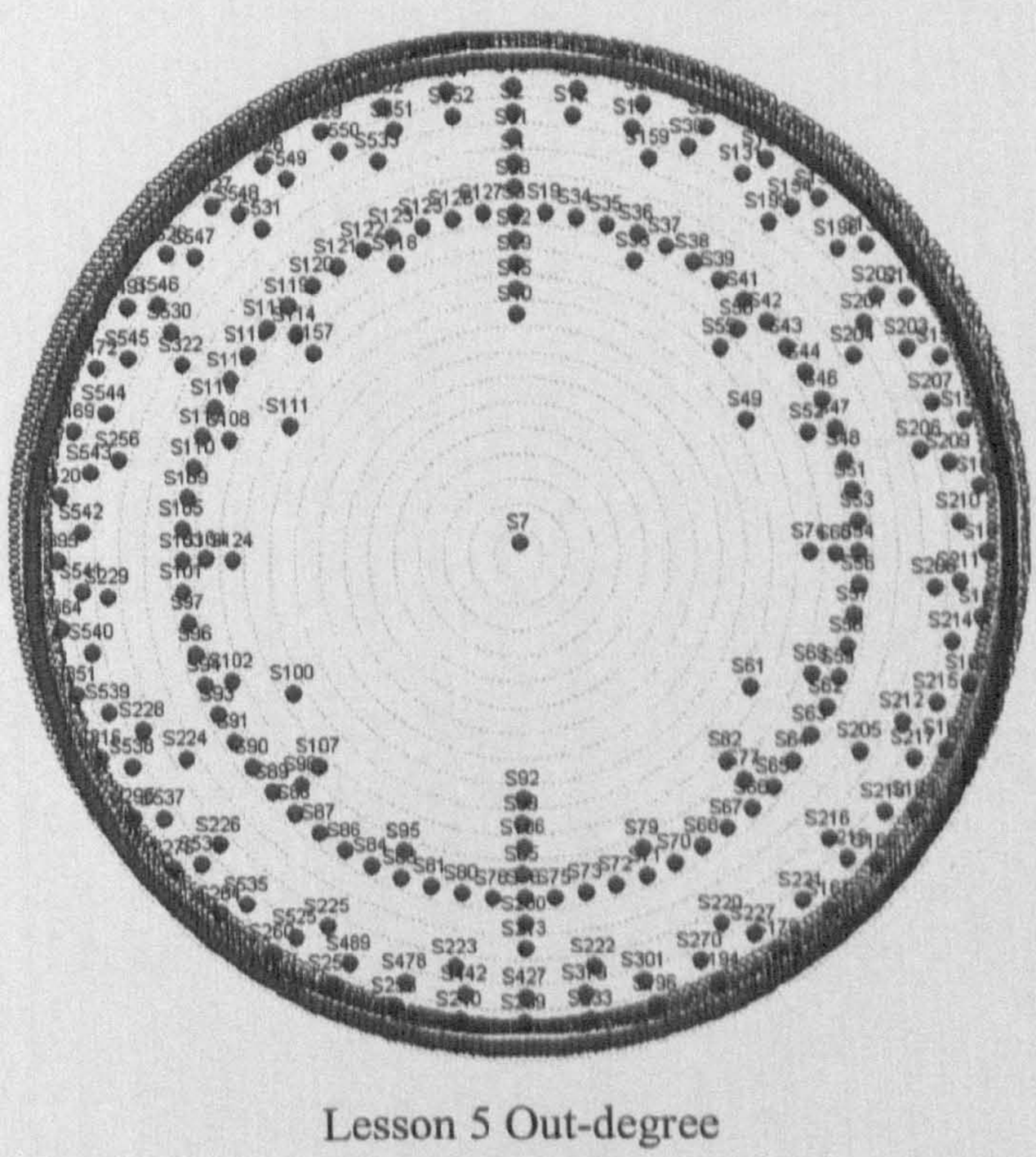
Lesson 4 In-degree



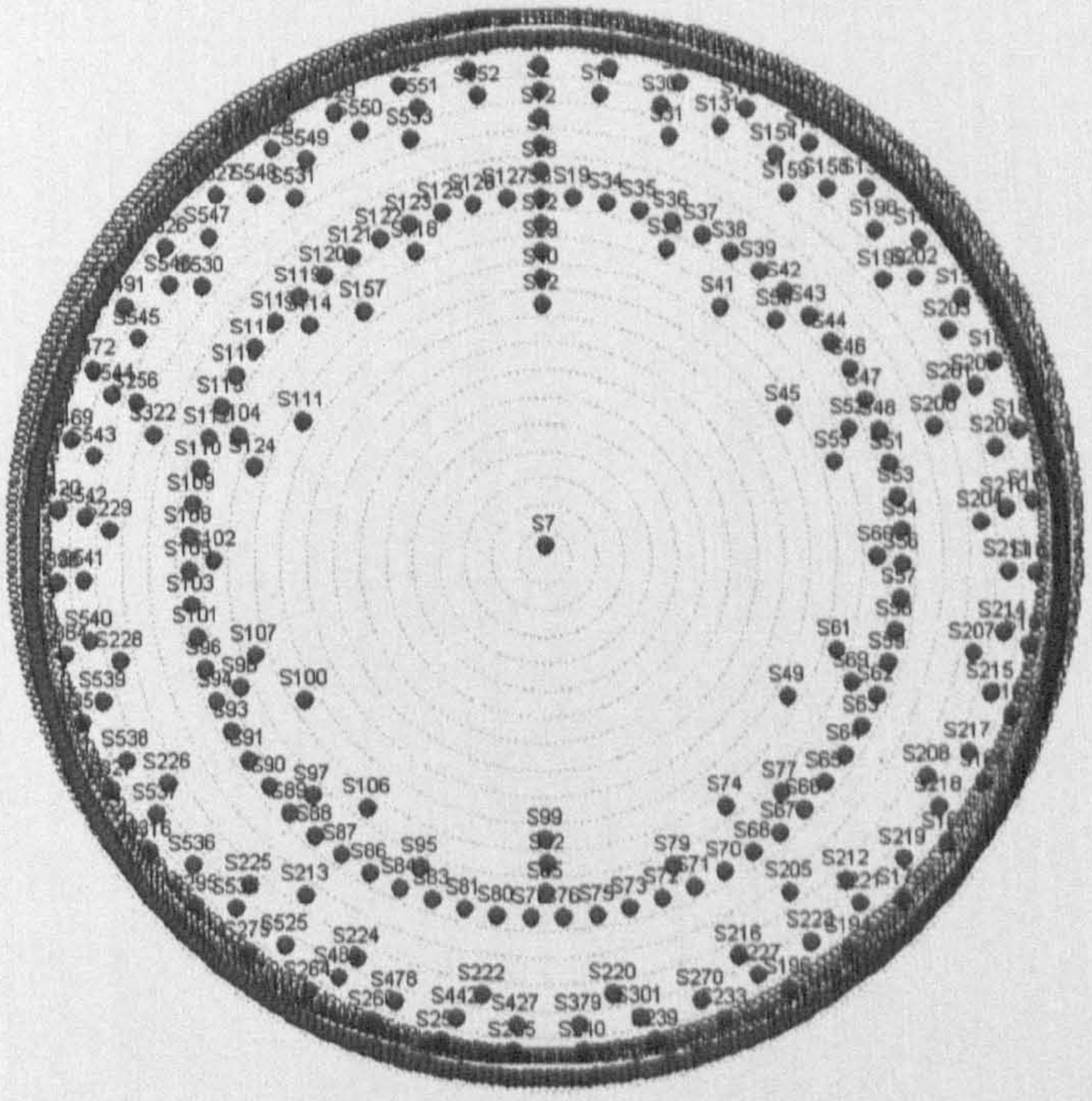
Lesson 4 Out-degree



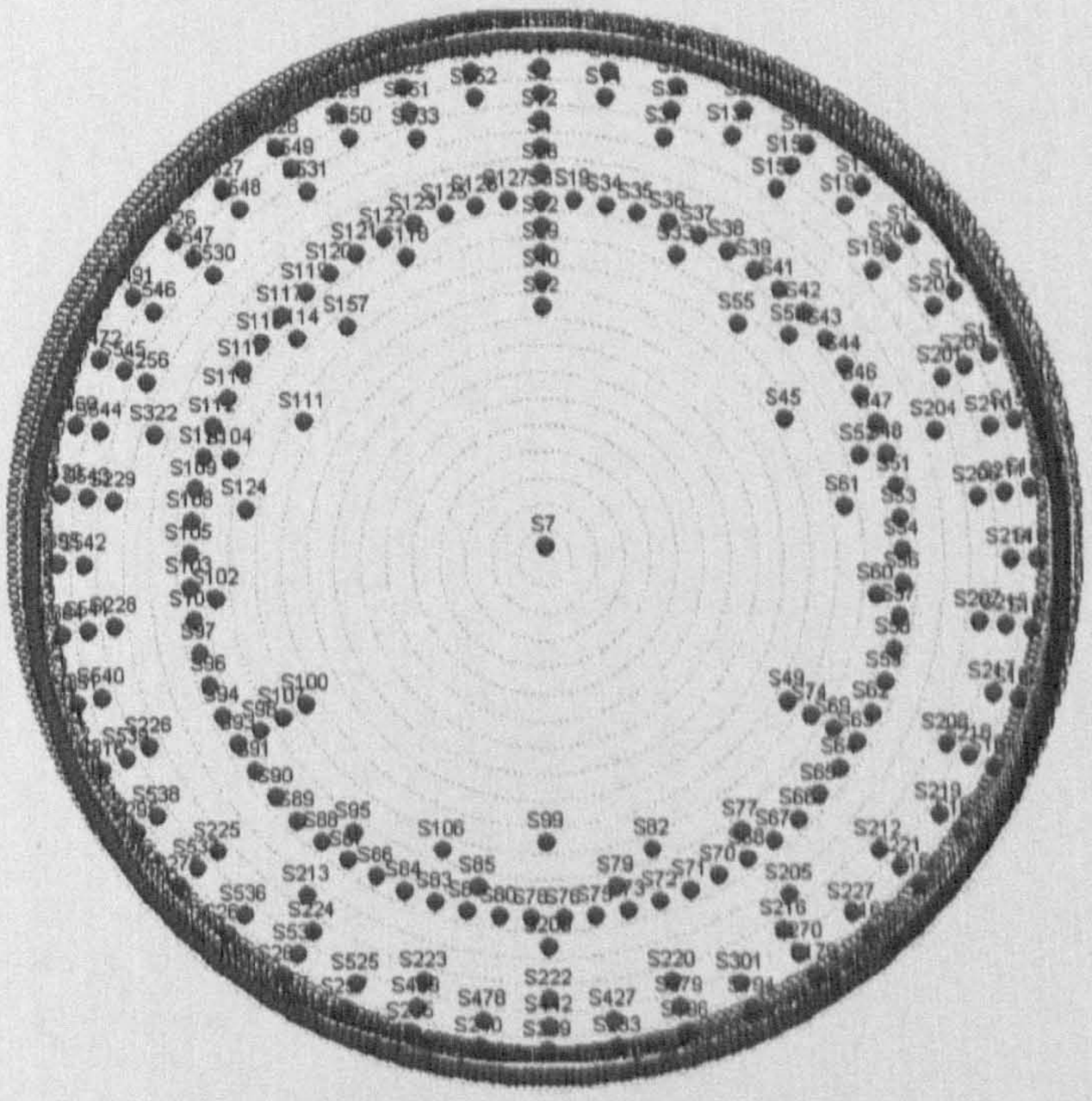
Lesson 5 In-degree



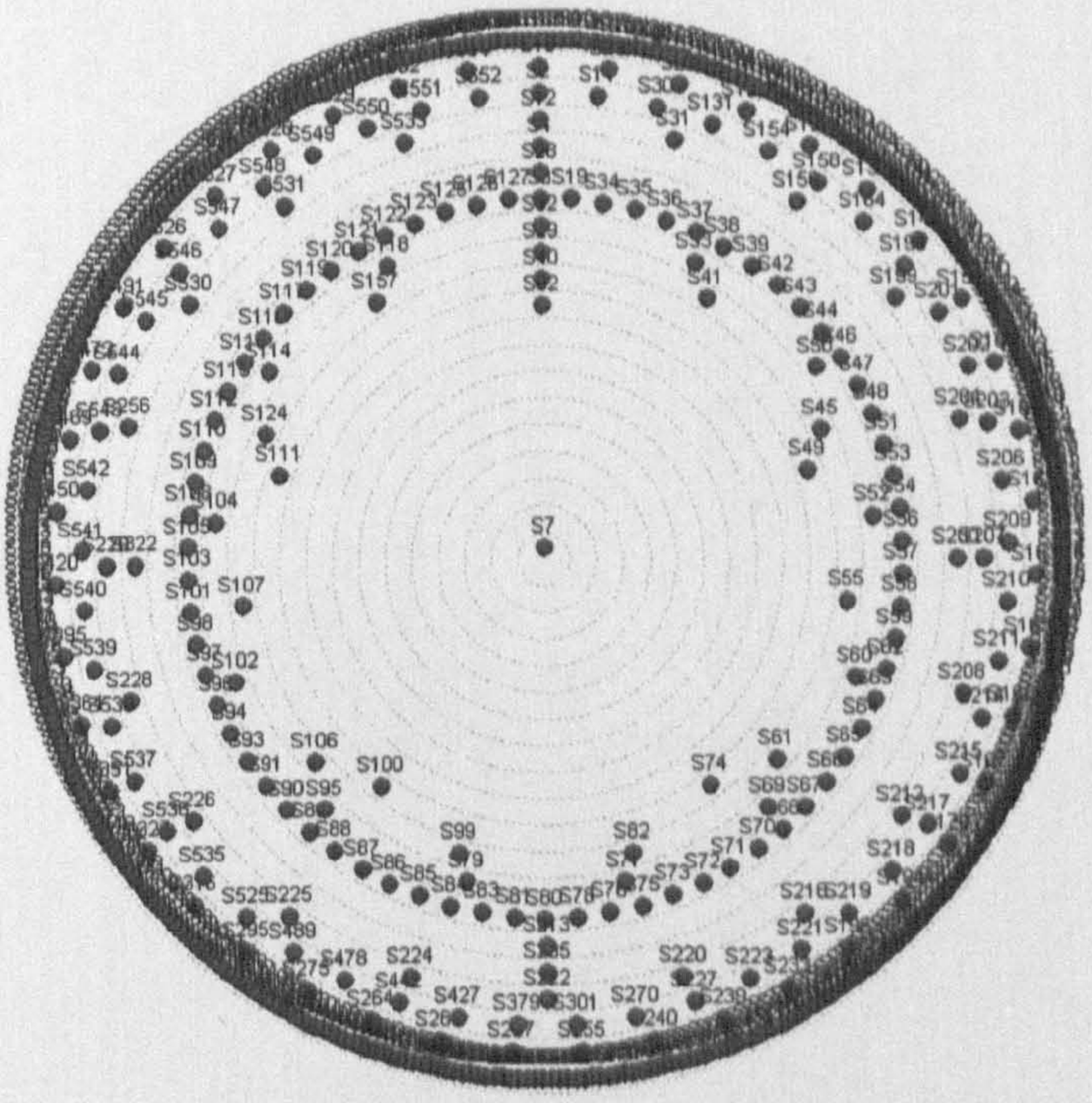
Lesson 5 Out-degree



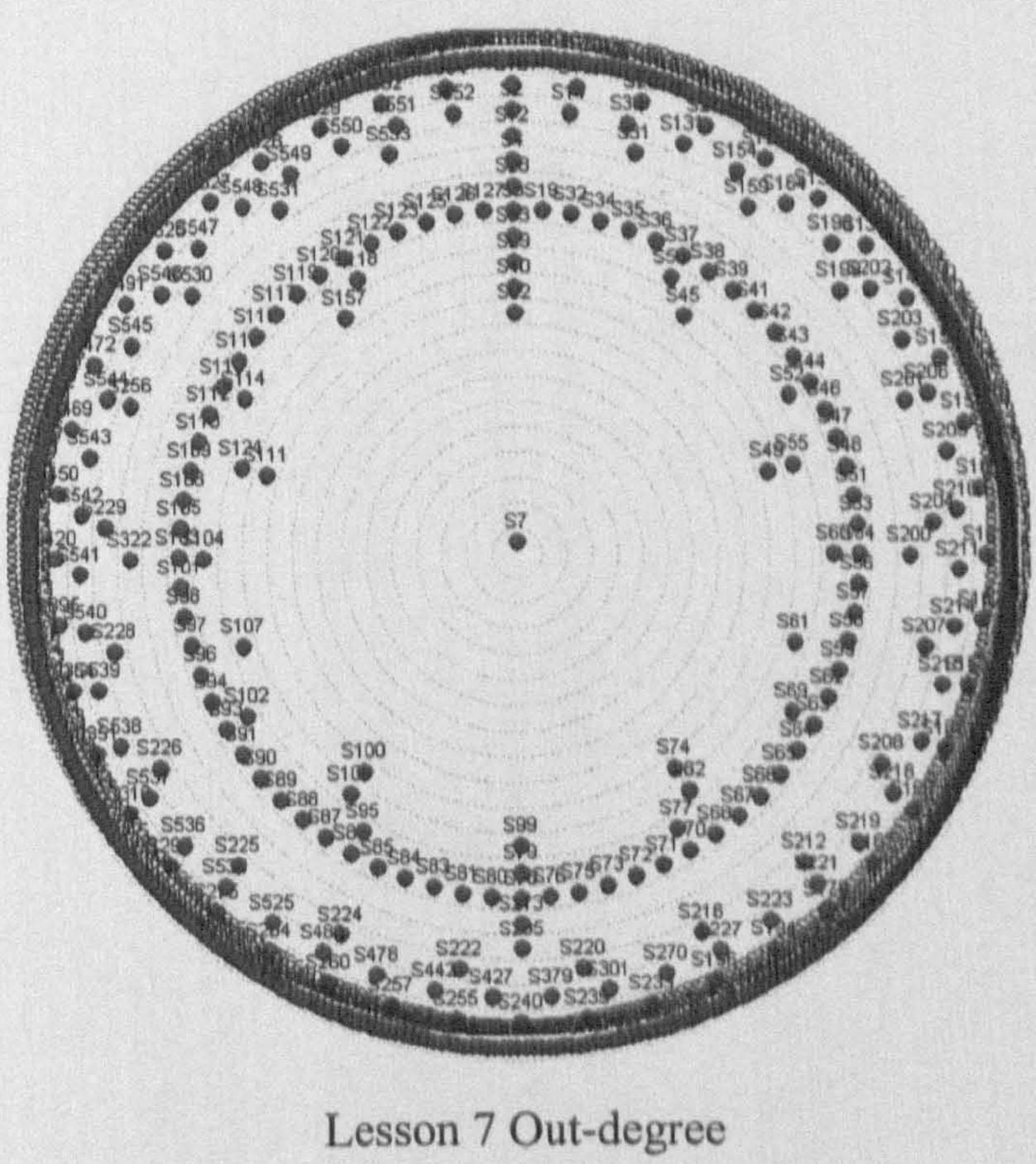
Lesson 6 In-degree



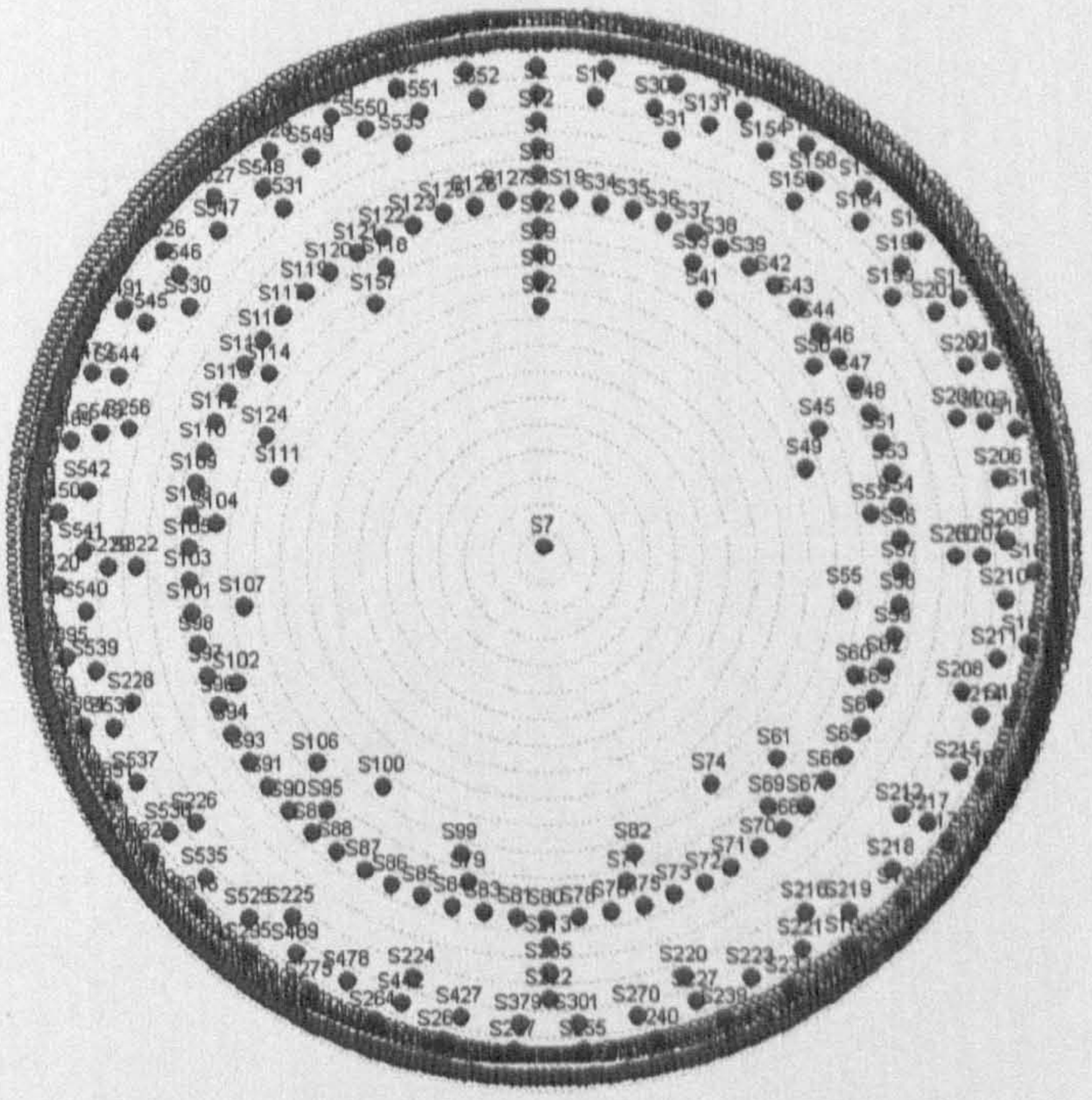
Lesson 6 Out-degree



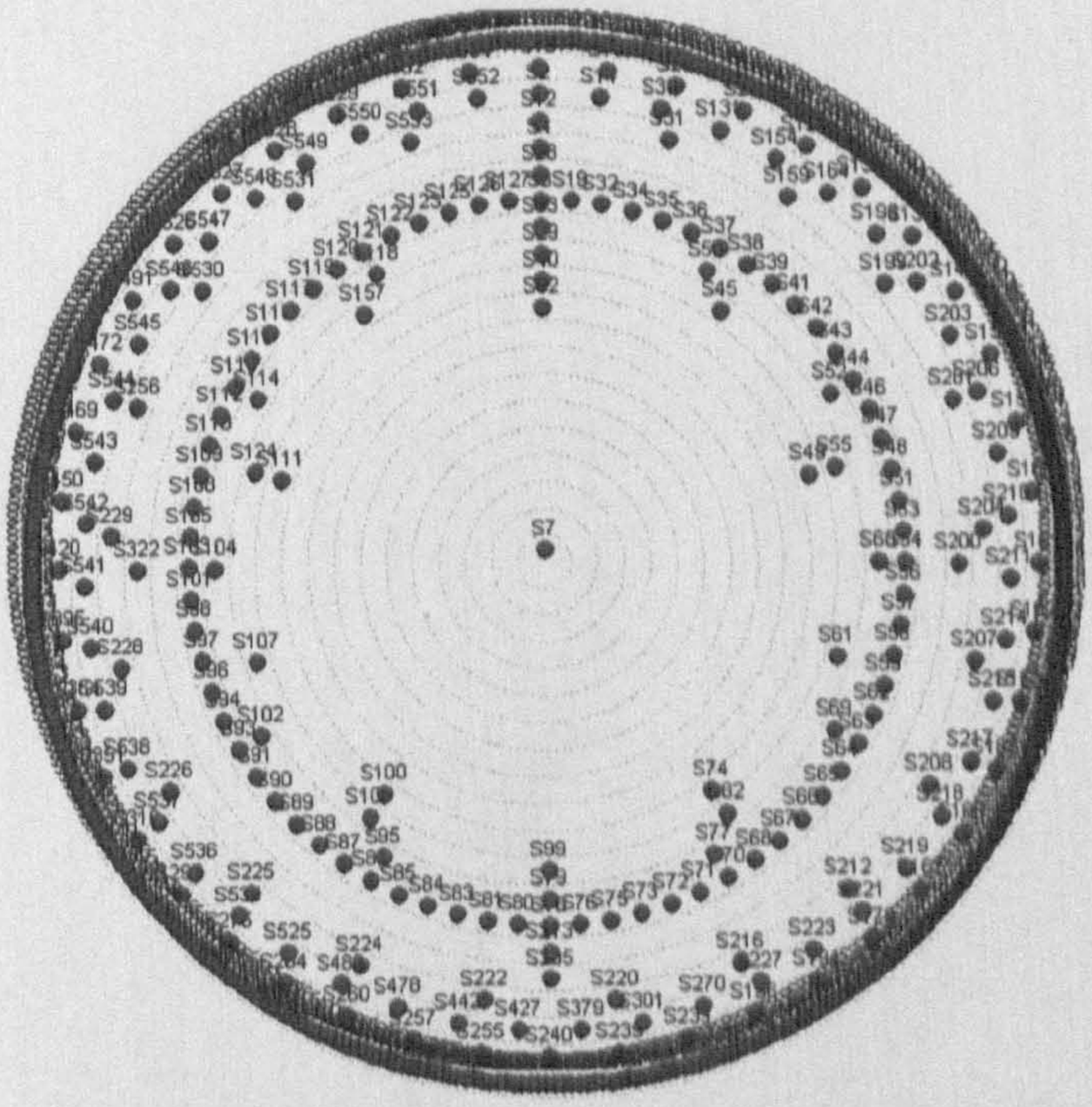
Lesson 7 In-degree



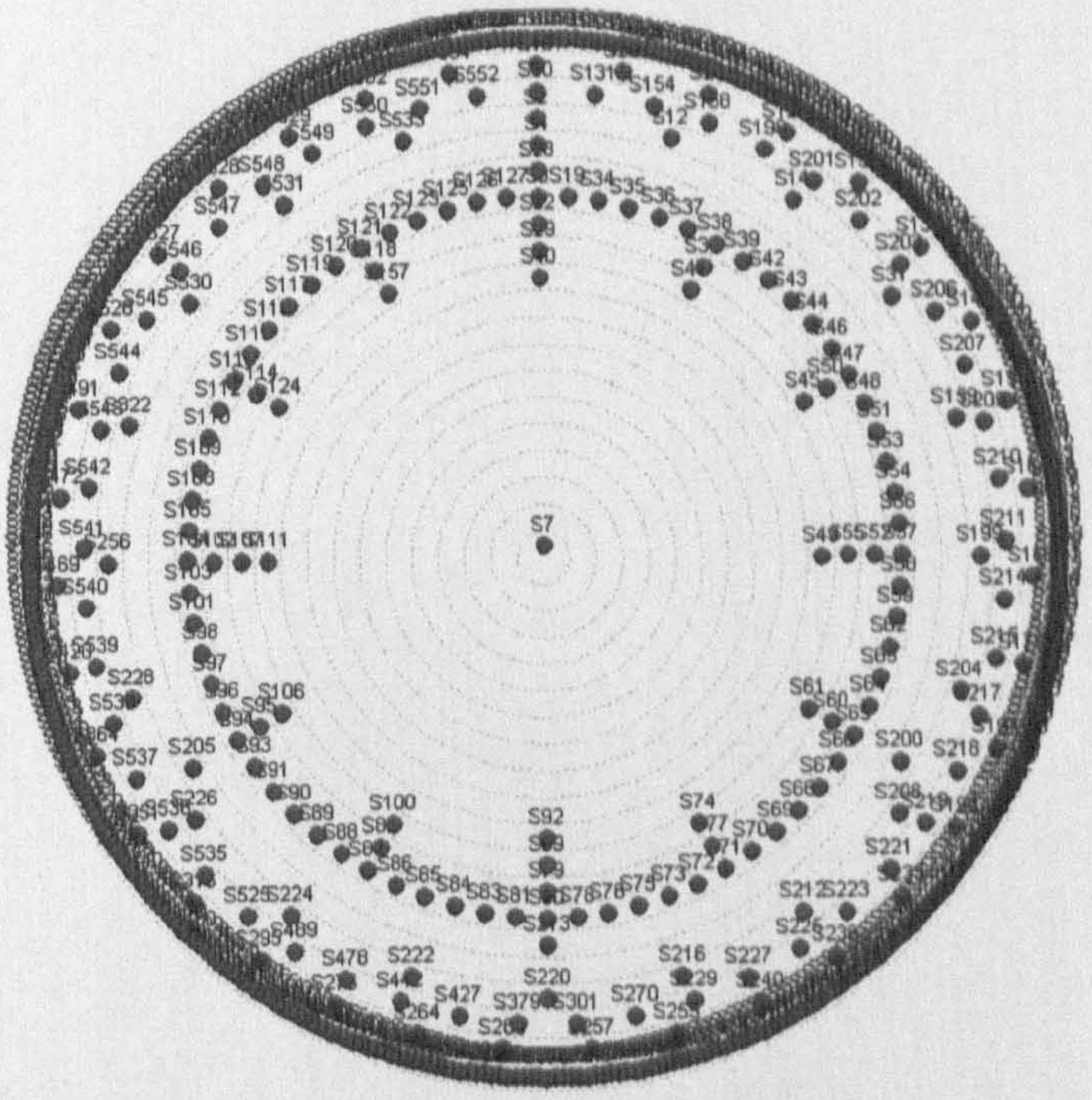
Lesson 7 Out-degree



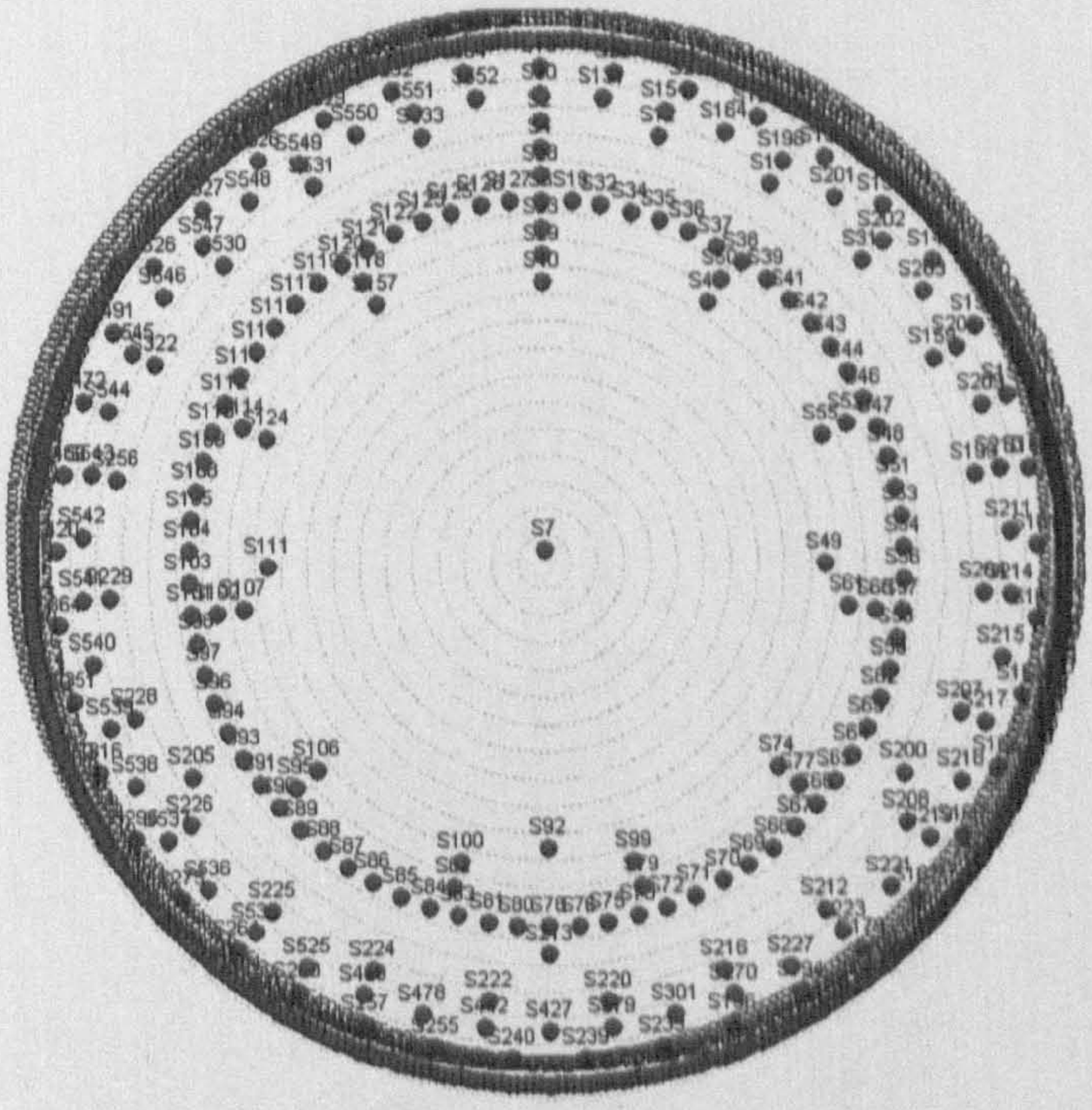
Lesson 8 In-degree



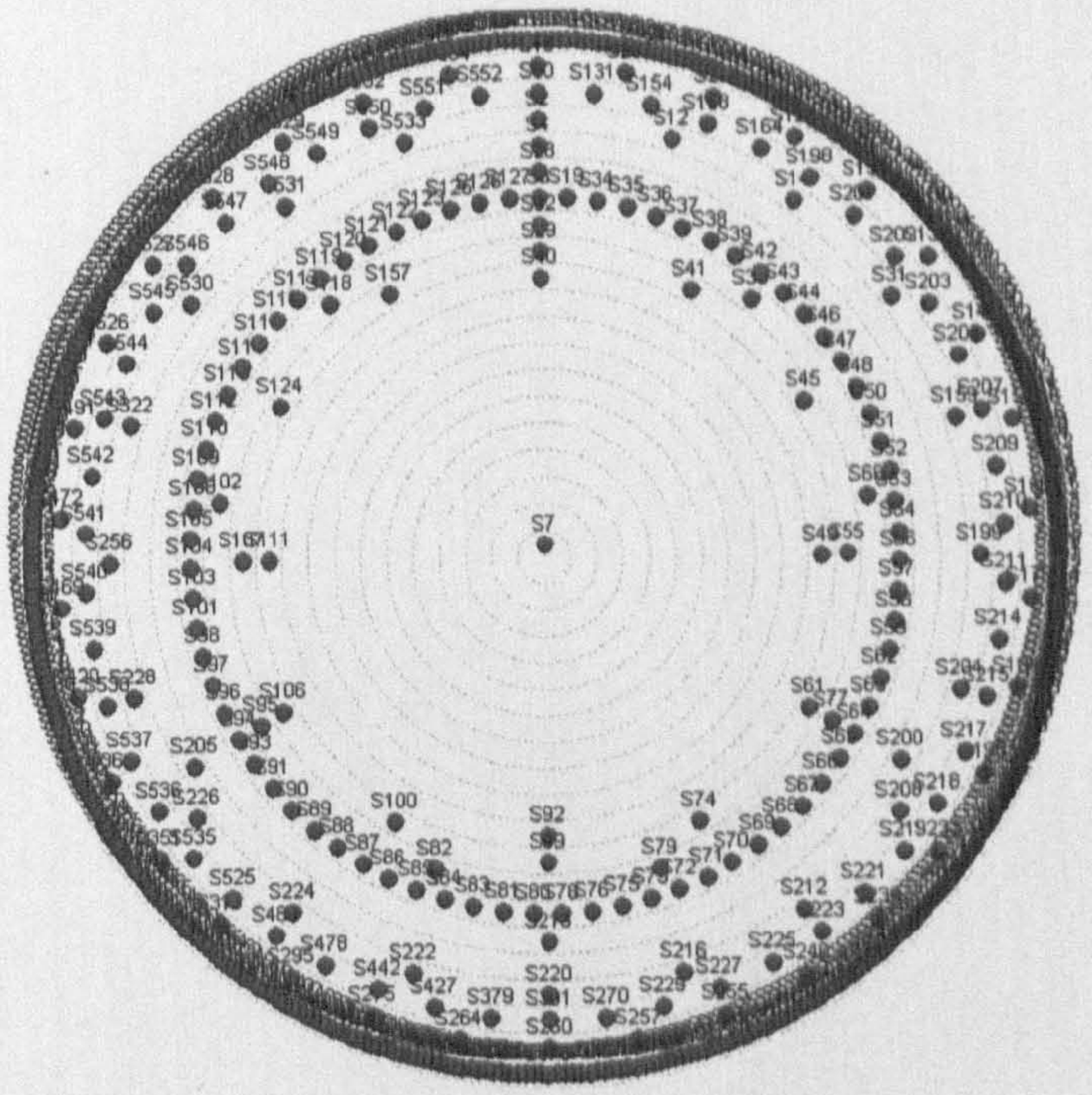
Lesson 8 Out-degree



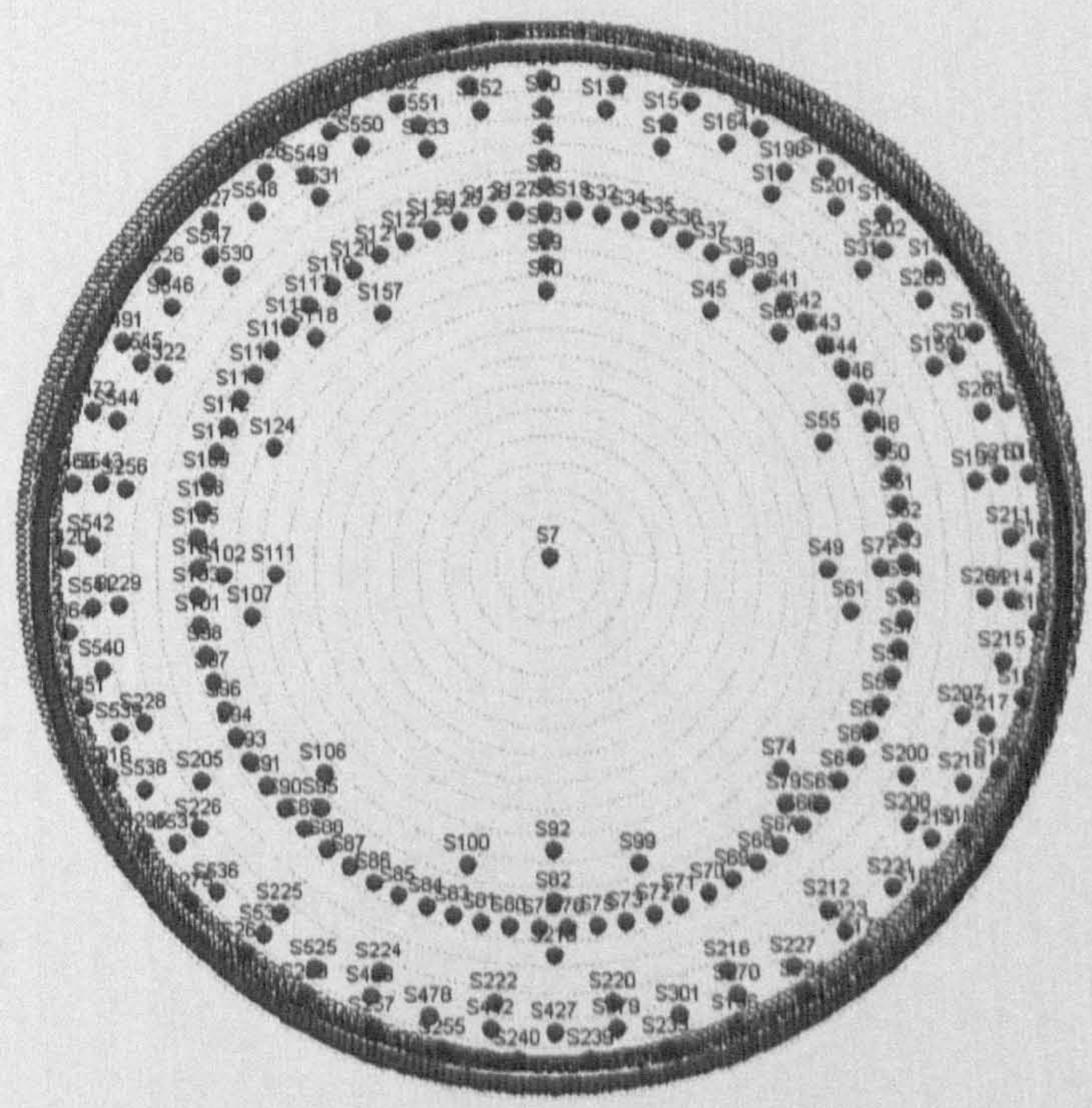
Lesson 9 In-degree



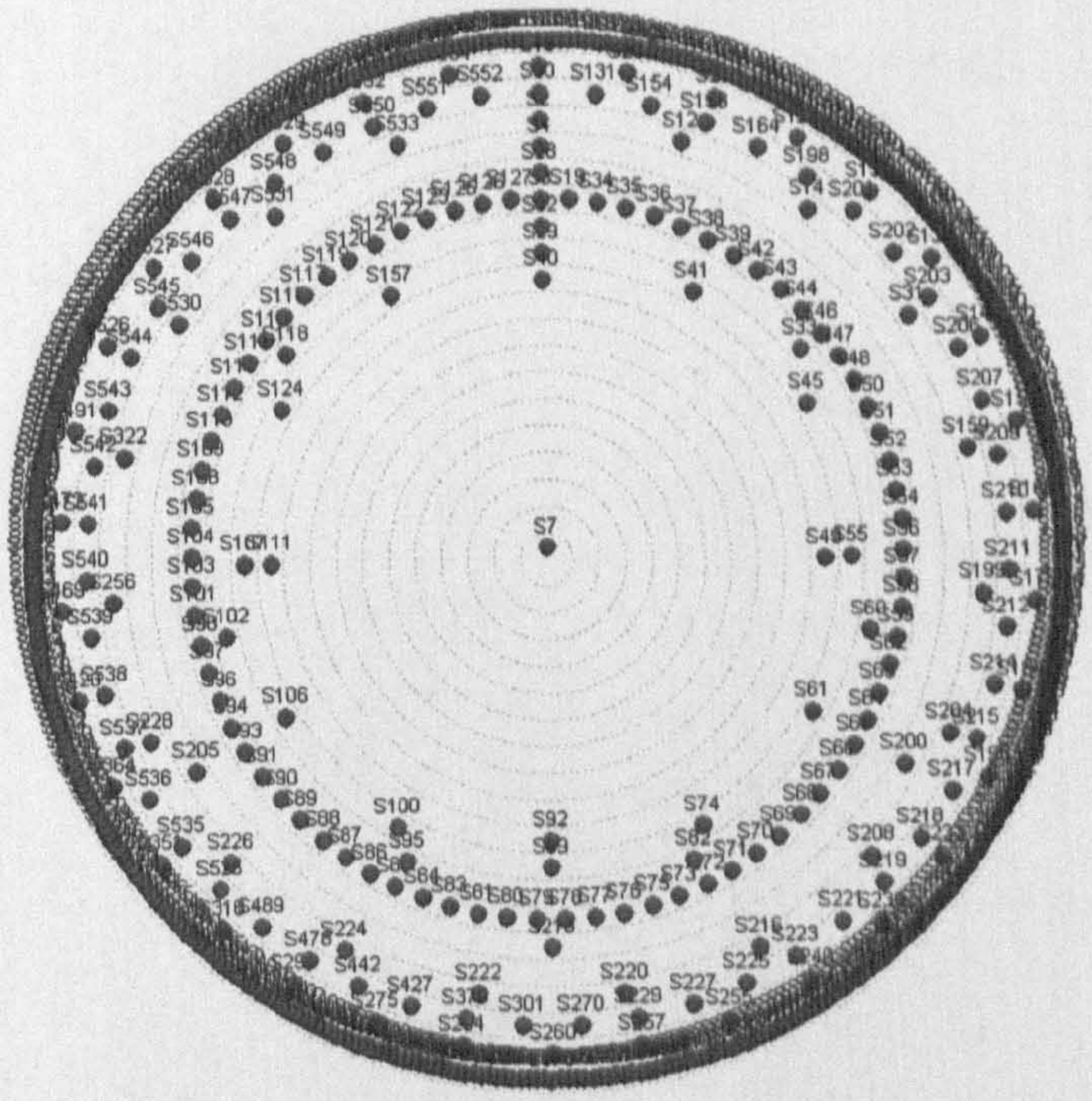
Lesson 9 Out-degree



Lesson 10 In-degree

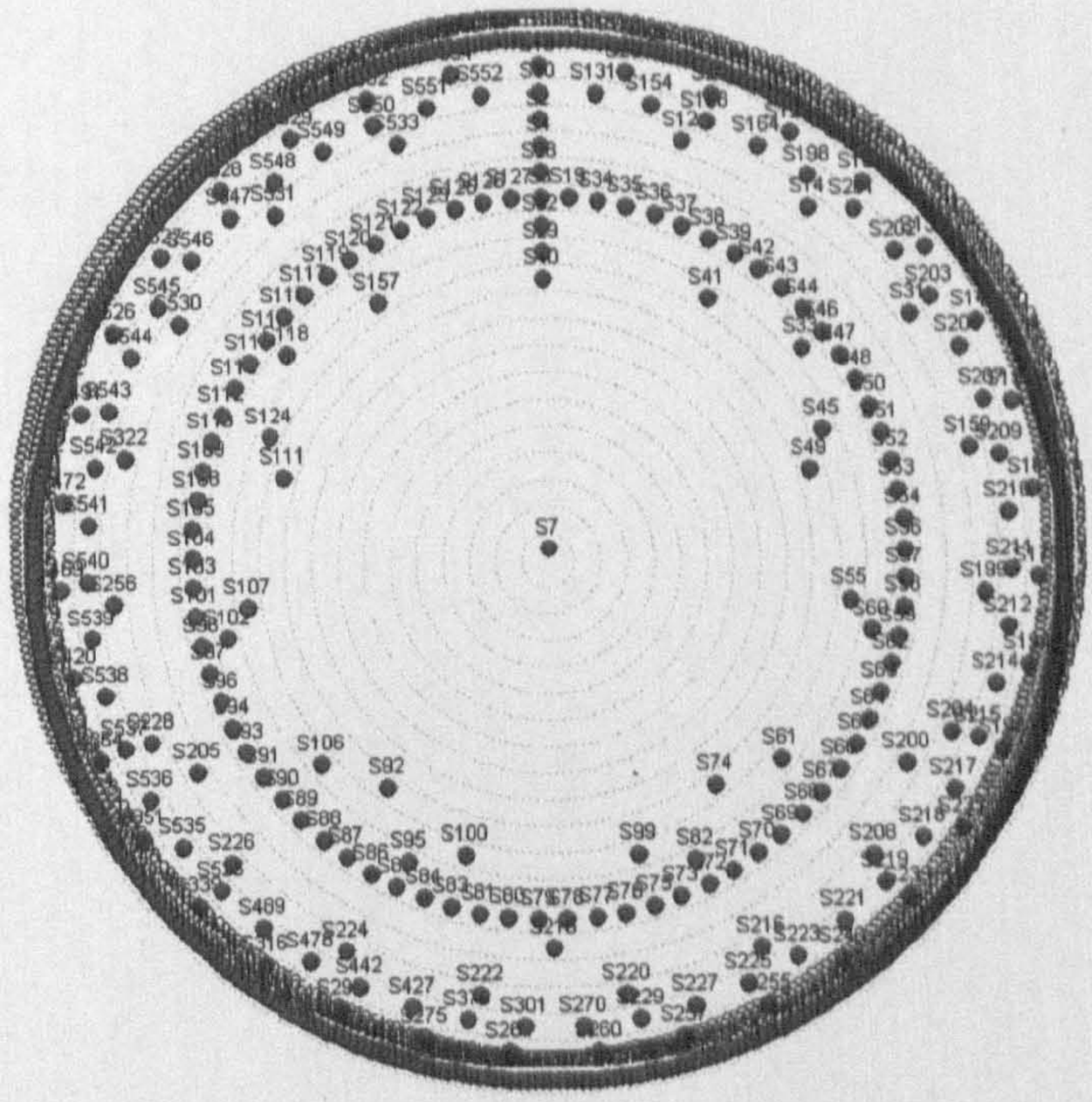


Lesson 10 Out-degree

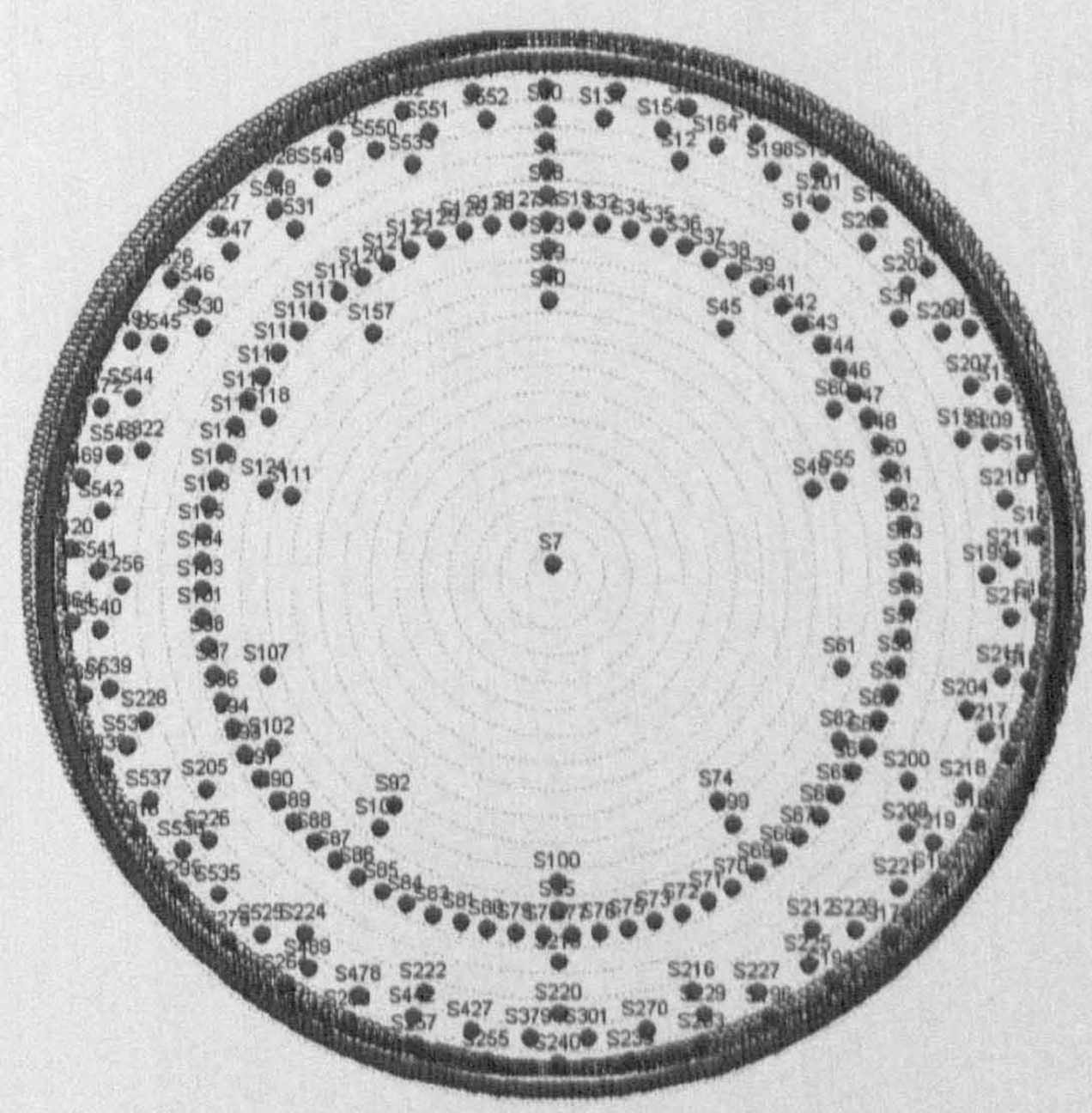


Lesson 11 In-degree

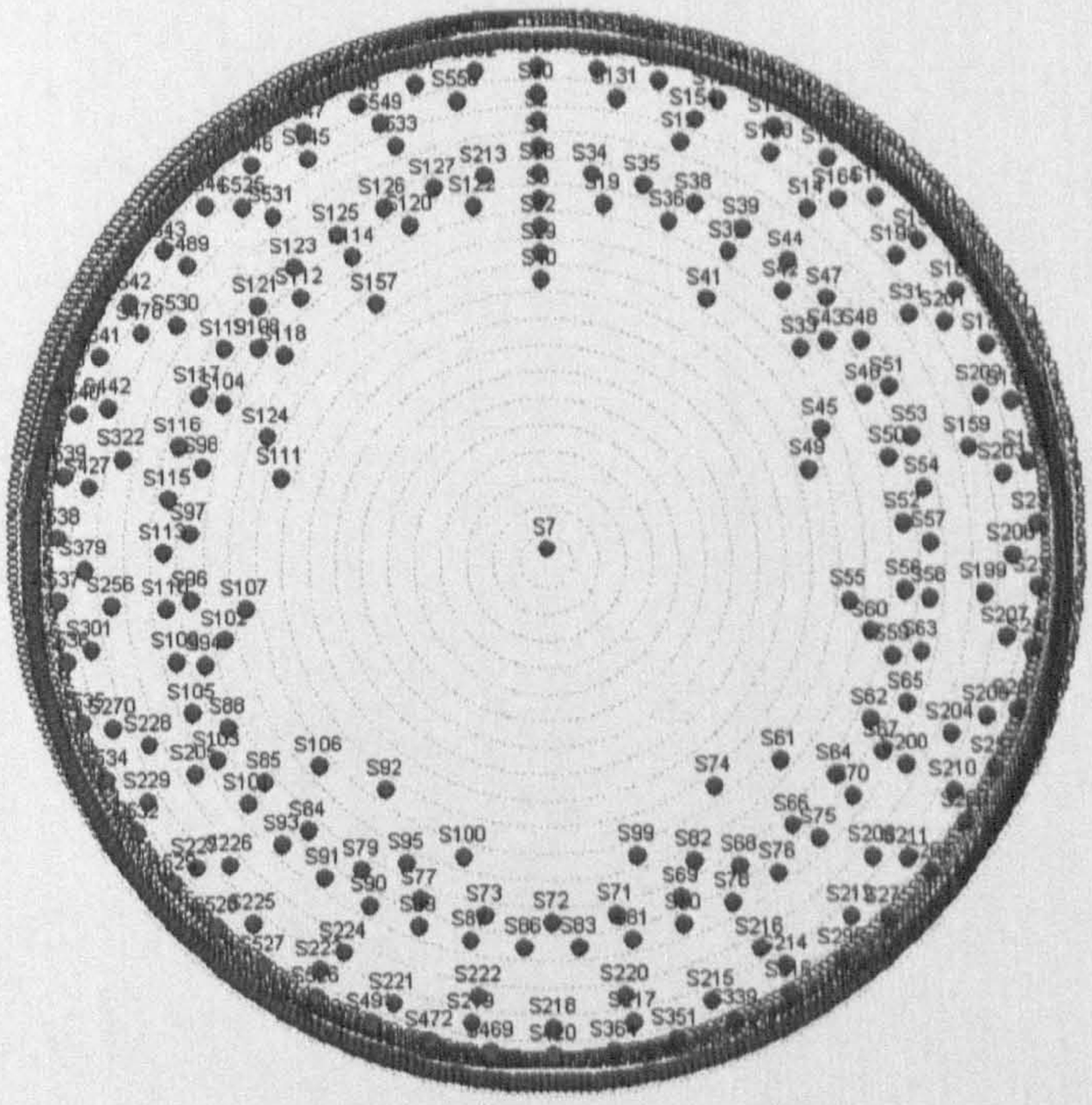
Lesson 11 Out-degree



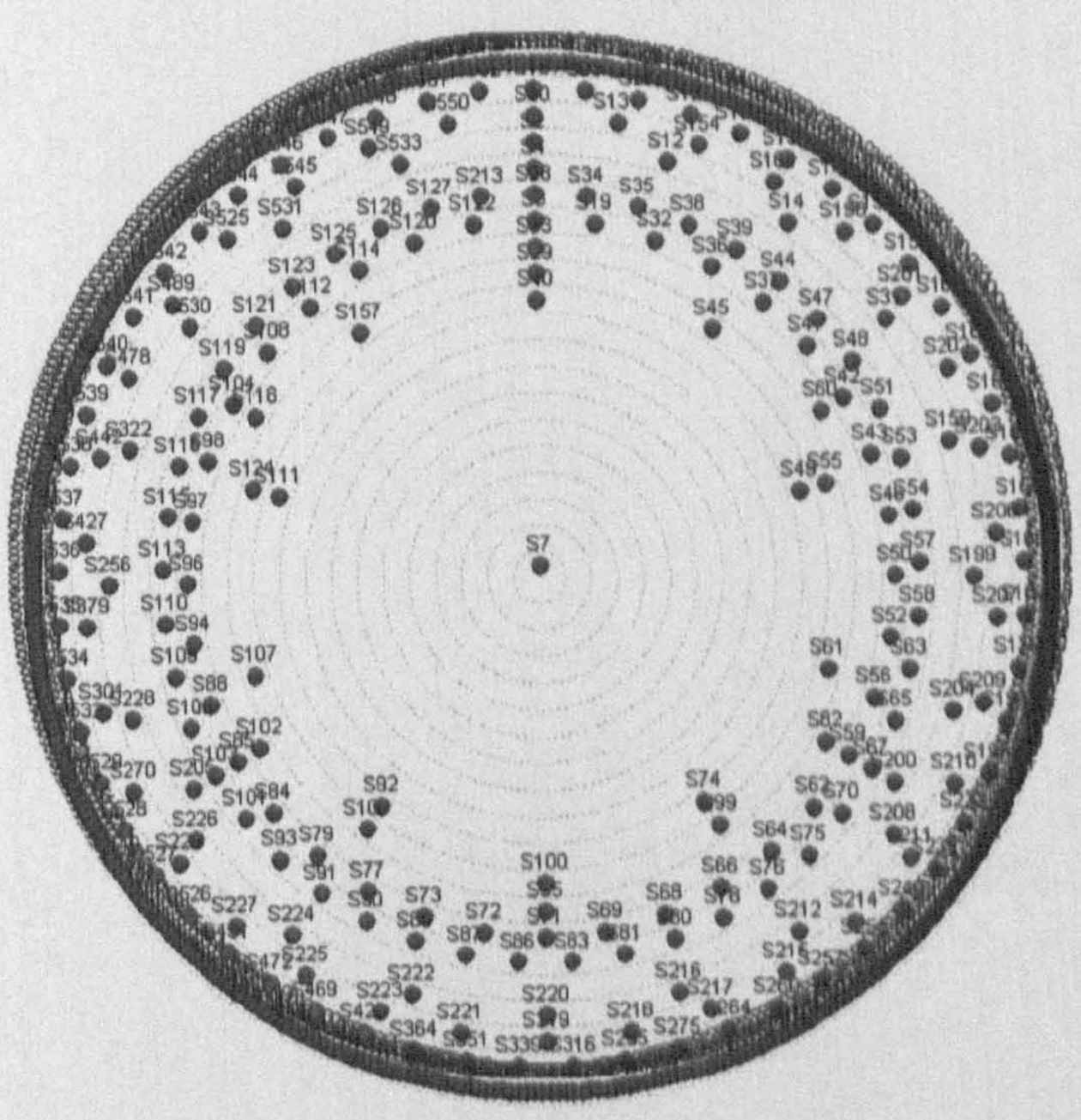
Lesson 12 In-degree



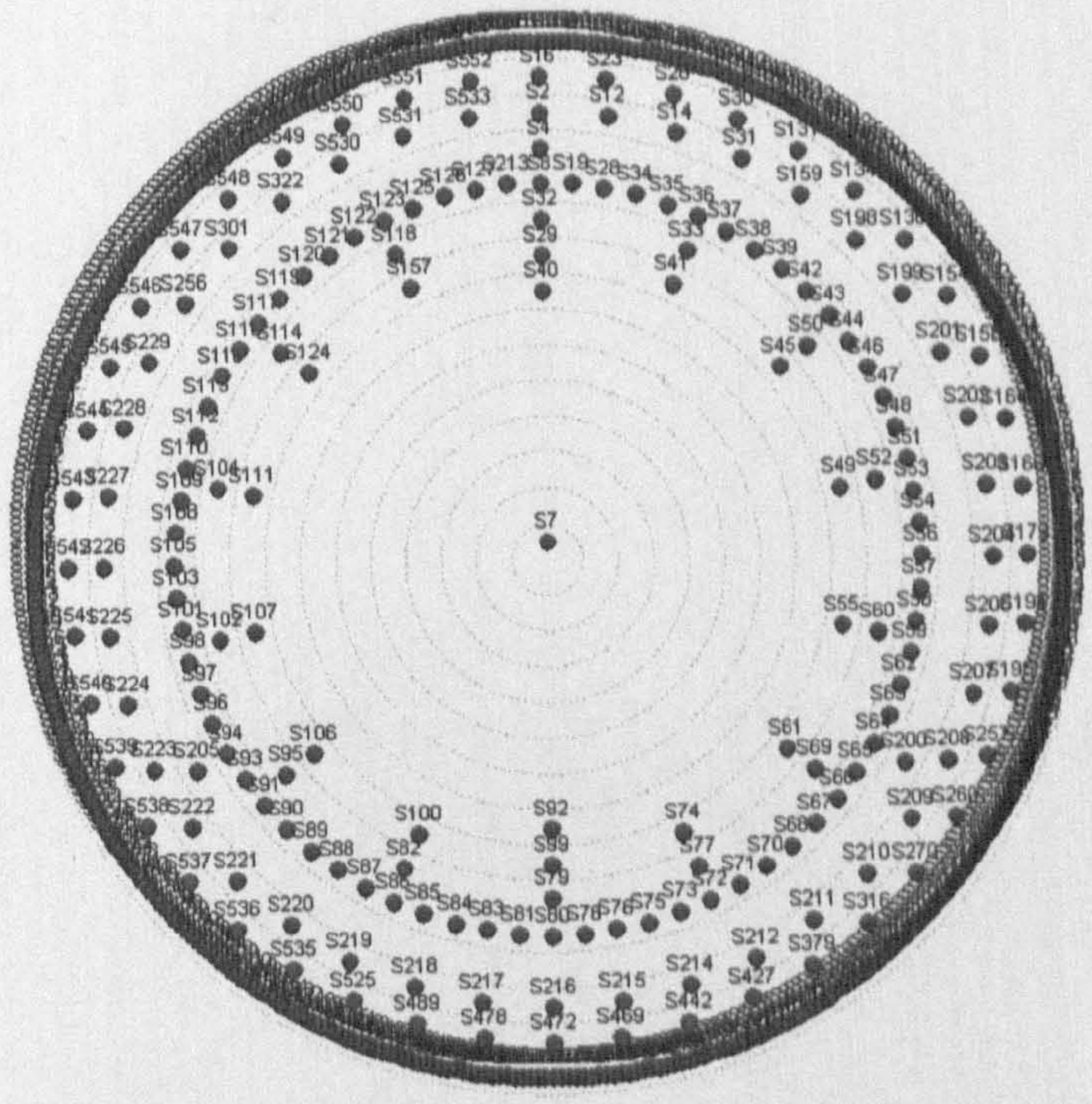
Lesson 12 Out-degree



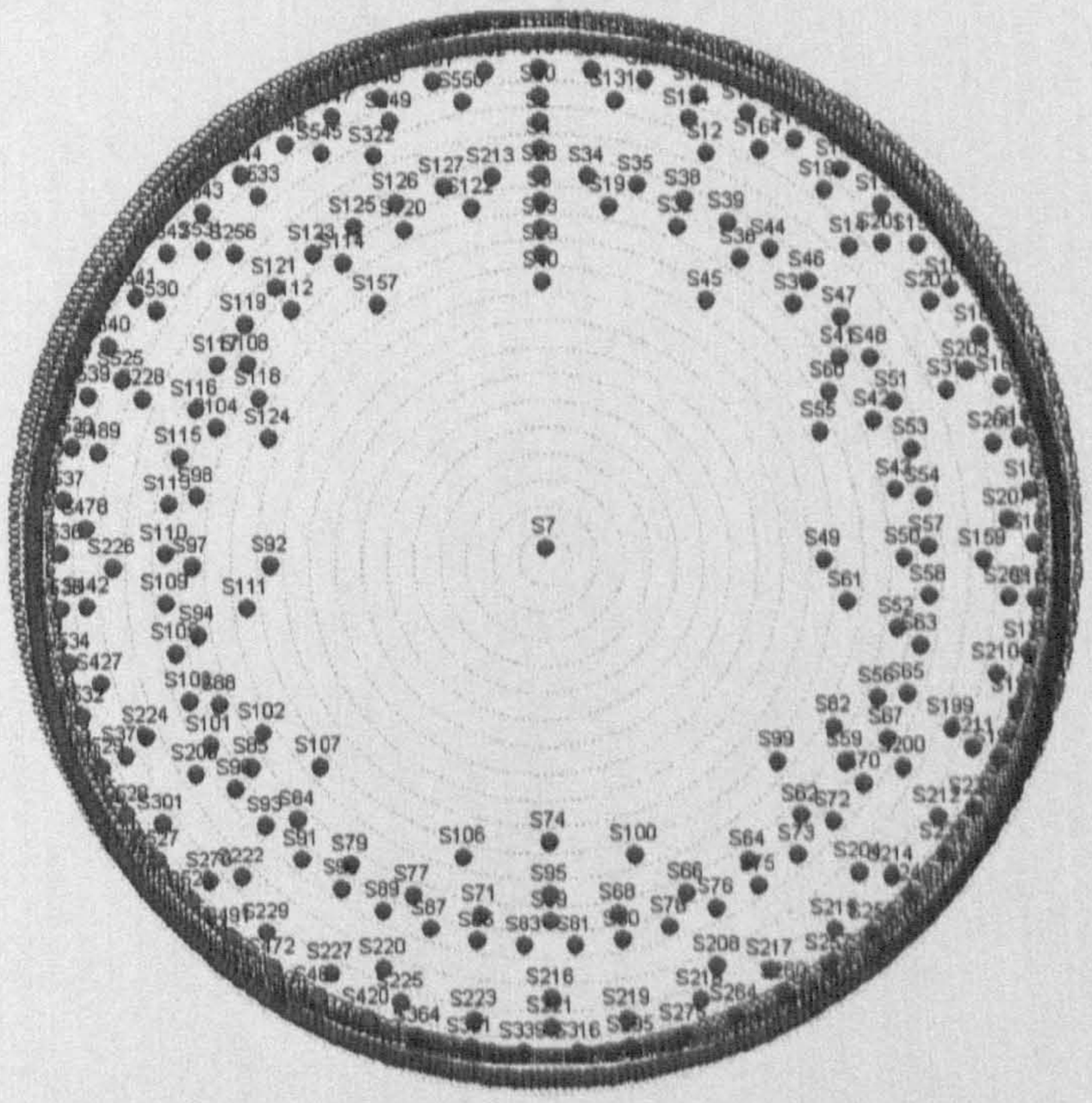
Lesson 13 In-degree



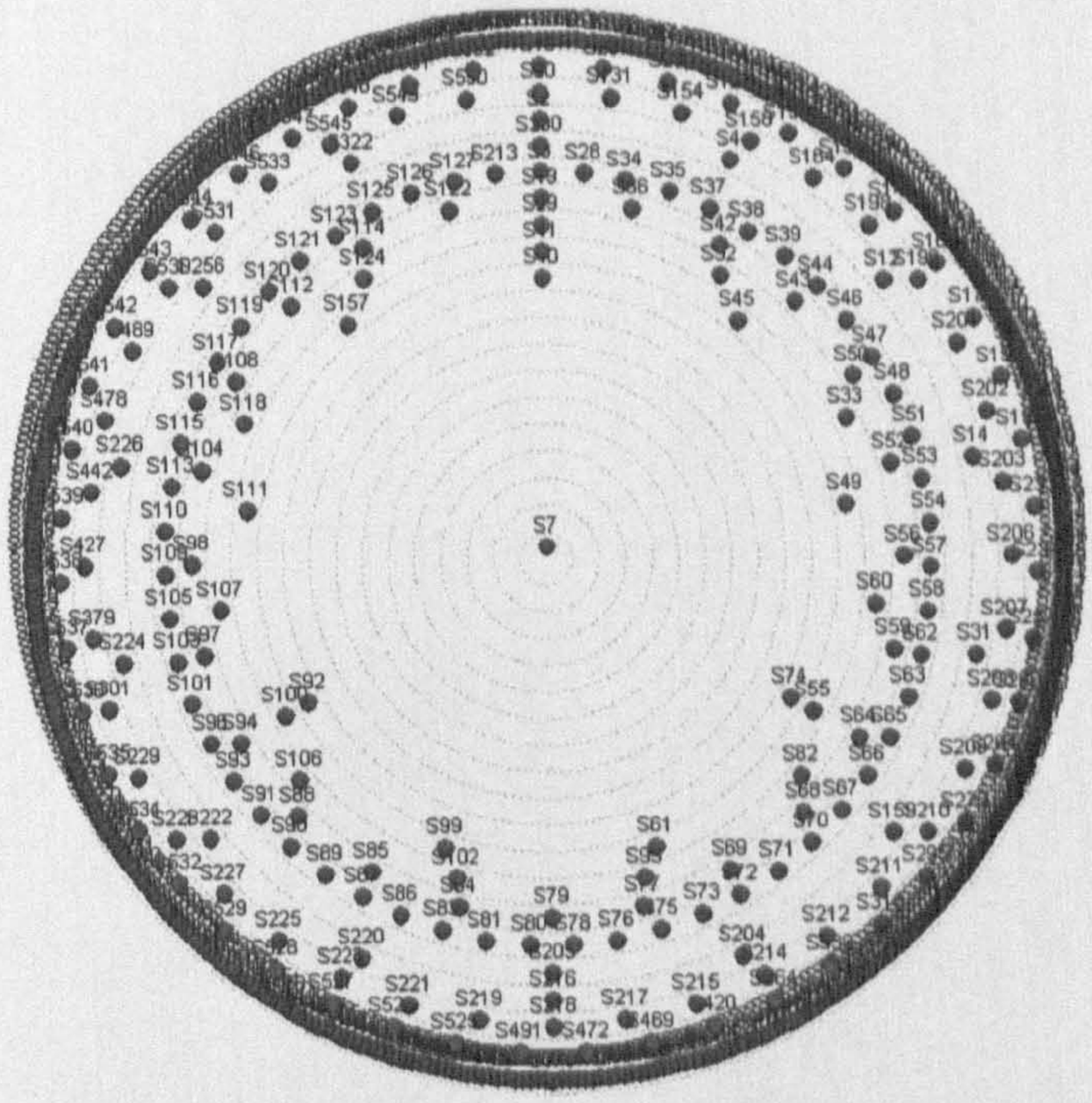
Lesson 13 Out-degree



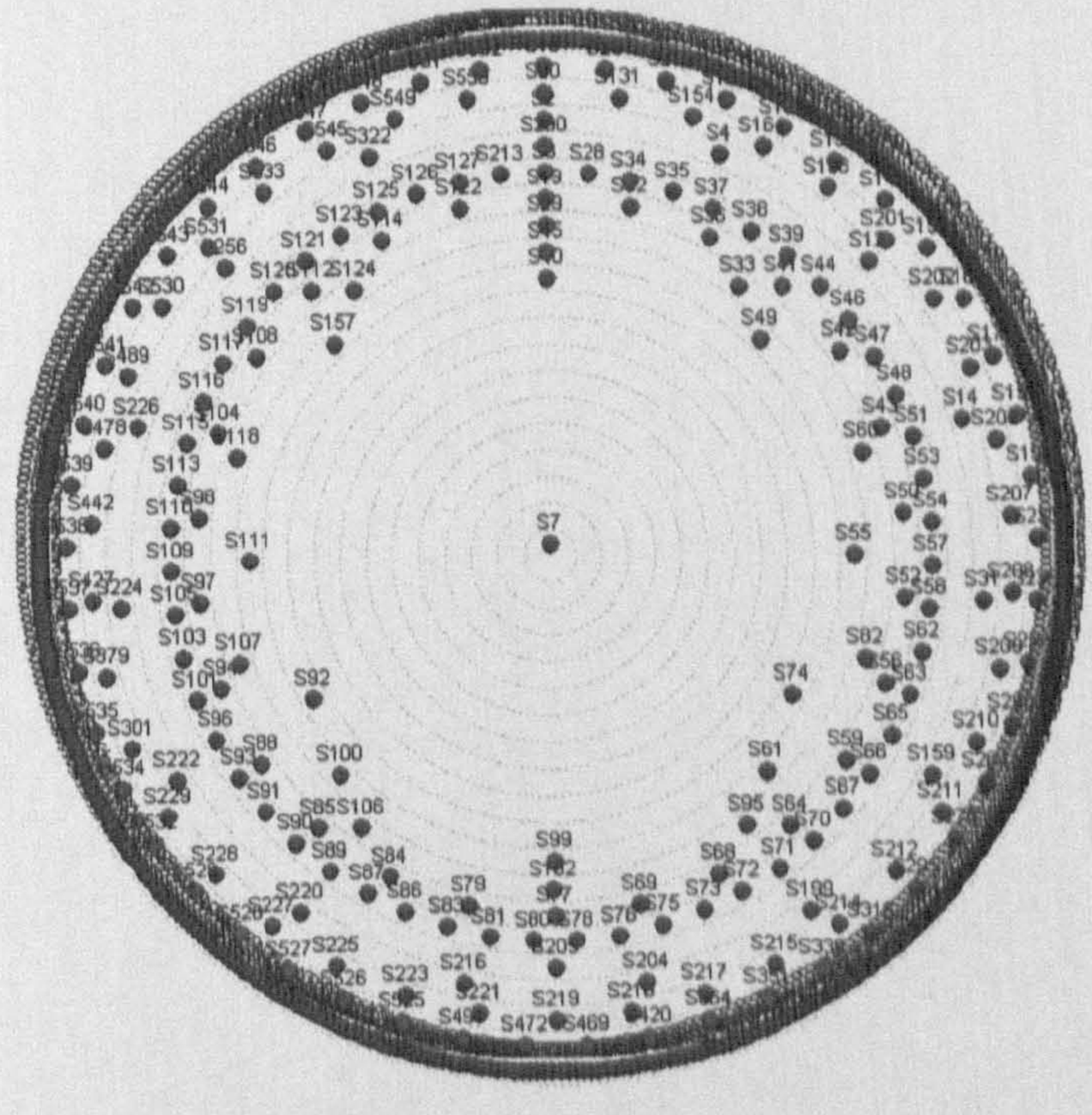
Lesson 14 In-degree



Lesson 14 Out-degree



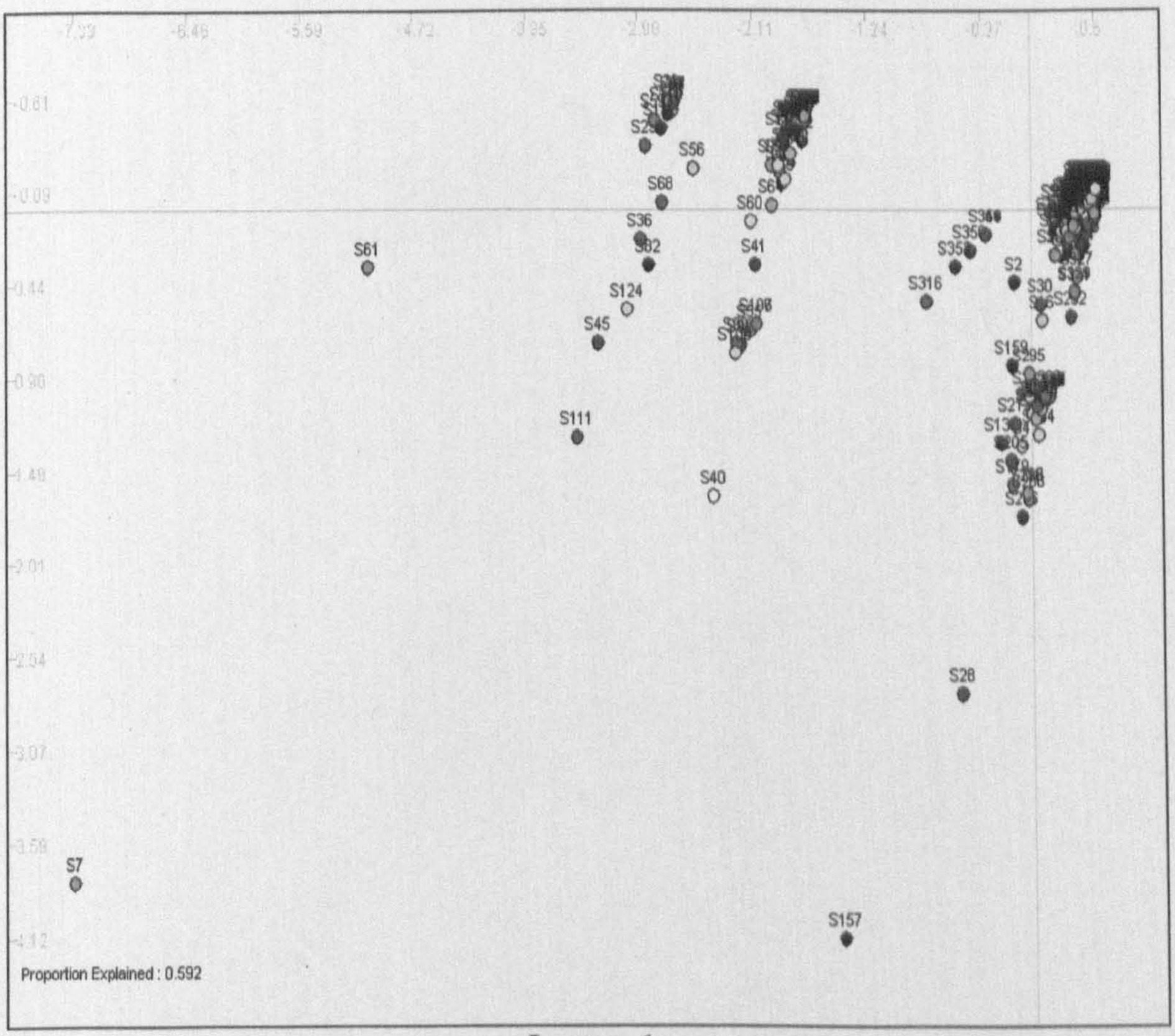
Lesson 15 In-degree



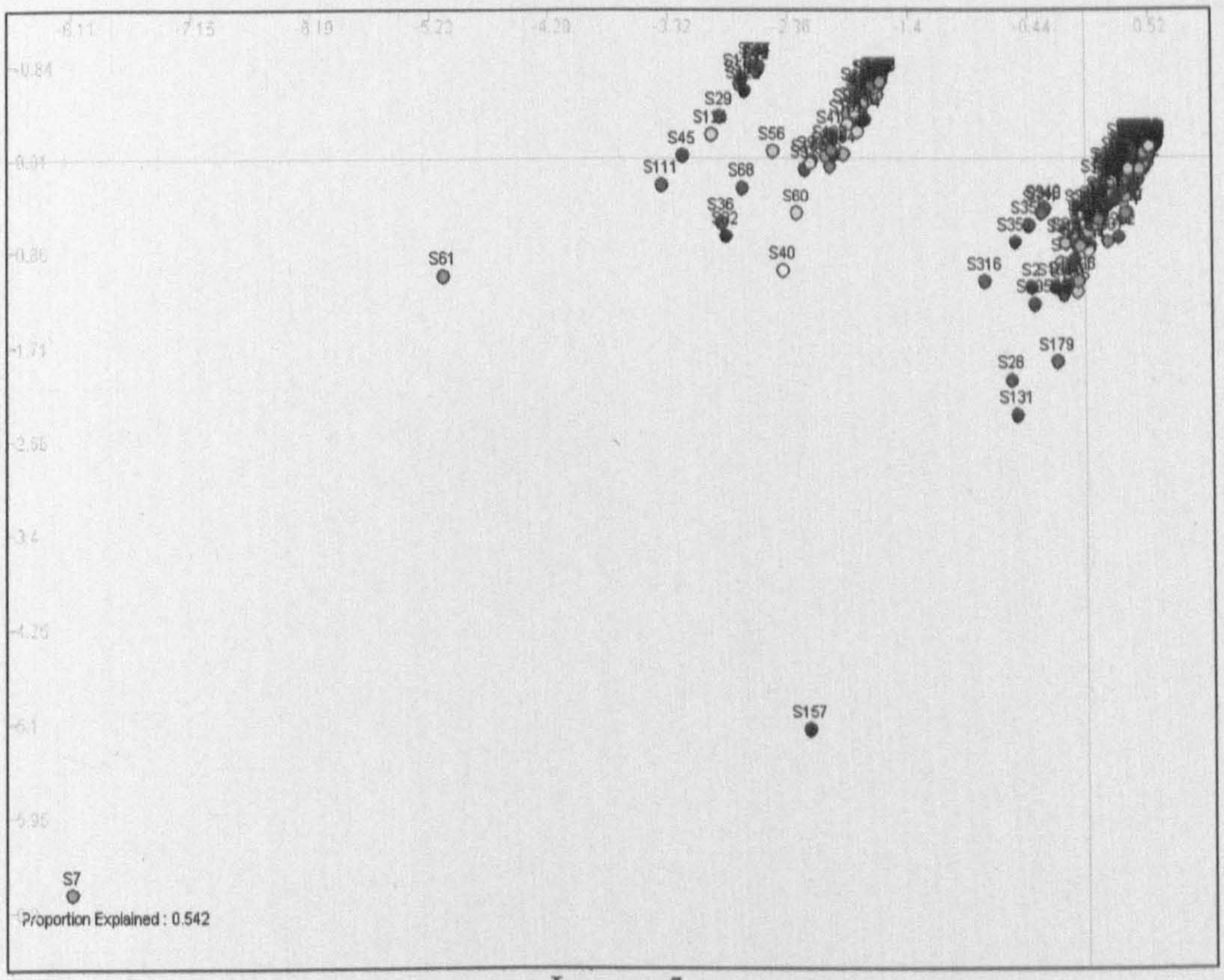
Lesson 15 Out-degree

Appendix G - Structural Equivalence Lessons 1,5,10,15

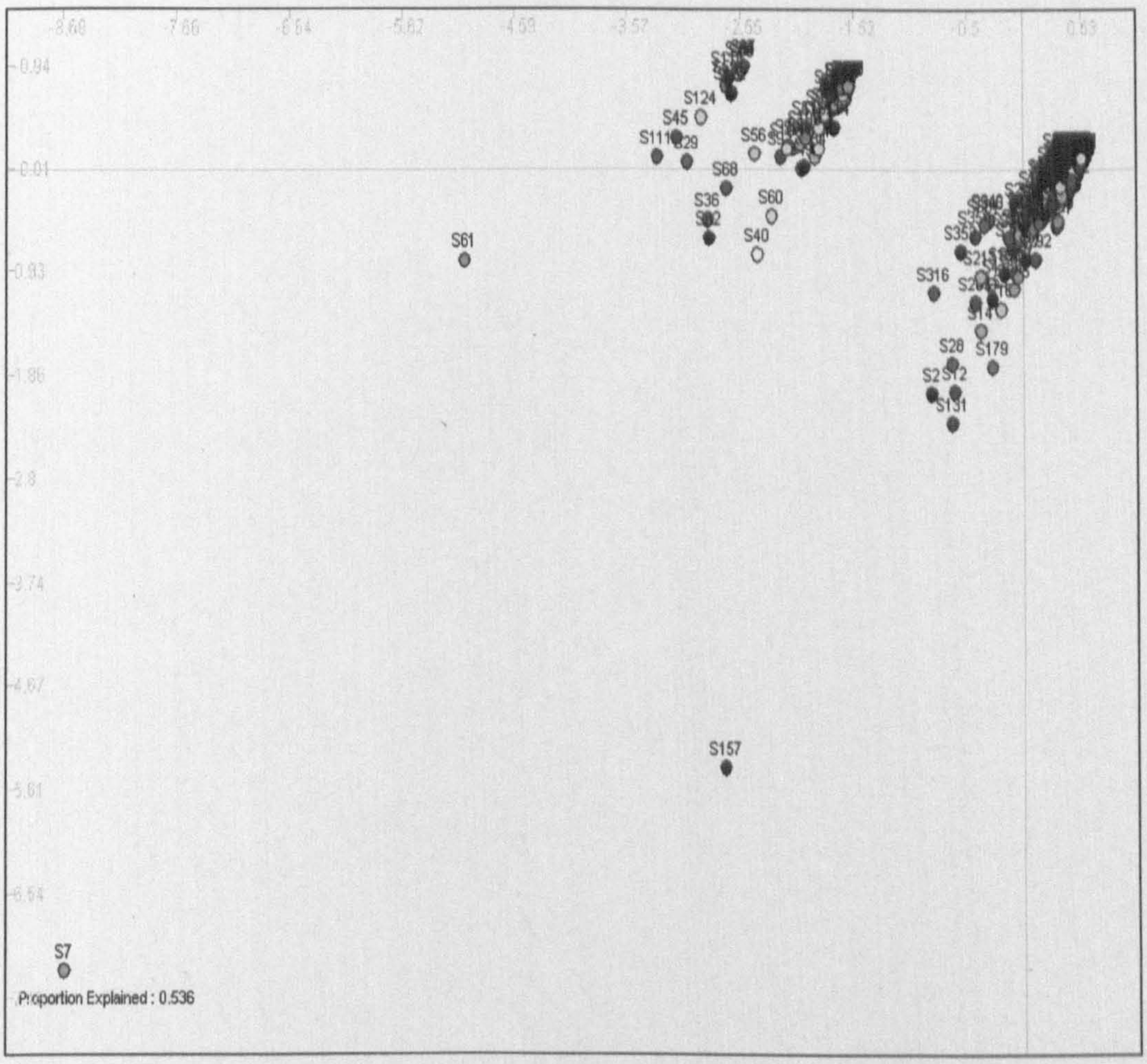
Sociograms



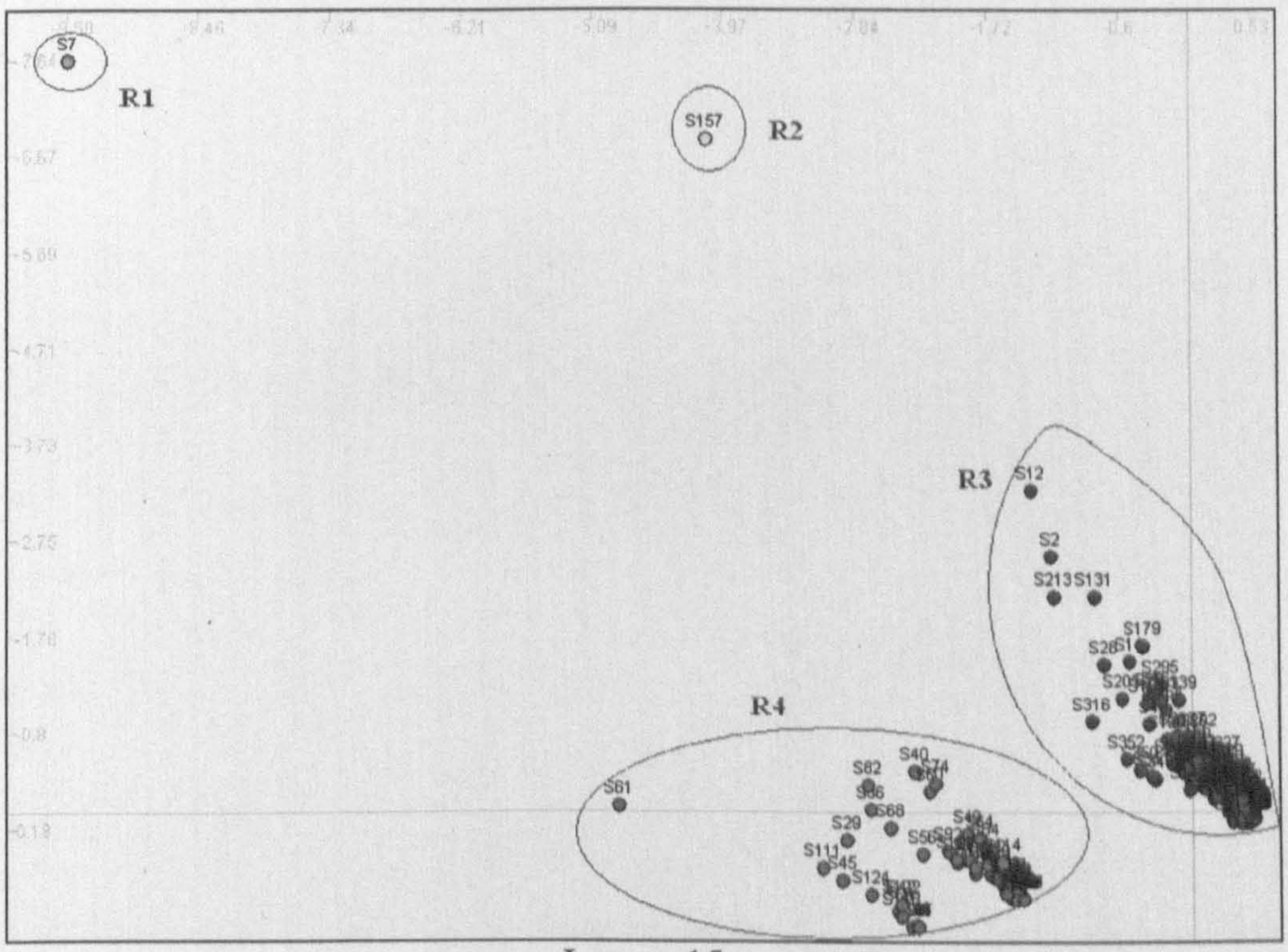
Lesson 1


-8.11
-7.15
-6.19
-5.23
-4.29
-3.32
-2.36
-1.4
-0.44
0.52
-0.84
-0.01
0.86
1.71
2.56
3.4
4.25
5.1
5.95
S29
S45
S56
S111
S68
S60
S36
S40
S61
S316
S179
S28
S131
S157
S7
Proportion Explained : 0.542

Lesson 5


-8.68
-7.66
-6.64
-5.62
-4.59
-3.57
-2.55
-1.52
-0.5
0.53
0.94
0.01
-0.93
-1.86
-2.8
-3.74
-4.67
-5.61
-6.54
S124
S45
S111
S29
S56
S68
S36
S60
S40
S61
S316
S28
S179
S2
S12
S131
S157
S7
Proportion Explained : 0.536

Lesson 10


S7
R1
S157
R2
R3
S12
S2
S213
S131
S179
S316
S352
R4
S61
S40
S82
S29
S111
S45
S124

Lesson 15

Appendix H – TRA results

	THREADS					Messages Posted				
	A1	A2	B	C1	C2	A1	A2	B	C1	C2
S1	3	0	0	0	0	3	0	0	0	0
S2	25	9	5	0	0	36	16	6	0	0
S3	2	0	0	0	0	2	0	0	0	0
S4	2	4	0	6	0	2	5	0	7	0
S5	0	0	0	1	0	0	0	0	1	0
S6	0	1	0	0	0	0	1	0	0	0
S7	42	39	25	21	0	56	48	27	42	0
S8	0	1	0	1	0	0	1	0	1	0
S9	1	0	0	1	0	1	0	0	1	0
S10	0	0	0	1	0	0	0	0	1	0
S11	0	1	0	0	0	0	2	0	0	0
S12	24	2	0	2	0	34	2	0	2	0
S13	0	1	0	1	0	0	1	0	1	0
S14	12	5	0	4	0	14	7	0	4	0
S15	0	1	0	3	0	0	1	0	3	0
S16	2	4	0	0	0	3	4	0	0	0
S17	0	1	0	0	0	0	1	0	0	0
S18	0	1	0	0	0	0	1	0	0	0
S19	1	1	0	1	0	1	1	0	1	0
S20	0	1	0	0	0	0	1	0	0	0
S21	0	1	0	0	0	0	1	0	0	0
S22	0	0	0	1	0	0	0	0	1	0
S23	7	2	0	2	0	8	5	0	2	0
S24	0	0	0	1	0	0	0	0	1	0
S25	0	0	0	1	0	0	0	0	1	0
S26	0	0	0	2	0	0	0	0	2	0
S27	0	0	0	1	0	0	0	0	1	0
S28	0	1	3	4	0	0	3	5	6	0
S29	3	2	1	4	0	4	2	1	5	0
S30	0	0	1	3	0	0	0	1	9	0
S31	0	0	0	2	0	0	0	0	2	0
S32	0	0	0	2	0	0	0	0	2	0
S33	0	0	0	3	0	0	0	0	4	0
S34	0	0	0	1	0	0	0	0	1	0
S35	0	0	0	1	0	0	0	0	1	0
S36	0	0	0	2	0	0	0	0	6	0
S37	0	1	0	1	0	0	1	0	1	0
S38	0	0	0	1	0	0	0	0	1	0
S39	0	0	0	1	0	0	0	0	1	0
S40	1	9	1	2	0	1	10	1	3	0
S41	1	0	0	2	0	1	0	0	2	0
S42	2	0	0	1	0	4	0	0	2	0

S43	3	0	0	1	0	3	0	0	1	0
S44	1	0	0	1	0	1	0	0	2	0
S45	0	0	2	2	0	0	0	2	3	0
S46	0	0	1	2	0	0	0	1	2	0
S47	0	0	0	1	0	0	0	0	1	0
S48	0	0	0	1	0	0	0	0	1	0
S49	2	0	2	3	0	2	0	3	3	0
S50	0	1	0	1	0	0	1	0	1	0
S51	0	0	0	1	0	0	0	0	1	0
S52	0	1	0	1	0	0	1	0	1	0
S53	0	0	0	1	0	0	0	0	1	0
S54	0	0	0	1	0	0	0	0	1	0
S55	0	0	1	2	0	0	0	1	2	0
S56	0	0	0	2	0	0	0	0	2	0
S57	0	0	0	1	0	0	0	0	1	0
S58	0	0	0	1	0	0	0	0	1	0
S59	0	0	0	2	0	0	0	0	3	0
S60	2	2	3	1	0	5	2	3	1	0
S61	0	0	1	4	0	0	0	1	11	0
S62	1	0	0	1	0	1	0	0	1	0
S63	0	0	0	1	0	0	0	0	1	0
S64	0	1	1	1	0	0	1	5	1	0
S65	0	0	0	1	0	0	0	0	1	0
S66	0	0	1	1	0	0	0	1	2	0
S67	0	0	0	1	0	0	0	0	2	0
S68	1	0	1	2	0	1	0	1	3	0
S69	0	0	2	2	0	0	0	4	2	0
S70	0	0	0	1	0	0	0	0	1	0
S71	0	1	0	1	0	0	2	0	1	0
S72	0	1	0	1	0	0	1	0	1	0
S73	0	0	0	2	0	0	0	0	2	0
S74	5	0	0	3	0	7	0	0	3	0
S75	0	0	0	1	0	0	0	0	1	0
S76	0	0	0	1	0	0	0	0	1	0
S77	0	0	0	3	0	0	0	0	4	0
S78	0	0	0	1	0	0	0	0	1	0
S79	0	0	0	4	0	0	0	0	6	0
S80	0	0	0	1	0	0	0	0	1	0
S81	0	0	0	1	0	0	0	0	1	0
S82	1	1	0	3	0	1	1	0	3	0
S83	0	0	0	1	0	0	0	0	1	0
S84	2	0	0	1	0	3	0	0	1	0
S85	0	0	0	3	0	0	0	0	4	0
S86	0	0	0	1	0	0	0	0	1	0
S87	0	0	0	1	0	0	0	0	1	0
S88	0	0	0	2	0	0	0	0	2	0
S89	0	0	0	1	0	0	0	0	1	0
S90	0	0	0	1	0	0	0	0	1	0

S91	0	0	0	1	0	0	0	0	2	0
S92	0	1	1	3	0	0	1	1	3	0
S93	0	0	0	1	0	0	0	0	1	0
S94	0	1	0	1	0	0	1	0	1	0
S95	0	1	1	2	0	0	1	1	2	0
S96	0	1	0	1	0	0	1	0	1	0
S97	1	1	1	1	0	1	1	1	1	0
S98	0	1	4	1	0	0	5	5	1	0
S99	0	0	1	2	0	0	0	1	2	0
S100	0	0	1	3	0	0	0	1	4	0
S101	0	0	0	1	0	0	0	0	1	0
S102	1	2	0	1	0	1	2	0	1	0
S103	0	0	0	1	0	0	0	0	1	0
S104	0	0	0	2	0	0	0	0	2	0
S105	0	0	0	1	0	0	0	0	1	0
S106	0	0	0	2	0	0	0	0	2	0
S107	0	0	0	2	0	0	0	0	2	0
S108	0	0	0	2	0	0	0	0	2	0
S109	0	0	0	1	0	0	0	0	1	0
S110	0	0	0	1	0	0	0	0	1	0
S111	0	0	1	3	0	0	0	2	5	0
S112	0	0	1	1	0	0	0	1	1	0
S113	0	0	0	1	0	0	0	0	1	0
S114	3	1	0	2	0	3	1	0	3	0
S115	0	0	0	1	0	0	0	0	1	0
S116	0	0	0	1	0	0	0	0	1	0
S117	0	0	0	1	0	0	0	0	1	0
S118	0	3	0	2	0	0	3	0	4	0
S119	0	0	0	1	0	0	0	0	1	0
S120	0	0	1	1	0	0	0	1	1	0
S121	0	0	0	1	0	0	0	0	1	0
S122	0	1	0	2	0	0	3	0	3	0
S123	0	0	0	1	0	0	0	0	1	0
S124	0	0	0	2	0	0	0	0	3	0
S125	0	0	0	1	0	0	0	0	1	0
S126	0	0	0	1	0	0	0	0	1	0
S127	0	0	0	1	0	0	0	0	1	0
S128	0	1	0	0	0	0	1	0	0	0
S129	2	2	2	2	0	2	4	2	2	0
S130	0	1	0	0	0	0	1	0	0	0
S131	6	13	1	4	0	7	20	3	5	0
S132	0	0	0	2	0	0	0	0	2	0
S133	0	0	0	1	0	0	0	0	1	0
S134	0	0	0	2	0	0	0	0	2	0
S135	0	0	0	1	0	0	0	0	1	0
S136	3	0	1	1	0	3	0	1	1	0
S137	0	0	0	1	0	0	0	0	1	0
S138	0	0	0	1	0	0	0	0	1	0

S139	0	0	0	1	0	0	0	0	1	0
S140	0	0	2	1	0	0	0	3	1	0
S141	0	0	0	1	0	0	0	0	1	0
S142	0	0	0	1	0	0	0	0	1	0
S143	0	0	0	1	0	0	0	0	1	0
S144	0	0	0	1	0	0	0	0	1	0
S145	0	0	0	1	0	0	0	0	1	0
S146	1	0	0	1	0	1	0	0	1	0
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S148	0	0	0	1	0	0	0	0	1	0
S149	2	0	0	1	0	3	0	0	2	0
S150	0	0	0	2	0	0	0	0	2	0
S151	0	0	0	1	0	0	0	0	1	0
S152	0	0	0	1	0	0	0	0	1	0
S153	0	0	0	1	0	0	0	0	1	0
S154	0	4	1	0	0	0	4	2	0	0
S155	1	2	0	1	0	1	2	0	3	0
S156	0	1	1	0	0	0	1	1	0	0
S157	20	13	6	4	0	37	22	9	5	0
S158	1	4	0	0	0	1	4	0	0	0
S159	3	2	0	6	0	4	3	0	13	0
S160	0	0	0	1	0	0	0	0	1	0
S161	0	0	0	1	0	0	0	0	2	0
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S163	0	0	0	1	0	0	0	0	1	0
S164	3	1	1	2	0	5	1	1	2	0
S165	0	0	0	1	0	0	0	0	1	0
S166	3	0	0	3	0	6	0	0	3	0
S167	0	0	0	1	0	0	0	0	1	0
S168	0	0	0	1	0	0	0	0	1	0
S169	1	1	0	0	0	1	2	0	0	0
S170	3	1	0	0	0	7	1	0	0	0
S171	1	0	0	0	0	1	0	0	0	0
S172	2	0	0	1	0	2	0	0	1	0
S173	0	1	0	1	0	0	1	0	1	0
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S178	0	1	0	0	0	0	1	0	0	0
S179	1	3	1	0	0	1	8	1	0	0
S180	0	1	0	0	0	0	1	0	0	0
S181	0	0	1	0	0	0	0	1	0	0
S182	0	0	1	0	0	0	0	1	0	0
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S184	2	0	0	0	0	2	0	0	0	0
S185	1	0	0	0	0	1	0	0	0	0
S186	1	0	0	0	0	1	0	0	0	0

S187	1	1	0	1	0	1	1	0	1	0
S188	1	0	0	0	0	1	0	0	0	0
S189	0	0	0	1	0	0	0	0	1	0
S190	0	0	0	1	0	0	0	0	1	0
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S192	1	0	1	0	0	1	0	1	0	0
S193	1	0	1	0	0	1	0	1	0	0
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S195	1	0	0	0	0	1	0	0	0	0
S196	1	2	0	0	0	1	2	0	0	0
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S200	0	0	0	2	0	0	0	0	2	0
S201	0	1	0	1	0	0	1	0	1	0
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S203	0	0	0	1	0	0	0	0	1	0
S204	2	0	0	2	0	2	0	0	2	0
S205	11	2	2	1	0	13	2	2	1	0
S206	0	2	0	1	0	0	3	0	2	0
S207	1	0	0	1	0	1	0	0	1	0
S208	0	1	0	1	0	0	1	0	1	0
S209	0	0	0	1	0	0	0	0	1	0
S210	0	0	0	1	0	0	0	0	2	0
S211	0	0	0	1	0	0	0	0	1	0
S212	1	3	0	2	0	1	4	0	2	0
S213	9	1	0	2	0	12	1	0	3	0
S214	0	0	0	1	0	0	0	0	1	0
S215	0	0	0	1	0	0	0	0	2	0
S216	0	0	2	1	0	0	0	2	1	0
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S219	0	0	0	1	0	0	0	0	1	0
S220	1	0	0	2	0	1	0	0	2	0
S221	0	0	0	1	0	0	0	0	1	0
S222	0	1	2	1	0	0	3	2	1	0
S223	0	1	0	1	0	0	2	0	1	0
S224	0	0	3	1	0	0	0	3	1	0
S225	0	0	0	2	0	0	0	0	2	0
S226	0	0	1	1	0	0	0	1	1	0
S227	0	0	0	1	0	0	0	0	1	0
S228	0	0	0	2	0	0	0	0	2	0
S229	0	1	0	1	0	0	1	0	1	0
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S232	0	1	1	1	0	0	1	1	1	0
S233	1	2	2	1	0	1	2	2	1	0
S234	0	0	0	1	0	0	0	0	1	0

S235	0	1	1	2	0	0	1	1	3	0
S236	0	0	1	0	0	0	0	1	0	0
S237	0	0	1	0	0	0	0	2	0	0
S238	0	0	1	0	0	0	0	1	0	0
S239	2	1	1	0	0	2	1	1	0	0
S240	0	1	1	0	0	0	1	1	0	0
S241	0	0	1	0	0	0	0	1	0	0
S242	0	1	1	1	0	0	2	1	1	0
S243	0	1	0	1	0	0	1	0	1	0
S244	1	0	1	1	0	1	0	1	1	0
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S246	0	1	0	0	0	0	1	0	0	0
S247	0	1	0	1	0	0	1	0	1	0
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S249	0	0	0	1	0	0	0	0	1	0
S250	1	0	0	0	0	1	0	0	0	0
S251	1	0	0	0	0	1	0	0	0	0
S252	3	0	0	0	0	3	0	0	0	0
S253	0	0	1	1	0	0	0	1	1	0
S254	0	1	0	1	0	0	1	0	1	0
S255	1	0	3	0	0	1	0	3	0	0
S256	1	1	0	2	0	1	1	0	2	0
S257	0	0	0	2	0	0	0	0	4	0
S258	0	0	0	1	0	0	0	0	1	0
S259	0	0	0	1	0	0	0	0	1	0
S260	0	2	0	1	0	0	2	0	1	0
S261	0	0	0	1	0	0	0	0	1	0
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S263	0	0	0	1	0	0	0	0	1	0
S264	1	2	0	2	0	1	2	0	2	0
S265	2	0	0	0	0	2	0	0	0	0
S266	1	1	0	0	0	1	1	0	0	0
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S268	0	2	1	0	0	0	2	1	0	0
S269	0	0	0	1	0	0	0	0	1	0
S270	2	0	1	1	0	2	0	1	1	0
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S272	0	0	0	1	0	0	0	0	1	0
S273	0	0	0	1	0	0	0	0	1	0
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S275	0	0	1	1	0	0	0	1	1	0
S276	0	0	2	1	0	0	0	2	1	0
S277	0	0	0	1	0	0	0	0	1	0
S278	0	2	0	0	0	0	2	0	0	0
S279	2	0	0	1	0	5	0	0	1	0
S280	0	0	0	1	0	0	0	0	4	0
S281	0	0	1	1	0	0	0	1	1	0
S282	0	0	0	1	0	0	0	0	1	0

S283	0	0	0	1	0	0	0	0	1	0
S284	0	0	0	1	0	0	0	0	1	0
S285	0	0	1	0	0	0	0	1	0	0
S286	0	0	1	0	0	0	0	1	0	0
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S288	0	0	1	0	0	0	0	1	0	0
S289	0	0	1	0	0	0	0	1	0	0
S290	0	0	1	0	0	0	0	1	0	0
S291	2	2	0	0	0	2	2	0	0	0
S292	2	4	0	1	0	3	8	0	1	0
S293	0	1	0	0	0	0	1	0	0	0
S294	0	0	1	0	0	0	0	1	0	0
S295	1	3	5	0	0	1	3	5	0	0
S296	1	1	0	0	0	1	1	0	0	0
S297	0	1	0	0	0	0	1	0	0	0
S298	0	1	0	0	0	0	1	0	0	0
S299	0	1	0	0	0	0	2	0	0	0
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S301	5	5	2	1	0	5	6	2	1	0
S302	0	1	0	0	0	0	1	0	0	0
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S304	0	1	1	0	0	0	1	1	0	0
S305	0	0	1	0	0	0	0	1	0	0
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S307	0	0	1	0	0	0	0	1	0	0
S308	1	0	0	0	0	2	0	0	0	0
S309	1	0	0	0	0	1	0	0	0	0
S310	1	0	0	0	0	1	0	0	0	0
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S314	0	0	0	1	0	0	0	0	1	0
S315	0	0	0	1	0	0	0	0	1	0
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S317	0	0	0	1	0	0	0	0	1	0
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S320	2	1	0	0	0	2	1	0	0	0
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S323	1	0	0	0	0	1	0	0	0	0
S324	1	0	0	0	0	1	0	0	0	0
S325	2	0	0	0	0	2	0	0	0	0
S326	1	0	0	0	0	2	0	0	0	0
S327	2	0	1	0	0	3	0	2	0	0
S328	1	1	0	0	0	1	1	0	0	0
S329	0	1	0	0	0	0	1	0	0	0
S330	0	0	0	1	0	0	0	0	1	0

S331	1	0	1	0	0	1	0	1	0	0
S332	0	0	1	0	0	0	0	1	0	0
S333	0	0	1	0	0	0	0	1	0	0
S334	0	0	1	0	0	0	0	1	0	0
S335	2	1	1	0	0	3	1	1	0	0
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S337	0	1	0	2	0	0	1	0	2	0
S338	0	1	0	0	0	0	1	0	0	0
S339	6	3	0	0	0	8	4	0	0	0
S340	0	1	0	0	0	0	1	0	0	0
S341	0	1	0	0	0	0	1	0	0	0
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S345	0	0	0	1	0	0	0	0	1	0
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S350	0	0	0	1	0	0	0	0	2	0
S351	0	1	1	1	0	0	1	1	1	0
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S353	0	0	0	1	0	0	0	0	2	0
S354	0	0	0	2	0	0	0	0	2	0
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S362	1	0	0	1	0	1	0	0	1	0
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S364	2	0	2	1	0	2	0	3	1	0
S365	0	0	1	1	0	0	0	1	1	0
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S367	0	0	0	1	0	0	0	0	1	0
S368	0	0	0	1	0	0	0	0	1	0
S369	0	0	0	1	0	0	0	0	2	0
S370	0	0	0	1	0	0	0	0	1	0
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S372	0	0	0	1	0	0	0	0	1	0
S373	0	0	1	1	0	0	0	1	1	0
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S376	0	0	2	1	0	0	0	2	1	0
S377	0	0	0	1	0	0	0	0	1	0
S378	0	0	0	1	0	0	0	0	1	0

S379	0	0	1	1	0	0	0	2	1	0
S380	0	0	1	0	0	0	0	1	0	0
S381	0	0	2	0	0	0	0	2	0	0
S382	0	1	0	1	0	0	1	0	1	0
S383	2	1	0	1	0	2	1	0	1	0
S384	0	0	0	1	0	0	0	0	1	0
S385	0	0	0	1	0	0	0	0	1	0
S386	0	1	0	0	0	0	3	0	0	0
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S388	2	1	0	0	0	3	2	0	0	0
S389	0	1	0	0	0	0	1	0	0	0
S390	0	0	1	0	0	0	0	1	0	0
S391	0	1	0	0	0	0	1	0	0	0
S392	0	1	0	0	0	0	1	0	0	0
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S395	0	0	1	1	0	0	0	1	1	0
S396	0	0	1	1	0	0	0	1	2	0
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S400	0	0	0	1	0	0	0	0	2	0
S401	0	0	1	0	0	0	0	1	0	0
S402	1	0	0	0	0	1	0	0	0	0
S403	1	0	0	0	0	1	0	0	0	0
S404	0	0	1	0	0	0	0	2	0	0
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S406	0	0	1	0	0	0	0	1	0	0
S407	0	0	0	1	0	0	0	0	1	0
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S417	0	0	1	1	0	0	0	1	1	0
S418	0	0	1	1	0	0	0	1	1	0
S419	0	0	0	1	0	0	0	0	1	0
S420	0	0	1	1	0	0	0	2	1	0
S421	0	0	0	1	0	0	0	0	1	0
S422	0	0	0	1	0	0	0	0	1	0
S423	0	0	0	1	0	0	0	0	1	0
S424	0	0	0	1	0	0	0	0	2	0
S425	1	0	0	0	0	1	0	0	0	0
S426	0	0	1	0	0	0	0	1	0	0

S427	1	0	2	1	0	1	0	2	1	0
S428	0	0	1	0	0	0	0	1	0	0
S429	0	0	0	2	0	0	0	0	6	0
S430	1	0	0	1	0	1	0	0	1	0
S431	0	0	0	1	0	0	0	0	1	0
S432	0	0	1	0	0	0	0	1	0	0
S433	1	0	0	0	0	1	0	0	0	0
S434	0	0	1	0	0	0	0	1	0	0
S435	1	0	2	0	0	1	0	2	0	0
S436	0	0	1	0	0	0	0	1	0	0
S437	0	0	1	0	0	0	0	1	0	0
S438	0	0	1	0	0	0	0	1	0	0
S439	0	0	1	0	0	0	0	1	0	0
S440	1	0	0	0	0	1	0	0	0	0
S441	1	0	0	0	0	1	0	0	0	0
S442	1	0	1	2	0	1	0	1	3	0
S443	0	0	1	0	0	0	0	1	0	0
S444	0	0	1	0	0	0	0	1	0	0
S445	0	0	1	0	0	0	0	1	0	0
S446	1	1	1	0	0	1	1	1	0	0
S447	1	2	2	0	0	1	2	2	0	0
S448	2	0	0	0	0	2	0	0	0	0
S449	1	0	0	0	0	1	0	0	0	0
S450	3	1	1	0	0	3	2	1	0	0
S451	0	0	0	2	0	0	0	0	2	0
S452	0	0	0	1	0	0	0	0	1	0
S453	1	0	0	0	0	1	0	0	0	0
S454	0	0	1	0	0	0	0	1	0	0
S455	0	0	1	0	0	0	0	1	0	0
S456	1	0	0	0	0	1	0	0	0	0
S457	1	0	0	0	0	2	0	0	0	0
S458	1	0	0	0	0	1	0	0	0	0
S459	0	0	1	0	0	0	0	1	0	0
S460	0	0	1	0	0	0	0	1	0	0
S461	0	0	1	0	0	0	0	1	0	0
S462	0	1	2	1	0	0	1	2	1	0
S463	0	1	0	0	0	0	1	0	0	0
S464	0	1	0	0	0	0	1	0	0	0
S465	0	1	0	0	0	0	2	0	0	0
S466	0	0	0	1	0	0	0	0	1	0
S467	0	0	0	1	0	0	0	0	2	0
S468	0	0	0	2	0	0	0	0	2	0
S469	0	1	0	1	0	0	1	0	1	0
S470	0	0	1	0	0	0	0	3	0	0
S471	0	2	3	0	0	0	2	3	0	0
S472	1	2	1	1	0	1	2	2	1	0
S473	0	0	0	1	0	0	0	0	1	0
S474	0	0	3	0	0	0	0	3	0	0

S475	0	0	0	1	0	0	0	0	1	0
S476	0	0	2	0	0	0	0	2	0	0
S477	0	1	0	0	0	0	1	0	0	0
S478	0	1	0	1	0	0	1	0	1	0
S479	0	0	1	0	0	0	0	1	0	0
S480	0	0	2	0	0	0	0	4	0	0
S481	0	0	1	0	0	0	0	1	0	0
S482	0	0	1	0	0	0	0	1	0	0
S483	0	0	1	0	0	0	0	1	0	0
S484	0	0	2	0	0	0	0	2	0	0
S485	0	0	2	0	0	0	0	3	0	0
S486	0	0	1	0	0	0	0	1	0	0
S487	1	0	0	0	0	2	0	0	0	0
S488	1	0	0	0	0	1	0	0	0	0
S489	0	0	1	1	0	0	0	3	1	0
S490	0	0	2	0	0	0	0	2	0	0
S491	0	0	2	0	0	0	0	2	0	0
S492	0	0	1	0	0	0	0	1	0	0
S493	0	0	1	0	0	0	0	1	0	0
S494	0	0	1	0	0	0	0	1	0	0
S495	0	1	1	0	0	0	1	1	0	0
S496	0	0	1	0	0	0	0	1	0	0
S497	0	0	1	0	0	0	0	1	0	0
S498	0	0	1	0	0	0	0	1	0	0
S499	0	0	1	0	0	0	0	1	0	0
S500	0	0	1	0	0	0	0	1	0	0
S501	0	0	1	0	0	0	0	1	0	0
S502	0	1	0	0	0	0	2	0	0	0
S503	0	1	0	0	0	0	1	0	0	0
S504	0	0	1	0	0	0	0	1	0	0
S505	0	0	1	0	0	0	0	1	0	0
S506	0	0	1	0	0	0	0	2	0	0
S507	1	0	0	0	0	1	0	0	0	0
S508	1	0	0	0	0	1	0	0	0	0
S509	1	0	0	0	0	1	0	0	0	0
S510	6	0	0	0	0	8	0	0	0	0
S511	1	0	0	0	0	2	0	0	0	0
S512	1	0	0	0	0	1	0	0	0	0
S513	1	0	0	0	0	1	0	0	0	0
S514	1	0	0	0	0	1	0	0	0	0
S515	2	1	0	0	0	2	2	0	0	0
S516	1	0	0	0	0	1	0	0	0	0
S517	1	0	0	0	0	1	0	0	0	0
S518	1	0	0	0	0	1	0	0	0	0
S519	0	0	1	0	0	0	0	1	0	0
S520	0	0	1	0	0	0	0	1	0	0
S521	0	1	0	0	0	0	2	0	0	0
S522	1	0	0	0	0	2	0	0	0	0

S523	0	0	1	0	0	0	0	1	0	0
S524	1	0	0	0	0	1	0	0	0	0
S525	1	0	0	1	0	1	0	0	1	0
S526	0	1	0	0	0	0	1	0	0	0
S527	0	1	0	0	0	0	1	0	0	0
S528	1	1	0	0	0	2	1	0	0	0
S529	0	1	0	0	0	0	1	0	0	0
S530	0	1	0	1	0	0	1	0	1	0
S531	0	1	0	1	0	0	1	0	1	0
S532	0	1	0	0	0	0	1	0	0	0
S533	0	1	0	1	0	0	1	0	1	0
S534	0	1	0	0	0	0	1	0	0	0
S535	0	0	0	1	0	0	0	0	2	0
S536	0	0	0	1	0	0	0	0	2	0
S537	0	0	0	1	0	0	0	0	1	0
S538	0	0	0	1	0	0	0	0	2	0
S539	0	0	0	1	0	0	0	0	1	0
S540	0	0	0	1	0	0	0	0	1	0
S541	0	0	0	1	0	0	0	0	1	0
S542	0	0	0	1	0	0	0	0	1	0
S543	0	0	0	1	0	0	0	0	1	0
S544	0	0	0	1	0	0	0	0	1	0
S545	1	0	0	1	0	1	0	0	1	0
S546	0	0	0	1	0	0	0	0	1	0
S547	0	0	0	1	0	0	0	0	1	0
S548	0	0	0	1	0	0	0	0	2	0
S549	1	0	1	1	0	1	0	1	1	0
S550	1	1	0	1	0	2	1	0	1	0
S551	0	0	0	1	0	0	0	0	1	0
S552	0	0	0	1	0	0	0	0	2	0
S553	1	0	0	0	0	1	0	0	0	0
S554	0	1	0	0	0	0	1	0	0	0
S555	3	1	0	0	0	4	1	0	0	0
S556	1	1	0	0	0	1	2	0	0	0
S557	0	1	0	0	0	0	1	0	0	0
S558	0	0	1	0	0	0	0	1	0	0
S559	0	0	1	0	0	0	0	1	0	0
S560	0	2	1	0	0	0	2	1	0	0
S561	0	0	1	0	0	0	0	1	0	0
S562	1	0	0	0	0	1	0	0	0	0
S563	0	1	0	0	0	0	1	0	0	0
S564	0	1	0	0	0	0	1	0	0	0
S565	0	0	1	0	0	0	0	1	0	0
S566	0	1	0	0	0	0	2	0	0	0
S567	0	0	1	0	0	0	0	1	0	0
S568	0	0	1	0	0	0	0	1	0	0
S569	0	0	1	0	0	0	0	1	0	0
S570	2	0	0	0	0	2	0	0	0	0

S571	1	0	0	0	0	1	0	0	0	0
S572	1	0	0	0	0	1	0	0	0	0
S573	1	0	0	0	0	1	0	0	0	0
S574	1	0	0	0	0	1	0	0	0	0
S575	3	0	0	0	0	3	0	0	0	0
S576	1	0	0	0	0	1	0	0	0	0
S577	0	0	0	1	0	0	0	0	1	0
S578	2	1	0	0	0	2	1	0	0	0
S579	1	0	0	0	0	2	0	0	0	0
S580	1	0	0	0	0	1	0	0	0	0
S581	0	1	0	0	0	0	1	0	0	0
S582	0	0	1	0	0	0	0	1	0	0
S583	1	0	0	0	0	1	0	0	0	0
S584	1	0	0	0	0	1	0	0	0	0
S585	1	0	0	0	0	1	0	0	0	0
S586	0	1	0	0	0	0	1	0	0	0
S587	1	0	0	0	0	1	0	0	0	0
S588	1	0	0	0	0	2	0	0	0	0
S589	2	0	1	0	0	2	0	1	0	0
S590	1	0	0	0	0	1	0	0	0	0
S591	1	0	0	0	0	1	0	0	0	0
S592	2	0	0	0	0	4	0	0	0	0
S593	1	0	0	0	0	1	0	0	0	0
S594	1	0	0	0	0	1	0	0	0	0
S595	1	0	0	0	0	1	0	0	0	0
S596	1	0	0	0	0	1	0	0	0	0
S597	1	0	0	0	0	2	0	0	0	0
S598	2	0	0	0	0	2	0	0	0	0
S599	0	1	0	0	0	0	3	0	0	0
S600	3	1	0	0	0	3	1	0	0	0
S601	0	0	1	0	0	0	0	2	0	0
S602	1	0	0	0	0	1	0	0	0	0
S603	1	0	0	0	0	1	0	0	0	0
S604	1	0	0	0	0	1	0	0	0	0
S605	1	0	0	0	0	2	0	0	0	0
S606	1	1	0	0	0	1	1	0	0	0
S607	1	0	0	0	0	1	0	0	0	0
S608	1	0	0	0	0	1	0	0	0	0
S609	1	0	0	0	0	1	0	0	0	0
S610	0	0	1	0	0	0	0	1	0	0
S611	0	0	1	0	0	0	0	1	0	0
S612	1	0	0	0	0	1	0	0	0	0
S613	1	0	0	0	0	1	0	0	0	0
S614	2	0	0	0	0	2	0	0	0	0
S615	0	0	0	1	0	0	0	0	1	0
S616	1	0	0	0	0	1	0	0	0	0
S617	1	0	0	0	0	2	0	0	0	0
S618	1	0	0	0	0	1	0	0	0	0

Appendix I – COLLES results

Student	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
S6	5	3	3	3	5	4	3	4	3	3	4	4
S7	1	1	1	1	5	5	5	5	2	3	2	3
S14	5	1	3	2	3	3	4	4	3	2	1	4
S31	5	5	5	5	5	5	5	5	1	1	1	1
S32	4	3	3	3	4	4	2	4	2	2	2	2
S40	4	1	4	2	4	4	4	4	3	3	2	2
S42	5	1	1	1	3	3	3	5	3	3	3	3
S44	5	2	1	1	4	1	1	3	1	1	1	1
S51	5	5	5	5	3	4	3	3	3	3	3	3
S59	4	1	1	1	5	1	3	5	3	3	3	5
S63	4	2	2	2	4	4	2	4	1	1	1	1
S67	5	3	4	4	4	4	3	5	3	2	2	4
S68	5	1	1	1	4	1	1	1	1	1	1	1
S75	5	3	3	3	4	4	4	4	4	4	4	4
S81	4	3	3	3	4	4	3	4	1	1	1	1
S83	5	1	1	1	5	3	3	5	3	3	3	3
S85	5	1	1	1	2	2	3	2	1	1	1	2
S86	4	1	3	3	3	3	2	1	1	1	1	1
S87	3	4	4	4	4	4	4	4	2	2	2	2
S88	4	4	3	3	4	3	3	4	2	2	2	2
S93	4	3	3	3	5	4	4	3	3	3	3	3
S97	5	2	2	3	3	4	1	5	1	1	1	1
S98	5	3	3	3	5	5	1	4	1	1	1	1
S99	4	1	2	1	2	4	2	2	1	1	1	1
S107	5	1	1	1	5	5	5	5	3	3	3	3
S109	5	1	1	1	4	2	1	3	1	1	1	1
S111	4	2	3	3	3	4	4	4	3	3	3	3
S121	4	3	3	3	5	4	4	4	2	2	1	1
S135	4	5	4	4	4	5	3	4	3	3	1	3
S136	5	1	1	1	5	5	1	5	1	1	1	1
S137	4	4	4	4	3	2	1	1	1	1	1	1
S139	5	4	4	3	4	4	4	4	2	3	2	2
S148	4	3	2	2	4	4	4	4	5	5	5	5
S154	5	1	1	1	5	5	5	5	2	2	2	2
S170	4	1	1	1	4	4	4	4	3	2	2	3
S181	5	1	1	1	4	4	1	4	1	1	1	1
S187	5	1	1	1	5	5	1	5	1	1	1	1
S198	5	3	2	2	5	5	5	5	4	4	4	4
S205	5	2	2	2	5	4	3	3	2	2	2	2
S210	4	3	3	3	5	5	3	4	3	3	1	3
S211	4	3	4	4	4	5	5	5	4	4	2	4
S222	5	1	1	1	4	4	3	3	3	3	3	3
S239	5	3	4	3	5	5	3	5	2	2	2	2

S243	5	3	4	3	4	4	4	4	3	3	3	3
S260	5	5	5	5	5	5	5	5	5	5	5	5
S276	5	4	4	4	5	5	5	5	2	2	2	2
S286	5	2	2	2	5	5	2	3	2	4	3	3
S301	4	1	1	1	4	4	4	4	3	3	3	3
S302	5	2	2	3	3	3	2	2	3	3	2	2
S307	3	4	5	4	4	4	2	3	5	5	5	5
S316	3	1	1	1	3	3	3	2	2	2	2	3
S320	4	3	3	3	2	2	4	1	1	1	1	1
S342	5	5	5	5	4	4	4	4	3	2	2	2
S345	5	5	5	5	5	5	5	5	1	1	1	1
S352	5	4	4	2	5	5	1	5	2	1	1	1
S360	5	4	4	4	5	5	5	5	4	4	4	4
S370	5	5	4	3	4	4	4	5	2	4	3	3
S379	4	4	4	4	5	5	5	5	1	1	1	1
S403	3	2	2	1	1	4	3	3	2	1	1	1
S411	4	2	2	2	3	3	3	3	5	5	5	4
S417	5	1	1	1	3	1	1	1	1	1	1	1
S424	3	5	3	1	4	3	1	3	1	2	3	3
S427	4	2	1	2	5	3	1	4	1	1	1	3
S435	5	3	2	2	5	5	5	5	5	1	1	1
S443	3	1	1	1	2	3	2	3	1	1	1	1
S450	4	4	3	3	4	4	3	2	3	2	2	4
S454	5	2	1	1	4	4	4	4	3	3	2	2
S460	5	4	4	3	4	4	2	4	3	3	1	1
S462	4	5	5	5	5	5	5	5	4	4	4	4
S470	5	3	3	4	5	5	5	5	4	5	5	5
S472	2	2	2	2	4	4	4	4	1	1	1	1
S476	4	3	2	3	4	4	3	4	1	1	1	1
S482	4	1	1	1	3	3	3	5	1	1	1	1
S484	4	3	3	3	4	3	4	3	2	3	3	3
S490	5	3	4	2	4	4	1	2	5	2	5	5
S497	3	4	4	4	5	2	2	3	1	1	3	3
S498	2	2	2	2	4	2	1	1	1	3	3	1
S500	5	3	3	3	4	3	2	5	4	4	1	1
S508	5	3	3	3	5	5	5	5	4	4	4	4
S513	4	2	4	4	4	4	4	4	3	3	3	3
S514	5	3	3	3	5	5	5	5	1	1	1	1
S524	5	1	1	1	5	4	2	4	1	1	1	1
S527	5	2	2	2	3	2	3	4	2	3	2	4
S531	3	3	3	3	3	3	2	3	2	2	2	2
S535	4	5	5	5	5	4	4	5	3	4	3	4
S541	4	5	4	5	3	3	2	4	1	3	2	3
S544	3	3	3	3	3	3	2	2	3	3	3	3
S545	5	2	2	2	5	5	2	5	2	2	3	3
S550	1	2	2	2	3	3	3	3	3	3	3	4
S551	4	4	3	4	3	3	3	4	4	4	4	4

S555	3	1	1	1	4	4	1	1	1	1	1	1
S562	3	1	3	3	5	5	5	5	1	3	1	1
S565	5	5	5	5	5	5	5	5	2	4	1	5
S572	5	3	3	3	5	5	3	4	1	1	1	1
S573	4	5	4	5	3	2	2	2	2	2	3	4
S581	5	5	5	5	5	5	4	5	1	1	1	1
S582	5	3	4	4	5	5	5	5	2	2	1	3
S584	5	3	3	3	4	5	2	5	3	3	3	3
S597	4	1	1	1	4	3	2	4	1	1	1	2
S598	5	5	5	5	5	2	2	2	3	2	2	2
S606	5	3	5	3	4	5	2	5	3	2	2	3
S610	5	5	5	5	3	2	2	2	3	3	2	2
S615	5	2	2	2	5	4	1	1	1	1	1	1
S616	4	3	1	1	3	3	1	1	1	3	3	3

Student	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24
S6	3	3	4	3	4	3	3	4	4	3	4	3
S7	4	3	4	4	3	3	3	3	3	3	3	3
S14	1	1	1	1	1	1	1	1	3	3	1	1
S31	1	1	1	1	1	1	1	1	1	1	1	1
S32	4	4	4	4	2	2	2	2	3	3	3	3
S40	3	3	3	4	2	2	2	2	1	1	1	1
S42	3	3	5	3	3	3	3	3	3	3	3	3
S44	1	1	1	1	1	1	1	1	1	1	1	1
S51	5	5	5	5	3	3	4	4	3	3	3	3
S59	5	4	4	4	3	3	3	4	4	5	4	4
S63	4	4	4	4	1	1	1	1	3	1	3	1
S67	4	3	4	4	3	3	4	5	4	4	4	4
S68	1	1	1	1	1	1	1	1	1	1	1	1
S75	4	4	4	4	5	5	5	5	5	5	5	5
S81	1	1	1	1	1	1	1	1	4	1	1	1
S83	3	3	3	3	3	3	3	3	3	3	3	3
S85	4	5	4	2	1	1	1	1	3	3	4	2
S86	3	1	5	2	1	1	1	1	1	1	1	1
S87	3	4	3	3	1	1	1	1	1	1	1	1
S88	1	1	1	1	1	1	1	1	3	3	1	1
S93	5	5	4	4	5	4	4	5	4	4	5	5
S97	5	5	5	2	2	1	1	4	4	4	4	4
S98	4	4	4	4	1	1	1	1	1	1	3	1
S99	2	2	2	2	1	1	1	1	1	1	1	1
S107	4	4	4	4	4	4	4	4	4	4	4	4
S109	1	1	1	1	1	1	1	1	1	1	1	1
S111	4	4	4	4	4	4	4	5	4	4	4	4
S121	5	2	4	2	1	1	1	1	1	1	1	1
S135	4	4	4	4	3	5	4	5	3	5	3	4
S136	1	1	1	1	1	1	1	1	1	1	1	1
S137	3	3	3	3	1	1	1	1	3	3	4	4

S139	3	3	4	3	4	3	3	1	5	4	5	3
S148	4	4	4	4	3	3	3	3	3	3	3	3
S154	5	5	5	4	1	2	2	3	4	4	4	1
S170	1	1	1	1	2	3	3	3	4	4	1	1
S181	1	1	1	1	1	1	1	1	3	1	1	1
S187	5	5	4	4	1	1	1	1	1	1	4	1
S198	5	5	5	3	5	4	4	4	4	4	4	4
S205	3	3	3	3	3	1	1	3	2	1	3	1
S210	5	4	5	5	3	3	5	5	5	5	5	5
S211	4	4	4	4	4	4	4	4	4	4	4	4
S222	4	4	4	4	4	4	4	4	4	4	5	4
S239	3	3	5	3	2	2	2	4	4	1	4	1
S243	3	3	3	3	4	4	4	3	4	4	3	3
S260	5	5	5	5	5	5	5	5	5	5	5	5
S276	5	5	5	5	2	2	2	2	1	2	3	2
S286	4	5	4	3	3	3	2	4	3	3	4	4
S301	1	1	1	1	3	3	3	3	4	3	1	1
S302	3	3	3	3	2	2	2	2	3	3	3	3
S307	4	5	4	4	1	1	1	1	1	1	3	3
S316	4	5	3	3	4	3	3	4	5	5	5	5
S320	1	1	1	1	1	1	1	1	2	3	3	3
S342	1	1	1	1	1	1	1	1	4	1	2	2
S345	5	5	5	5	1	1	1	1	1	1	4	1
S352	4	4	5	2	4	3	3	5	1	1	1	1
S360	5	5	4	4	5	4	5	3	5	5	4	4
S370	3	5	4	3	3	3	3	3	4	4	3	3
S379	1	1	1	1	1	1	1	1	1	1	5	1
S403	3	5	1	2	3	2	2	1	2	3	4	3
S411	1	1	1	1	1	1	1	1	1	1	1	1
S417	3	5	3	1	4	1	3	4	3	3	3	3
S424	3	5	1	3	3	1	1	1	1	1	3	1
S427	3	2	2	2	4	3	2	3	3	4	2	2
S435	5	5	5	5	1	1	1	1	5	3	5	3
S443	2	2	2	2	2	2	2	2	2	2	2	2
S450	3	4	4	2	1	2	3	3	3	4	4	4
S454	4	4	4	4	2	2	2	2	3	2	3	3
S460	3	1	3	2	2	1	1	1	4	1	5	1
S462	5	5	5	5	5	5	5	5	5	5	5	5
S470	5	5	5	4	5	3	5	4	5	5	5	5
S472	4	4	4	4	2	2	2	2	2	2	2	2
S476	1	1	1	1	1	1	1	1	1	1	1	1
S482	4	4	4	4	2	2	2	3	3	3	4	3
S484	1	1	1	1	1	1	1	1	4	1	1	1
S490	4	4	4	4	3	4	5	3	5	5	5	5
S497	4	4	4	4	2	2	2	3	1	3	5	5
S498	5	5	5	3	1	1	1	1	3	2	4	3
S500	5	5	5	5	5	5	5	5	3	3	5	5

S508	4	4	4	3	3	3	3	2	3	3	4	4
S513	3	3	3	3	3	3	3	3	3	3	3	3
S514	5	5	5	5	1	1	1	1	1	1	1	1
S524	1	1	1	1	2	1	1	2	5	1	5	1
S527	2	2	2	3	3	2	1	1	1	1	1	2
S531	4	4	4	4	2	2	2	2	1	3	4	3
S535	5	5	5	5	4	5	5	5	5	5	5	5
S541	4	4	4	4	2	1	3	5	5	5	5	5
S544	3	4	4	4	4	3	3	4	4	4	4	4
S545	4	4	4	4	3	3	3	3	3	2	4	3
S550	4	5	4	4	4	3	3	4	5	5	5	5
S551	5	5	5	5	5	5	5	5	4	4	4	4
S555	3	4	4	4	1	1	1	1	1	1	4	4
S562	3	3	3	3	3	3	3	3	3	3	3	3
S565	5	5	5	5	5	5	5	5	3	5	3	4
S572	1	1	1	1	1	1	1	1	1	1	1	3
S573	4	4	4	2	2	2	3	3	3	4	4	4
S581	5	5	5	5	1	1	1	1	1	1	1	1
S582	4	3	3	4	3	1	4	4	3	3	4	3
S584	5	5	5	5	3	3	3	3	2	2	5	5
S597	4	4	4	3	3	1	1	1	2	2	3	2
S598	3	3	3	3	2	2	2	2	3	3	4	4
S606	4	3	4	4	2	2	2	1	3	3	4	3
S610	3	4	5	5	1	1	1	1	1	1	1	1
S615	5	5	5	2	1	1	1	1	1	1	1	1
S616	3	4	5	3	3	3	3	4	3	3	4	1

Appendix J – ATTLS results

Student	CK01	CK02	CK03	CK04	CK05	CK06	CK07	CK08	CK09	CK10
S6	5	4	4	2	1	4	2	5	5	4
S7	4	4	3	5	4	5	3	5	5	5
S14	3	3	4	1	5	5	4	4	2	3
S31	3	5	5	2	5	4	5	5	5	5
S32	5	5	5	5	5	5	5	5	5	5
S40	4	5	4	4	5	4	4	4	4	4
S42	4	5	5	3	4	4	4	5	4	2
S44	3	4	5	1	3	1	2	4	3	4
S51	1	4	3	5	4	5	5	3	4	4
S59	2	5	5	1	4	2	5	1	5	5
S63	2	4	3	3	4	2	4	4	4	3
S67	3	4	4	4	3	3	3	4	4	4
S68	2	5	5	2	2	4	3	5	3	4
S75	1	5	5	5	3	5	3	5	3	4
S81	2	5	5	2	5	5	4	4	4	4
S83	3	5	4	2	3	3	4	4	4	4
S85	4	5	5	1	4	3	1	2	5	3
S86	5	5	5	5	5	4	4	4	5	4
S87	1	4	4	1	4	4	4	4	4	4
S88	5	4	3	4	4	4	1	2	4	4
S93	3	5	4	1	3	2	4	3	2	4
S97	5	5	5	3	5	4	2	5	3	5
S98	3	5	5	5	5	5	5	5	5	5
S99	5	5	3	1	2	4	2	2	4	1
S107	4	5	5	4	4	5	3	5	3	4
S109	5	5	5	5	5	4	4	3	4	5
S111	3	4	4	3	4	3	4	5	4	5
S121	1	5	4	1	4	5	4	4	4	4
S135	3	1	1	3	2	2	1	3	2	3
S136	5	5	5	1	5	5	5	5	5	5
S137	4	5	3	2	4	5	2	5	5	4
S139	4	5	5	3	4	4	4	5	3	3
S148	5	5	5	2	3	2	3	2	3	5
S154	5	4	5	4	3	4	2	5	4	5
S170	3	3	4	5	5	3	3	3	5	2
S181	3	5	4	3	5	4	4	5	4	5
S187	5	5	4	5	5	5	4	4	5	4
S198	5	5	5	3	4	4	3	5	5	4
S205	3	3	4	2	4	5	4	4	5	3
S210	3	5	4	3	3	4	3	5	4	4
S211	4	4	1	4	4	4	4	4	4	4
S222	2	4	5	2	3	4	4	5	3	5
S239	2	5	5	3	3	4	5	5	3	5

S243	3	4	4	2	4	3	4	4	4	2
S260	1	5	5	2	2	5	4	5	5	5
S276	2	5	4	2	4	4	2	5	4	5
S286	4	5	3	4	5	4	5	5	5	5
S301	3	5	5	3	4	4	4	4	4	4
S302	3	4	4	2	4	3	4	4	3	4
S307	5	5	5	4	3	4	5	5	3	4
S316	3	5	3	3	3	3	4	4	4	5
S320	3	4	5	4	5	4	3	4	4	4
S342	4	5	5	4	4	4	4	4	4	5
S345	4	4	4	4	4	4	4	4	4	4
S352	3	3	3	3	3	4	3	3	4	3
S360	3	5	5	2	5	5	4	4	5	3
S370	5	5	4	4	4	4	5	5	4	3
S379	4	5	5	5	5	5	5	5	5	5
S403	4	5	4	1	4	1	3	1	5	3
S411	5	5	4	2	2	5	3	5	5	4
S417	4	4	4	2	3	2	3	4	3	4
S424	3	5	5	3	5	4	4	5	3	4
S427	5	4	3	3	4	4	1	4	4	5
S435	3	4	5	4	4	4	5	4	5	4
S443	5	4	4	3	2	3	3	5	4	4
S450	4	5	3	2	3	4	2	2	3	3
S454	3	5	3	2	3	4	5	4	4	3
S460	3	4	3	5	5	3	4	2	5	5
S462	5	5	5	4	5	5	4	5	5	5
S470	5	5	5	3	4	3	3	5	3	5
S472	3	1	2	3	1	2	1	1	2	2
S476	4	5	5	4	3	3	3	5	3	5
S482	2	5	5	2	3	4	4	5	3	4
S484	4	4	4	2	4	4	4	4	5	3
S490	3	5	5	1	4	5	4	5	5	5
S497	2	5	5	1	4	2	4	5	1	5
S498	1	5	5	1	1	1	4	3	4	2
S500	5	5	5	5	4	4	1	4	5	3
S508	3	5	4	1	4	4	5	4	4	3
S513	3	3	3	3	3	3	3	3	3	3
S514	4	4	3	2	4	4	3	4	4	4
S524	3	4	2	2	4	5	4	2	5	2
S527	4	1	1	2	2	2	2	4	2	2
S531	4	4	4	2	4	4	4	4	5	4
S535	3	2	3	4	5	4	4	4	5	4
S541	3	3	5	3	3	3	3	3	3	3
S544	2	5	4	2	4	2	4	3	4	4
S545	4	4	4	2	4	4	4	3	5	4
S550	5	5	5	5	5	4	4	5	4	5
S551	3	5	5	3	3	4	4	4	3	4

S555	1	4	4	2	4	3	4	3	2	4
S562	1	5	2	5	3	1	2	2	2	4
S565	5	5	5	4	3	5	5	5	3	5
S572	3	5	4	3	3	4	5	5	2	4
S573	4	5	4	3	4	4	3	4	4	4
S581	5	5	4	5	5	5	5	1	5	1
S582	1	5	5	2	5	5	5	5	5	5
S584	3	4	4	1	5	4	5	3	4	4
S597	3	4	4	2	4	3	4	4	4	3
S598	5	5	5	5	5	5	5	5	5	5
S606	4	6	5	4	6	5	3	6	6	6
S610	2	4	4	2	4	4	5	4	4	4
S615	5	5	5	5	5	5	4	5	4	5
S616	4	5	4	3	5	4	4	5	4	5

Student	SK01	SK02	SK03	SK04	SK05	SK06	SK07	SK08	SK09	SK10
S6	4	2	5	4	5	2	5	4	5	5
S7	5	5	5	5	3	5	3	3	4	5
S14	4	4	4	4	4	3	2	2	3	3
S31	2	5	5	4	5	4	5	1	5	5
S32	5	5	4	4	5	5	5	4	5	5
S40	5	4	4	4	4	3	4	5	5	5
S42	4	3	5	4	5	3	5	3	4	5
S44	1	3	4	1	3	1	5	4	4	4
S51	5	5	2	4	2	5	3	1	4	4
S59	3	4	5	5	5	5	4	1	5	5
S63	4	4	4	4	4	4	5	3	4	4
S67	5	4	4	3	3	2	4	2	3	4
S68	4	4	4	2	4	4	4	4	3	2
S75	4	5	5	5	5	5	5	3	5	4
S81	4	5	5	3	5	4	5	4	4	4
S83	5	4	3	3	4	3	4	2	4	4
S85	4	3	2	5	3	4	4	4	4	3
S86	1	4	4	4	5	4	5	3	5	5
S87	4	4	4	2	4	4	4	1	4	4
S88	3	3	3	4	1	3	4	1	1	3
S93	2	4	4	2	3	2	5	3	4	3
S97	4	4	5	5	4	4	5	5	5	5
S98	5	5	5	5	3	5	5	4	5	5
S99	4	3	2	3	2	4	3	1	3	4
S107	4	3	5	4	5	4	5	5	5	3
S109	4	4	5	5	5	3	5	5	5	5
S111	3	4	5	3	4	4	4	3	4	4
S121	5	4	4	4	4	3	5	1	4	4
S135	2	2	1	1	2	1	3	2	2	3
S136	5	5	3	5	3	5	5	1	5	5
S137	5	4	4	2	2	4	5	4	3	5

S139	4	4	5	4	4	4	5	5	5	4
S148	4	4	5	5	5	3	4	2	5	5
S154	4	3	5	5	3	3	5	5	5	2
S170	4	3	3	4	2	3	4	4	2	4
S181	4	4	5	4	3	5	4	3	3	4
S187	5	4	4	5	4	4	5	5	5	5
S198	5	4	5	4	5	4	5	4	5	5
S205	4	2	3	4	1	4	4	2	4	4
S210	5	3	3	4	3	4	4	3	4	4
S211	3	4	3	4	4	4	1	3	3	1
S222	4	3	5	3	4	4	4	1	4	2
S239	4	5	5	3	5	4	5	3	4	4
S243	3	4	4	2	2	3	3	3	3	4
S260	4	4	5	2	4	4	4	2	4	5
S276	4	3	4	4	2	4	4	1	1	3
S286	4	5	5	4	5	3	4	4	4	5
S301	2	4	4	2	5	3	3	2	4	4
S302	4	3	3	3	4	2	4	2	4	3
S307	4	4	5	4	5	4	5	3	5	4
S316	4	4	4	3	2	3	3	2	3	4
S320	2	5	5	3	5	3	5	2	4	4
S342	5	4	5	4	5	4	5	1	5	5
S345	4	4	4	4	4	4	4	2	4	4
S352	3	3	3	3	3	4	3	3	3	3
S360	4	5	4	2	4	2	5	3	4	4
S370	4	4	4	4	4	4	4	3	4	4
S379	5	5	5	4	3	5	5	4	5	5
S403	4	5	5	2	5	5	3	1	1	5
S411	4	3	5	4	4	2	4	5	3	5
S417	4	4	3	4	4	3	4	4	4	2
S424	3	4	4	3	4	4	5	4	5	5
S427	5	3	2	5	2	3	3	3	1	5
S435	3	5	4	4	3	5	4	2	4	5
S443	3	3	3	4	3	4	3	3	4	2
S450	1	3	1	3	2	1	3	1	4	4
S454	3	5	5	3	4	4	3	3	4	3
S460	5	3	4	3	3	4	5	5	3	4
S462	5	4	5	5	5	5	5	4	4	5
S470	5	3	4	5	5	4	5	4	5	5
S472	1	2	1	2	1	2	2	3	1	1
S476	5	3	5	4	5	4	5	4	5	4
S482	3	3	5	4	5	3	5	2	5	4
S484	4	5	4	4	3	4	4	5	3	4
S490	3	5	5	5	5	4	5	1	4	3
S497	1	5	5	1	4	1	5	1	5	5
S498	1	4	4	1	3	2	5	1	1	5
S500	4	3	5	5	1	2	3	4	4	5

S508	4	5	2	3	4	4	3	2	4	4
S513	3	3	3	3	3	3	3	3	3	3
S514	5	4	4	3	4	4	3	3	4	3
S524	5	3	2	4	1	5	3	3	2	4
S527	3	2	4	2	2	3	2	1	2	2
S531	2	5	4	4	4	4	4	2	5	5
S535	4	5	5	4	3	3	4	3	4	4
S541	3	3	3	3	3	3	3	3	5	3
S544	3	4	4	2	4	3	4	2	4	5
S545	5	3	4	4	4	4	4	5	4	4
S550	5	5	5	4	5	4	5	3	5	4
S551	4	4	4	2	4	3	5	3	4	4
S555	3	4	4	4	4	3	4	1	4	4
S562	5	2	2	3	4	4	5	5	2	4
S565	5	5	5	4	5	3	5	1	5	5
S572	4	3	4	3	3	2	4	4	3	4
S573	3	5	4	3	4	4	4	3	5	5
S581	5	5	1	1	2	1	5	5	5	3
S582	5	5	5	4	5	5	5	3	4	5
S584	4	4	4	3	4	3	3	1	4	4
S597	3	4	4	4	4	3	4	4	5	4
S598	5	5	5	5	5	5	5	5	5	5
S606	5	5	6	5	3	6	3	4	5	5
S610	1	4	4	2	3	3	2	2	3	4
S615	5	5	5	4	3	5	5	5	5	5
S616	3	5	4	4	2	3	4	3	2	5

Glossary

Attitudes Towards Thinking and Learning Survey (ATTLS): A survey that seeks to measure the quality of discourse within a course.

Computer Aided Language Learning (CALL): Any kind of language learning activity that makes use of computers.

Computer Assisted Language Testing (CALT): An integrated procedure in which language performance is elicited and assessed with the help of a computer.

Computer Mediated Communication (CMC): the process by which people create, exchange, and perceive information using networked telecommunications systems (or non-networked computers) that facilitate encoding, transmitting, and decoding messages.

Constructivist On-Line Learning Environment Survey (COLLES): A survey that asks the students about the relevance of a course, opportunities for reflection and interactivity, peer and tutor support and interpretation.

Distance Learning: A planned teaching/learning experience that uses a wide spectrum of technologies to reach learners at a distance and is designed to encourage learner interaction and certification of learning.

Distributed Constructionism (DC): An extension of the constructionism theory to knowledge building communities, where the online learning community (instead of one student) collaborately construct knowledge artifacts.

Ethnography: The branch of anthropology that provides scientific description of individual human societies.

Human Computer Interaction (HCI): The study, planning and design of what happens when humans interact with computers.

Intelligent computer Assisted Language Learning (ICALL): The exploration of the use of Artificial Intelligence methods and techniques for language learning.

Online Communities: Social aggregations that emerge from the Net when enough people carry on those public discussions long enough, with sufficient human feeling, to form webs of personal relationships in cyberspace.

Participatory Design (PD): A design approach that focuses on the intended user of a service or product, and advocates the active involvement of users throughout the design process.

Pedagogy: The activities and theory of education or instructing or teaching.

Social Network Analysis (SNA): The mapping and measuring of relationships and flows between people, groups, organizations, computers or other information/knowledge processing entities. SNA glossary follows:

Bridge: A link in a network that if deleted along with any incident nodes, increase the number of connected components.

Centrality: Measures who is central (powerful) or isolated in networks.

Clique: A maximal complete subgraph of three or more nodes consisting of a subset of nodes which are adjacent to each other, and there are no other nodes in the network that are also adjacent to all of the members of the clique.

Cutpoint: A node that if deleted along with any incident links, increases the number of connected nodes.

Density: The number of actual ties in a network compare to the total amount of ties that the network can theoretically support.

Dependency: Measures how student *i* is dependent to student *j* when going to other nodes and is computed by the in betweenness centrality's process.

Distance: The number of actors that information has to pass through to connect the one actor with another in the network.

Ego network: Consists of a focal node and a set of alter nodes adjacent to or from the focal node.

Ego-net size: The number of nodes that are adjacent to or from a focal node.

Equivalence of the network members: When two actors have similar patterns of relations.

Geodesic distance: The length of shortest path between two nodes.

In-degree: The number of lines that are incident to a node.

Inclusiveness: The number of connected points expressed as a proportion of the total number of points.

Isolates: Nodes whose degree equals 0.

Link connectivity: The minimum number of links that must be removed to make the network disconnected.

Local role: Calculated using Winship and Mandel's measure which states that nodes *i* and *j* are more role equivalent if the collection of ways in which actor i relates to others is more the same as the collection of ways in which actor j relates to others.

Nodes: The actors or subjects of study.

Out-degree: The number of lines that are incident from a node.

Reachable nodes: If a path exists between two nodes they are said to be reachable.

Regular equivalence: When two nodes have the same profile of ties with members of other sets of actors that are regularly equivalent, then they are themselves regularly equivalent.

Relations: The strands between actors. They are characterized by content, direction and strength.

Structural equivalence: Analyzes the role-set structure of a network based on the similarity of tie-profiles among its nodes and is computed by the Euclidean distance of tie-value from and to all other nodes.

Topic Relation Analysis (TRA): A model for grouping CMC posts into meaningful categories.

User-centered design: User-centered design puts the user into the center of the software design process.

Videoconferencing: The use of multimedia elements, digital cameras and microphones to capture video and sound and transmit it live real time to other users who will receive it using their display units and speakers.

Web-based training (WBT): Anywhere, anytime instruction delivered over the Internet or a corporate intranet to learners.

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