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The Application of Network Analysis to the Study of Differentially Effective Schools.

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THE APPLICATION OF
NETWORK ANALYSIS
TO THE STUDY OF
DIFFERENTIALLY EFFECTIVE SCHOOLS

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Administrative and Foundational Services

by
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August 1996

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This dissertation is dedicated to John, Christopher, and Margaret Ann, the three most precious links I will ever have.

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Abstract

This study applied network analysis to the exploration of the structural characteristics of differentially effective elementary schools within the framework of school effectiveness research. The study took place in two parts: a Pilot Study, using archived data, and a Field Study, using data from a stratified sample of differentially effective schools.

The Centrality-Cohesiveness Model of School Effectiveness, developed through the Pilot Study, defined a communication structure as a function of the leadership status of the principal (defined by the principal's centrality) and the cohesiveness of the faculty (defined as network density).

Quantitative results from both the Pilot Study and the Field Study indicated that there are mean differences in the leadership position of the principal within differentially effective faculty networks. Three of six comparisons were significantly different at the $p < .05$ level on one measure of centrality, one measure of centralization and one measure of density. In addition, sociograms from both studies fit the expected patterns within the defined Centrality - Cohesiveness Model.

These results indicate that there are differential characteristics to the patterns of communication in differentially effective schools. Principals in effective schools are more often indicated as leaders than principals in ineffective schools. There was no indication that there are differences in differentially effective networks being more central around one individual. Both classifications of networks appear to be centered the same, but there are significant differences in who is the most central individual.

The results of this study support the conclusion that the properties of faculty network that can be observed and illustrated graphically, may not have the statistical or measurement parameters adequately defined as yet. The results of this study support further definitions of effectiveness within a network perspective and the exploration of a set of structural parameters within which effectiveness seems most likely to operate.

This study initiated one structural conceptualization of school faculties and the results: (a) provide direction for the refinement of this conceptualization (b) support the hypothesis that differentially effective schools have different structural configurations and (c) indicate that though these differential configurations are observable, they are complex and contextual in nature.

Chapter One: Area of Concern

*No man is an island, entire of itself;
Every man is a piece of the continent,
a part of the main. (Romans 14:7)*

Relationships are our connections with others. People engage in a complexity of relationships within a variety of arrangements classified as families, friends, social groups, work groups, acquaintances, and communities. The structure of our daily lives is woven with the connections and paths we have to others.

How we identify ourselves and are perceived by others is often associated with our political and religious affiliations, our occupational choices, our kinship ties, and our social relationships. We are born into families, connect to support groups, foster personal relationships, organize committees, live in neighborhoods, work in bureaucracies, fit into hierarchical chains of command, and participate in informal "grapevines" of communication. Our relationships range from the contractual to the accidental, from the purposeful to the unanticipated.

In addition to the multitudinous varieties of function and formality, our interactions with others can also be categorized by size. Though all interactions begin with "two," the diversity of our direct and indirect links to others ranges from these personal dyads to entire nation-states.

This study explored the relationships formed by elementary school faculties, working as small group. Faculties, though not often framed in a "small group" context, possess the characteristics that connect them to small group theory: interaction between members: (a) particular group size parameters; (b) a shared purpose, goal or task to accomplish; (c) differential positions, roles or member

behaviors; and (d) incentives to remain in the group (Levine & Moreland, 1990; Luft, 1984; Mills, 1967).

A rich history of research on small groups has included exploring what Mullen (1986) calls "critical elements" or Levine and Moreland (1990) describe as "aspects" of small groups. Categories of critical elements include: (a) member categorizations and group composition variables (Levine & Moreland, 1990; Mullen 1986); (b) the intangible and tangible personal rewards for belonging (Mullen, 1986); (c) the individual's need for interdependence, interaction and influence within the group setting (Mullen, 1986); (d) the ecology, or physical and social environments, and stages of group development, or "temporal environments" (Levine & Moreland, 1990, p. 590); (e) status systems, norms and roles (Levine & Moreland, 1990); (f) conflict paradigms such as social dilemmas, power tactics, bargaining, coalition formation, and majority and minority influence (Levine & Moreland, 1990); and (g) performance aspects such as leadership formation, productivity and decision-making (Levine & Moreland, 1990).

The sorting, enumerating, describing and explaining of these elements forms the basis for research agendas in disciplines such as anthropology, education, psychology, medicine, economics, political science, business, and sociology. The methodologies repeatedly concentrate on "attribute analysis" (Knoke & Kuklinski, 1982; Laumann, Marsden, & Prensky, 1989; Wellman, 1988). Attribute analysis is characterized by the "individual" as the unit of analysis and "traits" or "behavior" as the variable under investigation (Freeman, 1989; Rogers & Kincaid, 1981).

Of considerable extent and significance, research investigations about small groups, small group characteristics, and small group membership encompass a

breadth of interests within attribute categories, such as: (a) delineating the characteristics of primary and secondary groups (b) studying the effects of working conditions such as temperature, lighting, and space on productivity (Oldham & Rotchford, 1983); (c) identifying and defining the characteristics of support groups (Cohen & Syme, 1985; Vaux, 1988); and (d) distinguishing the stages and characteristics associated with group development (Bennis & Shephard, 1956, 1974; Caple, 1978; Tuckman, 1965).

School effectiveness and school improvement research has also operated exclusively within this tradition. Most SESI research has concentrated on delineating and describing the characteristics of differentially effective schools through studies such as: (a) Reitzug's (1989) investigation of principal-teacher interactions in instructionally effective and ordinary elementary schools; or (b) studies that have focused on the association of strong principal leadership with school effectiveness (Hallinger & Murphy, 1986; Teddlie & Stringfield, 1993); or (c) those that have investigated the relationship of a school's organizational culture to the organizational characteristics associated with effectiveness (Cheng, 1993).

Two key assumptions underlie this research tradition: (a) the independence assumed between the units studied and (b) the differential or correlational nature of explanation. In other words, the attitudes, characteristics and/or behavior of one unit studied is not influenced by any other unit being studied, and what is important are the differences in the attitudes, characteristics and/or behaviors of each unit, or the relation of the variables studied to other characteristics (Wasserman & Faust, 1994).

In contrast, this study shifted the perspective from attributes associated with school faculties to an investigation of school faculties as entities. Although groups

are composed of individual members and their unique attributes, groups also possess an identity singular in composition (Burt, 1982; Knoke & Kuklinski, 1982; Mills, 1967; Moreno, 1934). The individual links representing a specific relationship from one individual to another, form a network containing both these ties to others and, through absence, our non-ties. The network then becomes another unit of analysis.

Network analysis is the methodology used for exploring these relationships within the context of a network (Freeman, White, & Romney (Eds.), 1989; Hage & Harary, 1983; Knoke & Kuklinski, 1982; Laumann & Pappi, 1973; Marsden, 1990; Rogers & Kincaid, 1981; Scott, 1992; Wasserman & Faust, 1994; Wasserman & Galaskiewicz (Eds.), 1994). The symmetry, the transitivity and the strength of the link between two individuals can be measured within specific contextual and empirical frameworks. The purpose of this study was to apply network analysis to the study of the communication structures of elementary school faculties within the framework of school effectiveness research. Chapter One describes the formation of the research design generated through the process of linking network analysis methodology with the research questions identified in prior school effectiveness and school improvement research.

Background

Network analysis is a paradigm for identifying and exploring the structures formed in networks occurring both formally and informally, and can also be used for discerning the similarities, differences or the relationship between the two (Burt, 1982; Freeman, 1989; Hage & Harary, 1983; Knoke & Kuklinski, 1982; Rogers & Kincaid, 1981; Scott, 1991; Wasserman & Galaskiewicz (Eds.), 1994). Structure is

the pattern formed by a network consisting of ties and non-ties. The combined connections from group member to member have been described as interrelations (Moreno, 1934); webs (Simmel, 1955); nets (Kochan, 1989); and, more recently, networks (Burt & Minor, 1983; Freeman, White, & Romney (Eds.), 1989; Hage & Harary, 1983; Knoke & Kuklinski, 1982; Scott, 1991; Wellman & Berkowitz, 1988). Though the network is composed of the individual links connecting two, three or more individuals, the network whole is considered greater than the sum of its parts. Social structure conceptualizes this group parameter. Social structure conceptualizes the internal patterns of the relationships in a network.

Formally defined group structures are explicitly stated and recorded by job titles, contracts, work charts, evaluation procedures, and through management and financial control (McPhee, 1985). Formally defined groups . . . "are established on the basis of rationality, logic, and efficiency . . ." (Rogers, 1975, p. 118).

Informally defined structures occur from the selection of conversation partners, social choices, peer affiliations and from the multitude of ways we interact with other individuals. In groups, such as schools, formally defined structures may (a) correspond to the informal network structures that are constructed as individuals interact informally within formal boundaries; (b) may be a barrier to informal interactions that could exist within a group defined by formal structures; or (c) may be different from the informal interactions that develop within formal parameters.

Both the identification and the analysis of the structure of relationships within groups have been the subject of inquiry since the early 1930's. The importance of the structure of a group was first noted by pioneers such as J. L. Moreno in sociology

and by A. R. Radcliffe-Browne in anthropology. Moreno (1934) was the first to develop a basic methodology, known as sociometrics, for conceptualizing this group structure. Radcliffe-Browne was one of the first to conceptualize structure and to suggest the need for a separate theoretical and methodological "branch of natural science" (Radcliffe-Browne, 1959, p. 190) for exploring social structure.

Current social network analysis methodological procedures and techniques result from the convergence of several influences. These include the work of Beum and Brundage in sociometrics (1950); Festinger (1949), Forsyth and Katz (1946), Katz (1947, 1950, 1953), and Luce and Perry (1949) on the analysis of sociometric data using matrix techniques; Bavelas (1948) on understanding the mathematical models of group structures; and Hage and Harary (1983), Harary (1969), Harary, Norman, & Cartwright (1965), Lorrain and White (1971), Everett, Boyd & Borgatti (1990) in the fields of mathematics, graph theory and graph theoretic applications. Basic structural concepts such as isolates, cliques, density, and centrality were identified in the early traditions (Bales, 1950; Lindzey & Borgatta, 1954) while equivalences and blockmodels are the results of relatively more recent investigations (Arabie, Boorman, & Levitt, 1978; Burt, 1982; Doreian, Batagelj, & Gerligoj, 1994; Lorrain & White 1971).

During the 1970's, attention to the development of network analysis reemerged, after about a 30 year "incubation", with the advancement of computer based analysis techniques (Bonanich, 1972; Borgotti & Everett, 1989; Breiger, 1988, 1991; Burt, 1982; Freeman, 1979, 1988; Freeman, Roeder, & Mulholland, 1980). In conjunction with the advancement of the methodology, applications of network

analysis have also been diverse, as illustrated by (a) the research of Laumann and Pappi (1976) on community elites; (b) Bolland and Wilson's (1994) investigations of inter-organizational relationships in health and human services organizations; (c) research on social support networks (Barrera, Sandler, & Ramsay, 1981; Vaux, 1988); (d) the diffusion of family planning methods in Korean villages (Rogers & Kincaid, 1981); (e) the exponential application in HIV/AIDS research (Bond & Valente, 1996; Klovdahl, McGrady, Liebow, Aalegria, Lovely, Mann & Mueller, 1996; Wright & Myers, 1996); (f) communication research (Rogers & Kincaid, 1981); (g) political networks (Mizruchi & Potts, 1996; Mardon, 1996); (h) social influence (Burt & Uchiyama, 1989; Friedkin & Johnsen, 1990); and (i) even the Supreme Court (Han & Breiger, 1996).

Historically, the development of computer based analysis, built on complex algebraic, matrix, and/or graph theoretic models addressed the need to mathematically quantify and represent the structural conceptualizations of networks. Network analysis is unique to other statistical procedures for describing and explaining the characteristics, the differences and the associations between data in that "It cannot be solved by the incremental accretion of information, observation by observation, as [many] other statistical problems are. Rather it requires an overview of an entire structure" (Rogers & Kincaid, 1981, p. 71). The characteristics of network analysis, or what Wellman (1988) refers to as Structural Analysis, that guide inquiry are:

1. The focus is on the structural constraints and not on internal group forces.
2. Analysis is focused on relations, not categories of attributes.

3. Analysis is focused on the pattern of relationships among the network and not the accumulation of member relationships.

4. Structure may be partitioned into discrete groups.

Though some computer procedures for doing network analysis incorporate algorithms used in more traditional data analysis procedures such as factor analysis and multidimensional scaling, the differences are in the purpose for the analysis, the conceptualization of the data, and the incorporation of the results of the analysis.

The development of the computer assisted analysis has led to major advances and insights in understanding the properties of structural components. However, this understanding has often been in advance of a corresponding theory explaining network structure. This means that: (a) the clarification, delineation, and explanation of the structural components (such as isolates, dyads, wheels, and chains) which describe the patterns found in networks: (b) the structural and mathematical relationships of the components to each other; and (c) the algorithms for identifying these structural components have preceded a theory about what those components mean or tell us about the network structures being investigated (Holland & Leinhardt, 1979; Rogers, 1987). The complexity of the methodology and the diversity of the applications have provided a beginning theory of social structure (Freeman, 1989), but this theory is far from complete. The origin of this complexity and diversity can be illustrated by the major design components of the methodology (a) the line(s) of inquiry, (b) the context(s) of the structure, and (c) the level(s) of analysis.

There are three primary lines of investigation with social network analysis: (a) the total structure, (b) the subsets formed within the total group structure, and (c) the

"points". "vertices", "nodes" or individuals who comprise the network (Burt, 1982; Knoke & Kuklinski, 1982; Rogers & Kincaid, 1981). In other words, the parts making up the whole, either individually or in clusters, and/or the entire network can be the statistical unit of analysis. The contextual relationships explored through network analysis have included power structures, social support networks, communication networks, friendship networks, diffusion networks, kinship networks, corporate networks, community elites, and exchange networks.

Additionally, Cartwright and Harary (1979) identified seven levels of empirical structures (cognitive elements; persons; social roles and positions; groups and organizations; nations; tasks; and variables). The "context" of a structure (the conceptual and theoretical framework) crossed with these empirical structures (levels of analysis) form a matrix (see Table 1.1., p. 11) for sorting the variety of research agendas that have been explored or are possible to explore.

The identical tools (structural components and the mathematical algorithms) and lines of investigation (network, subgroups or points) are employed to describe and define the parameters of each of the empirical structures within the context of one or more theoretical structures. In other words, the tools of network analysis and the lines of investigation can be applied within each cell of the matrix formed by theory and level of analysis. In addition, within a specific study, it is common to explore multiple lines of investigation with multiple tools. Social network analysis

...seek[s] to describe networks of relations as fully as possible, tease out the prominent patterns in such networks, trace the flow of resources through them, and discover what effects they have on individuals who are or are not connected into them in specific ways. (Wellman & Berkowitz, 1988).

The resulting information is used to study the fit between the structure of the network and the theory explaining the behavior of the individuals forming the network (Wellman & Berkowitz, 1988). Historically, and in fact contingent upon this research agenda, the process of network analysis has included matching or linking the theoretical perspective from which the group is viewed with the appropriate network conceptualization, through structural explanations. This means linking through the research design: (a) the fit of the theoretical foundation for the study and the structural parameters and structural explanations, and (b) exploring the empirical foundations for the structural explanations. Network analysis is, therefore, more than an application of technique and procedure; it is also a process of linking or matching a conceptual framework with a structural framework. As Blau (1975) noted:

social structure refers to the patterns discernible in social life, the regularities observed, the configurations detected. But the nature of the patterns and shapes one can recognize in the welter of human experience depends on one's perspective (p. 3).

This exploratory study followed these philosophical and methodological traditions. This study explored networks on two levels, within a communication context. The level of the faculty as a group was explored through an investigation of faculty cohesiveness, based on the total structure of the network. The position of the principal was explored through a quantitative investigation of principal centrality within the total network and a qualitative analysis of faculty sociograms, using a subset of the total network. (The levels of analysis and the lines of inquiry for the study are indicated in Table 1.1.) In addition, an important contribution of exploratory research can be to focus on variables that have as yet not been fully defined or explained, but that have been shown through prior empirical research to

be important components of the theoretical framework within which the study is set. In this study the theoretical perspective explored was the communication structures of differentially effective school faculties.

The purpose of this study, which was conducted in two parts, was to apply network analysis methodology to the study of the communication structures of elementary school faculties within the framework of school effectiveness research.

Table 1.1.

Network Analysis Methodological Framework

LEVELS OF ANALYSIS	CONTEXT OF THE STRUCTURE: <u>COMMUNICATION</u> , POWER, EXCHANGE, SUPPORT, KINSHIP, FRIENDSHIP, DIFFUSION, ETC.		
	LINES OF INVESTIGATION		
	Total Structure	Subsets	Individuals
cognitive elements			
persons			
social roles and positions	principal	principal	principal
groups and organizations	school faculties	school faculties	
nations			
tasks			
variables			

Problem to be Studied

Nowhere has the importance of the communication structure of a group been so acutely apparent and so obviously overlooked as in school faculties. The cumulative results of both school effectiveness research and school improvement research (SESI) suggest two propositions that support the investigation of the communication networks of school faculties.

1. Schooling is a complex interactive social process which is, conceptually, a structural model of interactions between and within components and not an additive model of specific components. This is the core even though schooling is comprised of individual components such as resources, teachers, students, activities, and outcomes and is influenced by contextual variables and situations.

2. Many of the characteristics of the components associated with effective schools describe relationships or the results of relationships associated with communication structures. Identified in this study were those characteristics associated with the principal's leadership status within the faculty and faculty cohesiveness. These characteristics were defined as the structural indicators of a communication network.

Continuing with this rationale from a network perspective, this study investigated these structural indicators within the context of an interactive process model of schooling and not as attributes or characteristics (correlates) of differentially effective faculties.

Though past and current research has continued to support the concept of correlates that can distinguish between schools that are more and less effective, the concentration on isolated characteristics has not been an adequate explanation for why some schools are more effective than others (Scheerens, 1993; Slater & Teddlie, 1992). Levine and Lezotte (1990) noted this deficiency related to the original correlates in their monograph on effective schools:

It is necessary to move from what research indicates takes place to measures of a process within which these characteristics function. Not school effects - outcomes - but a school's effectiveness - the ability to produce desired outcomes - the effects.

Correlates of school effectiveness may not necessarily portray the variables that make some schools unusually effective, but instead may themselves be the product of unspecified processes, actions, and characteristics that lead both to higher achievement and to high scores on correlates dealing with variables such as climate, leadership and expectations. (p. 3)

Substantial empirical evidence supports the perspective of schooling as a holistic process not the adjusted sum of individual parts (resources, leadership, teachers, and students) (Chauvin & Ellett, 1994; Good and Brophy, 1986; Scheerens, 1993; Slater and Teddlie, 1992; Teddlie and Stringfield, 1993). Current investigators suggest incorporating this shift from investigating effects to investigating the nature and parameters of the process of schooling (Slater & Teddlie, 1992) within more complex research models that also respond to and lead to theory development (Ellett, et al., 1994; Scheerens, 1993).

The accumulation of evidence suggests that the road to effectiveness is not a sequential set of specific instructions and components for school faculties to clone, but rather should be a more global, comprehensive, interactive model of processes that explains how schools achieve their desired outcomes. A comprehensive model of an effective school provides a framework that: (a) identifies the essential elements or components associated with effectiveness, (b) defines the processes associated with effectiveness and (c) categorizes the specific characteristics of effective schools within the context of these identified components and processes (Hallinger & Murphy, 1986; Joyce, 1990; Lezotte, 1982; Murphy, Weil, Hallinger & Mitman, 1985; Scheerens & Creemers, 1989a, 1989b); Scheerens, 1993; Teddlie and Stringfield, 1993).

One such theoretical model of effective schooling is Slater and Teddlie's (1992) Typology of School Effectiveness and Leadership Model (TSEL). The TSEL

model (see Appendix A) defines effective schooling as a process in which schools move through stages of improvement or decline. The TSEL model incorporates three components: (a) management and leadership at the school level, (b) faculty preparedness at the classroom level, and (c) student readiness on an individual level. One element of the interactive nature of this model takes place among the three levels, which Slater and Teddlie define as the contextual nature of the schooling process.

Slater and Teddlie also explain the process of schooling as having both structure and culture. Structure, in the TSEL model, is defined in terms of hierarchical organizational patterns or differential groups, and culture as "shared orientations and beliefs" (p. 247). Although it is a fine line, the theoretical perspective of social structure utilized as the foundation for this study, differentiates "social structure" defined as empirical conditions (Blau, 1974), from "social structure" defined as social differentiation, or the aggregation of member attributes or behaviors, and from the "structure" associated with the rules and procedures by which groups operate (Luft, 1970). However, a second element of an interactive schooling process suggested by the Slater and Teddlie model is the explanation of school structure as the result of "The network of social interactions . . ." (p. 247). This explanation intuitively suggests a move from "attribute analysis" to a study of the relationships formed by these social interactions. Laumann, Marsden, and Prensky (1989, p. 62) note this fine line in "structural definition", and quoting Laumann (1979), clarify the role of network analysis:

Whether used as a basis for analyzing the structure of social systems or as a means of discovering the interaction-based group membership of actors, the eventual intent of network-analysis "is to explain, at least

in part, the behavior of network elements . . . and of the system as a whole by appeal to specific features of the interconnections among the elements" (Laumann, 1979, p. 394).

The purpose of this study was to explore the structural characteristics of elementary school faculties as suggested by the components and the interactive nature of the Slater - Teddlie model. Exploring the structure, or the patterns of social interactions, of faculties is one perspective for organizing the complex tangle of findings from the school effectiveness and school improvement traditions. Related research traditions such as organizational effectiveness and organizational communication (Halpin, 1966; Kreps, 1990; McPhee, 1985) have provided further support for exploring the structure of the group, suggesting that: "The structure of the group determines the way a group functions and this determines the outcomes for the group members." (Krevelde, 1970, p. 1).

Social structure describes the internal organizational patterns within which the processes operate. Structure, though stable, is not static and consequently also responds to the dynamics occurring from group processes. The structure of a group therefore provides both a static picture of a group at a point in time and a way to systematically measure stability and changes over time.

Applying network analysis to the structural characteristics of schools based on an interactive schooling model, within a school effectiveness research agenda, contributes to, supports and expands an emerging theory of schooling as a complex interactive system in three ways. First, there is a fit between conceptualizing schooling as an interactive process and network analysis as a methodology appropriate for exploring interactive processes. Models currently in development.

such as the TSEL model, explain schooling as a complex interactive process, leaving behind a definition of schooling as an input - output production function equation.

The TSEL model directs attention to the importance of the relationships between the components comprising the model. Although, in this study, network analysis was not applied at this level, the view of effectiveness resulting from the interactive nature of multiple components and processes supports a move from "attribute analysis" to a methodological approach that has the potential to explore this aspect of the interactive nature of schooling.

Second, theoretical models of the schooling process, such as the TSEL Model, include components that are particularly appropriate for exploration through a network analysis perspective. One such component that suggests a network approach is the position of the principal as a leader within a faculty group; the second component is the conceptualization of the faculty working together as a group. This, again, supports a different methodological approach and it is at this level that this study applied network analysis.

And third, two of the aims of theoretical models of schooling are to (a) pursue answers to prior concerns and (b) integrate previous findings resulting from prior school effectiveness and school improvement research. One particular concern that is appropriate within a network analysis perspective is with the contextual nature of effectiveness. Teddlie, Stringfield, Wimpelberg and Kirby (1989) have asked two questions related to the contextual differences of schools:

1. Are the characteristics that define an effective school in one context the same as those found in other contexts?

2. Are the techniques that produce an effective school in one context the same in another (p. 126)?

School effectiveness research has identified context in terms of the socioeconomic status of students or their parents (SES) variables, grade level variables, and urbanicity (Slater & Teddlie, 1992; Teddlie & Stringfield, 1993; Wimpelberg, Teddlie, & Stringfield, 1989).

Adding to the complexity of the "contextual framework", Slater and Teddlie (1992) define each component within levels of the TSEL model as "contextual" in the sense that effectiveness results from the unique interactions that take place within each school and not from the accumulation of specific attributes or characteristics. Both dimensions of context augment the importance of developing a schooling process model. Both "contextual" orientations emphasize the need for a comprehensive, conceptual framework that can accommodate the activities, behaviors, and processes associated with contextual differences but which can also be organized into more globally defined components. In other words, contextual variables may not be individual components of a schooling model, but may work within the framework of a model (Levine, 1992; Slater & Teddlie, 1992).

4. Network analysis has not been applied to the study of differentially effective faculties and this study is an important addition to the methodology.

Previous Empirical Research

To date, there have been few empirical research studies that have specifically explored the social structures of school faculties with the application of network analysis. Most applications of network analysis have been classroom applications of

sociometric measures focusing on the relationships of the children within classrooms. An extensive literature search located only two related studies that have specifically addressed the principal's leadership, within the context of an advice network, with the application of network analysis. Slater (1991) investigated leadership, social networks and school performance in effective and higher performing schools. He found that high performing elementary schools communicate about instructional matters rather than friendship orientated matters, and that the structural patterns found include minimal hierarchial patterns and dense, flat webs. Friedkin and Slater (1994) explored principal leadership within the context of professional egalitarianism with advice networks and found support for the association between the principals' role and school performance. They define principals as leaders who have a formally defined role and competence which is acknowledged by teachers. Leadership, however, functions within the constraints of a teacher culture such that principals are theorized to have influence within a narrow band of teacher activities.

Another noted application of network analysis was a school evaluation study by Teddlie and Kochan (1991). Teddlie and Kochan employed a sociogram to illustrate the partitioning of a dysfunctional faculty. The sociogram used in the Teddlie and Kochan evaluation illustrated very compellingly (See [Figure 1.1](#)) the division among faculty members that the evaluation found.

Though the application of network analysis to the investigations of school faculties is unique, combining leadership and cohesion variables in a model of organizational effectiveness is not. Kelly and Duran (1985) measured leadership and

cohesiveness as dimensions of group effectiveness. Past research has defined interaction generally as "discussion", which has been operationalized and measured as verbal and nonverbal behaviors, procedural acts, frequency of volunteering, frequency of communication acts, the quality of the content of interactions, and leadership influence. The literature Kelly and Duran reviewed supported continued investigations on the relationship between group interactions and group effectiveness in this tradition.

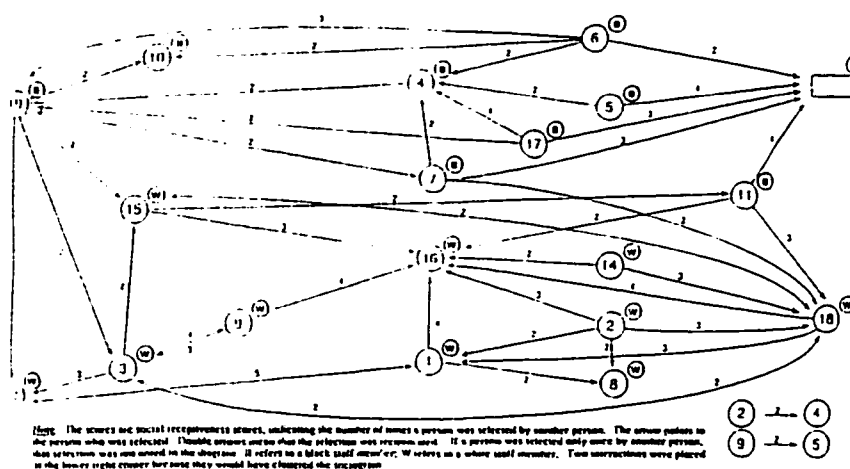


Figure 1.1. Teddlie-Kochan Evaluation Sociogram¹

In their study, building on their own past research, Kelly and Duran (1985) explored the relationship between group effectiveness and the members' perceptions of the group. They examined the members' perceptions to identify distinguishing configurations (leadership and cohesiveness) of the group, using the Adjective Rating Method on the three dimensions of SYMLOG. SYMLOG is A System for the Multiple Level Observation of Groups and was developed by Bales and Cohen (1979). The groups were formed from intact classes of college students and

Note. From Evaluation of a troubled high school: Methods, results, and implications by C. Teddlie and S. Kochan, 1991, Paper presented at the annual meeting of the American Educational Research Association, April 3-7, 1991, Chicago, Illinois. Reprinted by permission.

effectiveness was defined as grades on an oral and written report. Their results suggest that there are differences between effective and ineffective groups in the identification of a leader and in the cohesiveness of the group, based on the members' perceptions of the group. They report that effective groups have a cohesive configuration, all members tend to participate, and there is a clear task leader who emerges early on in the group formation process. They found that what seemed to differentiate between levels of effectiveness was the presence of this leader. Ineffective groups on the other hand were either very cohesive with no leader, or were factional with no leader. The results of their study, reported as descriptive, and with limitations of a small sample size (7 groups) and concern about group categorization methods, were consistent and continue to support further research to identify group interaction variables that are related to group effectiveness.

Keyton and Springton (1990) replicated and extended the Kelly and Duran study (1985) with students enrolled in 10 sections of a small group communications course. Students self-selected into groups in each section, with three to seven members in each group. The measure of effectiveness was similar to the Kelly and Duran study, a class assignment. SYMLOG was also used as the measure of cohesion, with two other instruments used to establish construct validity.

Through five levels of analysis, Keyton and Springton did not find the same results as Kelly and Duran, a significant relationship between effectiveness and cohesiveness combined with leadership. From their results they do suggest that cohesiveness alone does not account for group effectiveness. They did not explore the role of leadership in their study. Both studies, though combining related theoretical perspectives, are still confined to measuring attributes of variables.

The Slater (1991), the Friedkin and Slater (1994), the Kelly and Duran (1985), and the Keyton and Springton (1990) studies illustrate the exploratory nature of both the conceptual definition of this research perspective (the association of leadership and group cohesiveness and the impact of this association on a group's effectiveness, and particularly school faculties as small groups) and the methodological application (the study of relationships through network analysis). Though the study of leadership characteristics has been a traditional research theme across a broad expanse of disciplines, the combination of the research perspectives illustrated by these studies with the application of network methodology is an emerging agenda.

The implications both from SESI research and limited prior research are that effectiveness: (a) results from complex interactions (b) can sometimes be delineated and defined from specific variables, but (c) has not been fully explored and explained. This study was the first application of network analysis to the study of the faculties of differentially effective schools.

Purpose of Study

Accumulated school effectiveness research has underscored how a school's level of effectiveness is associated with the characteristics of the social structure of the faculty, specifically the communication structure of the faculty. However, the avenues for applying this information have not been previously utilized. Network analysis has the potential for providing information on (a) the actors and their positions within a social structure and (b) the social structure of the organization itself. Examining the social structure of school faculties through the "dualistic

quality" (Knoke & Kuklinski, 1982, p. 10) of the network analysis window is important for three reasons:

1. Social structure removes the individual from the locus of investigation and focuses on the faculty as a group. Though the variation among individuals (measured by variables such as the theoretical orientation of principals) has been shown to be important, network analysis focuses on the relationships of individuals, such as the principal, to the structure of the group. A network perspective emphasizes model components instead of a list of the attributes, behaviors, or characteristics of individuals engaged in the processes. Applying this new methodology to school effectiveness research shifts the attention to the schooling process. A network perspective does not assume or imply that there are no connections between the attributes of individuals and the relationships formed, but within the context of this study, provides a larger framework for understanding this relationship.

2. The results from network analysis can add to the existing body of school effectiveness knowledge. This includes: (a) knowledge about the sociometric characteristics of effective schools, (b) an understanding of faculty social structures, and (c) an understanding of the contributions faculties make to the effectiveness level of a school. (Scheerens, 1993).

3. Network analysis can be an important methodological instrument for future school effectiveness and school improvement research in two ways. First, if schools are constantly in the process of changing, either getting better or worse, as suggested by the TSEL model, then the capability to longitudinally track the network structure of the group over time is an important research tool (Doreian, 1986; Scheerens.

1993). Secondly, network analysis provides a measurement framework that can sustain the shift from outputs and effects to components and processes that are necessary as researchers search to redefine the operational definitions of an effective school.

To date most definitions of effectiveness have been linked to student achievement, retention rates, or rate of student absenteeism, which channels the focus from the processes that produce high achievement and positions it only on an end result of schooling, often with conflicting conclusions (Levine, 1992). The real research question, though, is whether a particular faculty can function (within the definition of an interactive process model) in a way that produces high student achievement. Scheerens (1993) describes this as rephrasing the problem to "how can a schoolleader realize school effectiveness" (p. 31). The measurement questions then become (a) how can researchers move the measure of effectiveness closer to the variable under investigation (the schooling process) and (b) how can researchers define measures in terms that can then inform the processes and components of a model of effective schooling within which faculty work. Network analysis provides an avenue for the exploration of these questions.

Research Goals

There is strong evidence from school effectiveness and school improvement research supporting three structural conceptualizations of differentially effective schools. These are:

1. Differentially effective elementary schools appear to have different structural configurations.

2. Specific communication patterns identified through behavioral and activity characteristics of faculties appear to be associated with particular structural configurations.

3. The leadership of the principal appears to be an important component for achieving effectiveness within a structural framework.

This study defined the communication structure of elementary schools and explored this structure through the application of network analysis in a two part process.

1. The goal of Part I was to develop a Centrality - Cohesiveness Structural Model representative of the structural characteristics of differentially effective schools.

2. The Goal of Part II was to test the Centrality - Cohesiveness Model.

Definitions

Centrality - Cohesiveness Model

This study hypothesized that the communication structure of the faculty is positively associated with the effectiveness level of a school (defined as higher than expected student level achievement). To test this hypothesis, a structural model depicting levels of differentially effective schools was developed. (The complete description of the development and testing of this model is found in Chapter Four, p. 81. A brief summary is provided here.) The Centrality-Cohesiveness Model of School Effectiveness defined a communication structure as two network parameters. This structural model begins to illustrate the complex, interactive nature of the schooling process and includes components which appear, from extant SESI research,

to be important, but which have not individually provided a clear picture related to effectiveness. The communication structure of a school was defined as a function of the leadership status of the principal (defined by the principal's centrality) and the cohesiveness of the faculty (defined as network density). The two parameters, the principal's centrality and the cohesiveness of the group were ranked as "High" or "Low". The two indicators were arranged in a matrix with the leadership status aligned on the left and the cohesiveness variable across the top. There were then four classifications, within the four cells of the matrix: high leadership with high cohesiveness (HH), high leadership with low cohesiveness (HL), low leadership with high cohesiveness (LH), and low leadership with low cohesiveness, (LL).

Additionally, it was anticipated that the structural configurations of the faculty networks (as illustrated by sociograms) would be different for each classification. It was also anticipated that there would be differences in the sociograms attributable to formal organizational configurations such as (a) the presence or absence of assistant principals, (b) curriculum supervisors, and (c) grade chairpersons. Slater and Teddlie (1992) hypothesized that there are eight stages of school effectiveness ranging from most effective to most ineffective. Guided by (a) the Slater Teddlie TSEL model, (b) the vast amount of qualitative descriptions on the characteristics of effective and ineffective schools, and (c) the specific findings from the Louisiana School Effectiveness Study (LSES) (Teddlie & Stringfield 1993), six definitions for the structural representations (sociograms) were developed. The six definitions seem to capture both the differential characteristics of schools as suggested in the literature, and to accommodate for the variety of formally defined organizational configurations

found in elementary schools. The differences in configurations within cells indicate that though faculties may behave alike, the structural configurations may vary within certain boundaries (Scheerens, 1993).

The definitions for the principal's leadership status and the group's cohesiveness characteristic on the six expected sociograms patterns are (the uppercase initials represent high or low principal status and high or low cohesiveness):

Type 1. (HH) The principal is the only identifiable leader in a hierarchical chain of command, with high faculty cohesiveness.

Type 2. (HH) The principal is the only identifiable leader within one highly cohesive group.

Type 3. (HL) The principal is an identifiable leader with low faculty cohesiveness.

Type 4. (LH) The principal is not an identifiable leader, there is an identifiable rival, with high faculty cohesiveness.

Type 5. (LH) There is no identifiable leader, with high faculty cohesiveness.

Type 6. (LL) There is no identifiable leader and low faculty cohesiveness.

Faculties with high principal centrality and high faculty cohesiveness were hypothesized to have a Type 1 or a Type 2 structure. (Type 1 accounts for a more formal hierarchical leadership authority structure with defined grade leaders, or a leader authorized and supported by the principal). Faculties with high principal centrality and low faculty cohesiveness were hypothesized to have a Type 3 structure. Faculties with low principal centrality and high cohesiveness were

hypothesized to have a Type 4 or 5 structure and faculties with low principal centrality and low faculty cohesiveness were hypothesized to have a Type 6 structure.

Table 1.2. illustrates the Centrality - Cohesiveness Model of School Effectiveness, including the hypothesized sociogram types in each cell. The definitions for each indicator, the leadership of the principal and the cohesiveness of the faculty, are described in detail in Chapter Two.

Centrality

The communication structure of a school is theorized to be a function of the leadership position of the principal and the cohesiveness of the faculty. Within this model, the leadership is defined as "a group process in which an individual, in a given situation, is able to direct and control group interaction more influentially than any other group member" (Palazzolo, 1981, p. 213). The principal's leadership was measured by how central the position of the principal was within the network.

Table 1.2.

The Centrality - Cohesiveness Model of School Effectiveness

		FACULTY COHESIVENESS	
		HIGH	LOW
PRINCIPAL LEADERSHIP	HIGH	HH (Types 1 or 2)	HL (Type 3)
	LOW	LH (Types 4 or 5)	LL (Type 6)

Centrality describes the status, power or popularity of an individual within a group. A central principal would be strategically located and could connect with the other members of the network to strategically control and direct communication. In

Part I, three measures of centrality were tested to determine if any one communication strategy seemed to best differentiate between levels of effective schools. Based on the Pilot Study, centrality was then operationalized in Part II as the popularity of the principal, or the number of connections faculty indicated they had to the principal and was measured by the Freeman's normalized indegree centrality (Freeman, 1979). A second measure, Freeman's normalized betweenness was also calculated.

Network Cohesiveness

Network cohesiveness describes the overall connectedness of the members of the group to each other. Network cohesiveness in this study was determined by a measure of network density, defined as the proportion of links actually made by faculty to each other out of the total links for the network that are possible.

Hypotheses and Questions

Hypothesis One

Principals of effective schools will be more central to the leadership of the school than principals of ineffective schools as measured by their centrality scores.

Question One

Are there more rivals for positions of leadership in ineffective schools than in effective schools as measured by centrality score ranks?

Question Two

Can effective schools be differentiated and characterized by a Type 1 or 2 configuration; ineffective schools by Types 3, 5, or 6 configurations; and changing schools by Types 4 or 5 configuration?

Question Three

Do faculties of effective schools form a more cohesive group than faculties of ineffective schools as measured by overall group cohesiveness scores?

Summary

The following chapters describe the details of this study. Chapter Two is a literature review. Chapter Three details the research design and methodology, Chapter Four describes the Centrality - Cohesiveness Model and the Pilot Study. Chapter Five contains the analysis of the sociograms for Part II, the Field Study, Chapter Six contains the combined results of the analysis for the Pilot and Field Studies. Chapter Seven is the Results, Suggestions for Future Research and Conclusions.

Chapter Two: Review of Literature

Introduction

Two themes were merged within this study to build a foundation for the research questions and for the methodology applied. The first was the conceptualization of schools as social institutions. This perception guided (a) the definitions for leadership and faculty cohesiveness, and (b) the choice of methodology. The second theme was understanding schooling as a complex and interactive process. This perception guided the exploration of the variables within the context of a schooling process model, and also supported the selection of the methodology.

Schools, at their very core, are social institutions engaged in a complex and interactive process. On the basis of this perspective, this study related the research traditions of school effectiveness and school improvement to the study of the communication structure of a small group through the application of network analysis. A "social" viewpoint meant exploring the structure of specific communication interactions, or relationships. This study explored two propositions related to the communication interactions of school faculties, generated from school effectiveness and school improvement research:

1. Schooling is a complex interactive social process which is, conceptually, a structural model of interactions between and within components and not an additive model of specific components. This is the core even though schooling is comprised of individual components such as resources, teachers, students, activities, and outcomes and is influenced by contextual variables and situations.

2. Many of the components associated with effective schools describe relationships or the results of relationships associated with communication structures. Identified in this study were those characteristics associated with the principal's leadership status within the faculty and faculty cohesiveness. These components were defined as the structural indicators of a communication network.

Two areas of literature were reviewed:

1. School effectiveness and school improvement research related to: (a) the development of school effectiveness models and (b) the two structural indicators of effective schooling utilized within this study.

2. Communication theory as the framework for conceptualizing the two structural indicators.

School Effectiveness and School Improvement Research

Two areas of school effectiveness and school improvement literature were reviewed. In the first section the literature related to the development of theoretical models of effective schools was reviewed. The second section defines the two structural parameters utilized in this study as indicators of a communication structure: the principal's leadership status and the cohesiveness of the faculty.

Model Development

The deficiency of a theory explaining schooling processes has been a predominant and consistent conclusion of school effectiveness and school improvement (SESI) research. This deficiency has been noted by a diversity of researchers, both in the United States and elsewhere. School effectiveness research has always, according to Mortimore (1991), been a search "... to measure the quality

of the school." (p. 214). The debate has been about what constitutes quality and how to measure it. Mortimore has suggested that it is time to pull together the results from the SESI research tradition and the procedure for accomplishing this is through theory and model development. Mortimore describes theory development as a more narrow focus on suggestive components and processes which could be part of an interactive process model.

Scheerens (1993) has described the prior and current status of SESI research as "applied" research which has resulted in "...uncertainties concerning the analytic delineation and empirical basis of school effectiveness." (p. 23) and has diagnosed the necessity for both "foundational" and "fundamental" studies. Theory formation and model building are aspects of fundamental research.

Slater and Teddlie (1992) have clearly noted this "impoverishment" of a theoretical foundation for school effectiveness and leadership. Their Typology of School Effectiveness and Leadership Model (TSEL) addresses theory formation through the conceptualization of a differentially effective schooling and leadership model.

Though there is no consensus on a definitive model, there is little doubt that some schools are different from others and that these schools also exhibit higher student achievement test scores. This has its foundation in common sense, what Lezotte (1982) calls sensible or "face validity" and is identifiable. This intuitive evaluation of schooling coincides with the more "quantitative" and "qualitative" results of school effectiveness research and school improvement applications.

The history of SESI theory and model development has been twofold. In one sense, SESI theory and model development has been a response to find order within

the seemingly jumbled clutter of SESI findings. In another sense, theory and model development are the next sequential stages of SESI research. Model building provides the means of making sense out of the vast and often conflicting results of past research. Theory and model development have occurred as researchers endeavored to incorporate the findings from extant research that were often conflicting, unclear, or contextual. The complexity of SESI findings have epitomized the necessity to: first, refine how school effectiveness is conceptualized; and second to delineate at what levels a school might be effective. In other words schooling is a complex, multilevel process.

Levine (1992) has suggested that theory and model development should (a) account for how the various levels of schooling (student, teacher, school) interact and impact student achievement and (b) be within the context of a larger comprehensive theory on the schooling process. Model development, therefore, pushes the focus of research within the SESI tradition from describing the nature of the schooling process as a linear, additive model towards investigating schooling within a larger interactive schooling process model.

As a sequential stage of SESI research, two specific aspects resulting from previous SESI research have influenced current and future investigations: first, the consensus that schooling is complex; and second, that schooling is contextual in nature. Theory and model development move the SESI tradition from a stage of describing the characteristics of schools that seem to have the "ability to promote the average academic achievement of the students they serve" (Good & Brophy, 1986, p. 57) towards more comprehensive explanations of the school effectiveness process.

The complexity of the schooling process stands out, illustrated by a chronology of correlational and case study research on school effectiveness which has provided a rationale and substantial evidence to propose that a school's level of effectiveness is related to multiple factors (Good & Brophy, 1986; Levine & Lezotte, 1990; Levine, 1993; Murphy, Weil, Hallinger, & Mitman, 1985; Purkey & Smith, 1983; Sergiovanni, 1991; Teddlie & Stringfield, 1993). Research which has focused on the attributes that seem to delineate between differentially effective schools has been a critical step in the development of comprehensive schooling models. As a result of this focus, the dimensions of effectiveness that have been identified and, though somewhat conflicting, form the basis for identifying (a) the components of conceptual frameworks and (b) the underlying characteristics of these components.

Schooling is contextual. Current debates, discussions and reviews resulting from school effectiveness research and school improvement efforts continue to highlight the contextual environment of the schooling process and the need to better define a comprehensive framework or model that allows for contextual differences such as socioeconomic status of the parents, parents' educational level and leadership style of the principal. A comprehensive model of an effective school provides a framework that unifies the components, delineates the processes and defines the characteristics of effective schools within an overall structure (Hallinger & Murphy, 1986; Joyce, 1990; Lezotte, 1982; Murphy, Weil, Hallinger & Mitman, 1985; Scheerens & Creemers, 1989a, 1989b; Teddlie & Stringfield 1993).

The sequential aspect of the theory and model building of school effectiveness and school improvement has generally moved through two stages and is

into a third. During the first stage of school effectiveness research, school effectiveness investigations focused on input-output linear relationships based on the assumption that inputs (generally resources) directly affected outputs (i.e. student achievement) in an additive manner (e.g., Madaus, Airasian, & Kellaghan, 1980). The methodology focused on understanding and explaining those variables that seemed to be associated with the inputs.

The second stage is distinguished by a concentration on understanding how schools are or become effective. This phase of research resulted in the generation of correlates associated with effective schools and has been extensively reviewed (Good & Brophy, 1986; Levine & Lezotte, 1990; Purkey & Smith, 1983; Murphy et al., 1985). Though the number of correlates varied according to the variables investigated, the five included in the five factor model (Edmonds, 1979) have received the most attention and have been supported by others. These correlates are:

1. Strong educational leadership.
2. High expectations of student achievement.
3. Emphasis on basic skills.
4. A safe and orderly climate.
5. Frequent evaluation of pupils' progress.

During this stage, in the process of understanding the schooling process, the correlates themselves were referred to as a conceptual framework for effective schools (Hallinger & Murphy, 1986; Lezotte, 1982). On the application side, school improvement plans often included the correlates as key components, and some plans implemented in a literal manner the correlates as prescriptions for improving

schooling and thus increasing achievement. Additionally some school improvement plans focused on one specific correlate such as instructional leadership (Brookover et al., 1984; Clark & McCarthy, 1983; Joyce, 1990; Joyce, Hersh & McKibben, 1983). (The use of the correlates continues to be the focus of many plans, such as the State Department of Education School Effectiveness Project in Alabama). The correlates are a set (Levine, 1992) and not a shopping list. As D'Amico (1982) noted, the correlates did not provided a recipe for specific roads to effectiveness, but were probably the result of other processes.

In the sequential development of theory and model building, the correlates and other characteristics have provided extensive details which formed a beginning paradigm about differentially effective schools. Cumulative results have also lent support to studying the social structure of schools because the correlates and other descriptions of differentially schools taken together, described processes, behaviors, activities or products that are characteristics of differentially successful groups. These have included processes such as a problem solving orientation, activities such as frequent monitoring of student progress, and products (often the results of processes and activities), such as high expectations, group norms, consensus, a spirit of collegiality and "high" achievement. However, without a theoretical framework and a corresponding model, these characteristics remained attributes associated with effectiveness, but not a process for effecting successful schooling. Sergiovanni (1991) emphasized:

Lists of effectiveness characteristics, such as proposed by knowledgeable researchers remain useful if viewed as general indicators. They are not so much truths to be applied uniformly, but

understandings that can help principals and others make more informed decisions about what to do and how in improving schools. (p. 91).

Models and theories of schooling processes provide a framework within which these indicators can be organized.

During the most recent and current phase, the third phase of school effectiveness theory and model development, the effort has been on identifying and/or explaining: (a) the structures and processes contained in a conceptual model which relate to the characteristics associated with effective schools (often the correlates), (b) the interpretations for explaining how these descriptions or characteristics might contribute to the effectiveness of schooling, and (c) the conceptual structures for organizing the framework based on theories from disciplines such as organizational effectiveness and leadership. The development of conceptual models has been a process of moving from the descriptions and explanations of the numbers and perceptions towards theories of social dynamics.

Components of school effectiveness conceptual frameworks vary. Murphy, Weil, Hallinger, and Mitman (1985) have produced a framework consisting of 14 variables which they have arranged in a relationship "between environment and technology." Environmental variables consist of what are commonly called "climate" and technology, which includes curriculum and instruction variables. The Slater-Teddlie model, which was utilized within this study, provides a typology of school effectiveness leadership as a beginning theoretical model of school effectiveness. Slater and Teddlie (1992) describe effectiveness as the combination and interaction of three elements: management and leadership, faculty preparedness, and student

learning readiness. Effectiveness is determined by the interaction that takes place between the three "levels" of the schooling process. Coleman and Collinge (1991) build a model of effective schools from a political systems view, configured as a web, described as a political sub-system, and composed of external and internal influence variables. Four classes of influence variables (administrative, professional, societal and familiar) affect the classroom, placed at the core of the web. Other authors (Creemers, 1991; Glasman and Biniaminov, 1981, Murphy, Weil, Hallinger & Mitman, 1982; Reynolds & Reid, 1985; Scheerens & Creemers, 1989a, 1989b) have also conceptualized models of comprehensive school effectiveness processes or indicated components of conceptual models.

Models provide a framework for organizing and making sense out of the accumulation of information on effective schools. Though each model uniquely describes the schooling process, three components across models stand out: interaction, principal leadership, and faculty cohesiveness. These three concepts formed the foundation for the propositions developed for this study about the structure of effective schools. The next section defines the structural indicators - the leadership of the principal and faculty cohesiveness.

Structural Indicators of Effective Schools

Theoretical models which describe schooling as an interactive process highlight the importance of the group in attaining effectiveness. Structure is the internal organization of the patterns of relationships within a group. This study identified two structural indicators or components of organizational patterns: (a) the leadership position of the principal within the faculty and (b) the conceptualization of the faculty working as a cohesive group.

Principal leadership.

Leadership, as defined in this study is "a group process in which an individual, in a given situation, is able to direct and control group interaction in a more influential way than any other group member" (Palazzolo, 1981, p. 213).

"Strong leadership" has consistently been associated with effective schools (Beck & Murphy 1993; Chauvin, & Ellett, 1994; Cheng, 1993; Hoy & Miskel, 1982; Levine & Lezotte, 1990; Murphy, 1988; Stringfield & Teddlie, 1988; Teddlie & Stringfield, 1993). Cumulative SESI research has indicated a differential nature to the principal's leadership characteristics and behaviors, and leads to the supposition that the (a) communication structure of a school faculty, and (b) position of the leader within the faculty network structure, for differentially effective schools, may also be conceptually different (Teddlie & Stringfield, 1993).

Assumptions for this perspective are centered around two aspects of communication. First, communication is a key to attaining group goals and second individuals hold differential positions within the network structure which have strategic communication characteristics (Freeman, 1979). Bonacich (1990) notes:

... occupants of different positions may have different incentives to behave cooperatively (by communicating freely) or competitively (by withholding information from other network positions) (p. 449).

Within the context of an effective school, this means that the principal is located in a strategic position for accumulating and disseminating information. This model (though similar to other models of communication such as those that relate position and the distribution of power within networks and models that focus on the relationship between personality traits and network position) makes an assumption

about the importance of the group goal(s) as a reason for communication, which other models do not.

There are other explanations for how leadership functions within a group such as those based on social influence (Marsden & Friedkin, 1993). Influence ... "links the structure of social relations to attitudes and behaviors of the actors who compose a network" (p. 127). The leadership behavior/activities of the principal are conceptualized as focused towards attaining specific goals. Leadership, as conceptualized in this study, is defined as being able to motivate, or influence the faculty so that a more cohesive group forms around the focus of attaining those goals. This definition of leadership could also be conceptualized as a dimension of communication power, which is one aspect of activities related to focusing goals.

This study did not define or explore the purpose of communication or the content of communication events. What the principal is trying to accomplish through his/her leadership is defined as contextual in nature and beyond the scope of this study. Principals may be trying to motivate, control, influence, persuade, force, delegate to, hamper, or assist their faculties towards attaining specific goals. If the actions of the principal fit with the leadership needs of the faculty, as a group, the principal's relationship to the faculty will identify him/her as a leader, within the structure of that group. Within this context, it would be reasonable to assume that principals of school classified as ineffective, might also be identified as leaders. However, for this study, built within the parameters of a differentially effective schooling model, it was expected that there would be identifiable differences in the patterns and location of principals in differentially effective schools.

Historically, school effectiveness (SE) and school improvement (SI) research have focused on variables such as the principal's leadership style or the principal's influence on climate to explain how this leadership component contributes to the effectiveness level of a school. Principals have been defined as: instructional leaders (Jackson, Logsdon, & Taylor, 1983; Smith & Andrews, 1989); change agents (Chauvin & Ellett, 1994); strategic coordinators (Goldring & Pasternack, 1994); initiators, risk-takers and mavericks (Teddle & Stringfield, 1993); managers (Ubben & Hughes, 1992); or facilitators (Chauvin & Ellett, 1994). Principals build alliances, pull it all together, and/or provide support to faculty. Principals have been described as directing the action, protecting their "turf", and as working within the system or flying on their own. In the context of this study, the orientation of leadership and the specific behavioral attributes of a principal are considered contextual in nature. In this study, principals are successful leaders if: (a) there is a identifiable principal-teacher communication interaction, and (b) a communication path and/or pathways through which the leader can be identified by his position in the network. Within the context of an effective school, this means that the principal is located in a strategic position for accumulating and disseminating information throughout the entire faculty.

Leadership is also more than who talks the most. Prior research indicates that the principal's leadership status within a faculty communication structure, illustrated by position within the network structure, is based on both the authority of the individual to have that position and other parameters, such as acceptance. Fernandez (1991) supports the complexity of understanding leadership and suggested that

though there are no exact definitions of leadership, "leadership is understood most clearly as a particular form of power or influence over other actors, grounded in legitimate authority" (p. 36). He also notes that "The structural approach consistently has show that individuals with the greatest control over communication tend to be viewed as leaders by other group members" (p. 37). Friedkin and Slater (1994) found that principals are perceived as leaders when they have both this formal authority and when their competence is acknowledged by teachers.

Levine and Lezotte (1990) found that although other individuals can and sometimes do provide leadership within schools, the majority of studies identify the principal "as the most critical leadership determinant of effectiveness" (p. 16). Others in the network may be identified in positions of leadership based on their connections to the group. Within the definitions of this study, these individuals should also be connected to the principal. In other words, the principal should be connected to those other individuals who are most connected to the less connected in the network. This makes sense in schools where there are grade leaders, committees, and other forms of hierarchial management structures. Shared leadership, or "leadership density", which is defined as "...the extent to which leadership roles are shared and leadership itself is broadly based and exercised" within an organization (Sergiovanni, 1991, p. 136) may therefore reflect: (a) a level of leadership development within the context of group development, (b) a situational and contextual leadership type, (c) a hierarchial structure or (d) a combination of any of the above. Shared leadership, in the context of this study, describes a structural pattern that could be observed from the network parameters. (Though understanding

the specific contextual variables within the school would be necessary in order to verify a specific structural definition for a school.)

From a structural perspective, a principal's location in and path through a faculty network indicate the principal's position of status. Defined in this manner, leadership does not take place in isolation from the context of the group and as such is conceptually aligned with the concept of schooling as an interactive process model. The principal is a leader if he/she can be identified as a leader in the structure of the network. The connotation is that there is a match between the kind of leader the principal may be and the leadership needs of the faculty.

Cumulative school effectiveness research supports the proposition that it is not only the "role" of the principal within a hierarchical chain of command that defines the principal as a leader, but the "position" the individual holds within the structure of the network that identifies the principal as a leader (De Bevoise, 1984; Slater & Teddlie, 1992; Teddlie & Stringfield, 1993). The distinction between principal leadership as (a) a defined "role" and (b) an identifiable "position" has been indicated by such findings as the differences in the leadership styles of principals in differentially effective schools within an SES contextual framework (Teddlie & Stringfield, 1993); the five forces of leadership - the technical, human, educational, symbolic and cultural (Sergiovanni, 1991); and the complexity of fitting the principal's role to the needs of the organization within the context of tightly and loosely coupled schools (Sergiovanni, 1991; Weick, 1982, 1988). These distinctions also reflect the differences between formal and informal networks and "self-perceived" and "other perceived" leadership roles.

Grounded in small group theory, "role" is synonymous with "functional role". Hare (1976) describes a "functional role" as involving those components found in job descriptions (control over other individuals, and access to resources), and that are understood, but may not be defined (such as the status normally accorded a formally assigned leader). Principals may have an assigned or an adopted role (such as a job description, or an image of their own leadership style) but they may or may not be identified in a leadership position within the network structure. Position is relative to the interactions of the entire network.

Murphy (1988) describes this same kind of distinction between "role" and "position" in terms of the meaning teachers may give to principal actions, "The actions of the administrator and the perceptions of the teachers must be considered" (p. 124). Within the context of this study, this means that if principals act as leaders and are perceived by teachers as leaders, then they can also be identified as a leader by their position within the network structure. Fiedler (1967, 1971) describes this as a leader-member dimension. This dimension is one of three factors that determines leader effectiveness within his contingency model of organizational effectiveness.

The leadership position as a component in the process of schooling appears to be a criteria for differentiating effectiveness which can incorporate both the specific attribute composition of principals and the theoretical foundations for leadership. Principals can be hypothesized as being in a pivotal point in a network. Within the context of a communication structure, it is this "position" of the principal in relation to the entire faculty that was explored in this study and not the defined, formal role of the principal, which is described by attribute characteristics and theoretical frameworks for leadership.

With a structural definition of leadership, there are two propositions clarifying the position of the principal within a network. First, the principal could be identified as a leader by his/her position alone within the network, and second the principal could be identified as a leader through his/her individual pattern of connections and in the context of other group parameters. This means that first, principals can be identified by where they are in the network (for example, in the middle of the network, or as an isolate). Second, the identification of the principal as a leader may not always be clearly observable, but the principal's position could be identified within the context of other parameters such as to whom the principal is connected, and the overall connectedness of the network. Defined in this manner, leadership does not take place in isolation from the context of the group and as such is conceptually aligned with the concept of schooling as an interactive process model. The principal is a leader if he/she can be identified as a leader within the structural context of the entire network. The principal's leadership was defined in this study as his/her status within the network and was measured quantitatively by centrality. This status reflects the power the principal has to direct and influence communication by his/her location in the communication network relative to the rest of the faculty.

Faculty Cohesiveness

Crosbie (1975) defines a group as ..." a collection of people who meet more or less regularly in face to face interactions, who possess a common identity or exclusiveness of purpose and who share a set of standards governing their activities" (p. 2). Luft (1970) defines a group by similar criteria: (a) groups must have some sort of interaction between members and (b) the group must have a shared purpose

or goal. Luft also adds (c) differentiation of behavior or function and (d) an increase in the value of the individual as a member of the group. This last criterion is similar to what Burgoon (1974) calls an assemble effect - the group produces more than the individuals' combined productions.

Faculties meet any combination of the criteria for a small group, and the specific findings from school effectiveness research have highlighted the relationship between the characteristics of successful groups and the effectiveness level of a school. One such characteristic is "cohesiveness".

The value of the group over the value of the individual can also be interpreted as cohesion or the binding together of the individuals into a group. Burgoon (1974) includes frequent interaction, group norms, role differentiation and interdependent goals, group personality and coping behavior to the list of criteria for a defining a cohesive group. Cartwright and Zander (1960) emphasize the goals and interrelationships that characterize successful groups. Bertcher (1979) specified the characteristics of goals that define successful groups. One, the goals are common to the group as opposed to an individual goal or a composite of individual goals. The second characteristic is interdependence which can be divided into "task" behaviors and "socio-emotional behaviors".

Cohesiveness is defined as a sense of togetherness, a united focus. In the same sense as the earlier more nebulous constructs of "group mind" and "herd instinct" were used to explain group behavior (Luft 1984), cohesiveness tries to capture the collective mental and emotional essence of the group as a whole.

Cohesiveness, also referred to as ... "solidarity, cohesion, comradeship, team spirit,

group atmosphere, unity, 'oneness', 'we-ness', 'groupness', and belonginness" (Hogg, 1992, p. 1) is a strong theme in school effectiveness research.

Extant research within the school effectiveness and school improvement traditions have empirically identified the cohesiveness of the faculty through a variety of variables. Though not always specifically defined as "cohesiveness" these variables reflect cohesive behavior and have primarily been categorized as mission, culture, climate, collegial interaction, and ethos. (Purkey & Smith, 1983; Sergiovanni, 1991; Teddlie & Stringfield, 1993; Wimpelberg, Teddlie, & Stringfield, 1989). This entanglement of (a) the constructs, (b) the operational definitions and (c) the specific variables under investigation results from both the complexity of the organizational/school effectiveness issue and the diversity of investigations within both areas. Three conceptualizations of cohesiveness that fill SESI research are mission, culture and climate.

"School mission" has been conceptualized as: "The school staff shares a common understanding of what the school is trying to accomplish and mobilizes around activities designed to meet school goals" (Hallinger & Murphy, 1986, p. 331). Mission has been defined as "what the school stands for", with principals in effective schools mentioning children and those in ineffective schools focusing on matters peripheral to academics (Teddlie & Stringfield, 1993).

The conceptualization of a cohesive group is also illustrated by the association of school effectiveness with "school culture" variables. Joyce, Hersh and Mckibbin (1983) define school culture as having four components: organizational norms, expectations, beliefs, and behaviors. Chauvin and Ellett (1994) define one

component of school context as "culture", and include membership interactions as a culture variable. Slater and Teddlie (1992) include commitment, cohesion, focus, and high expectations as variables defining culture, based on the Levine and Lezotte classification of culture variables. Slater and Teddlie explain the process of developing a school culture as rising out of the interactions that take place within the school structure. Cheng (1993) found a strong relationship between culture variables and effectiveness levels.

A third category of variables that indicates a cohesive group are those defined as "climate" variables. Climate has been described as the overall general beliefs of the group. These general beliefs are composed of the "collective norms, organization and practices" among members of the social system (Brookover, et al., 1984). The interactive nature of schooling, and the components of the leadership of the principal and the cohesiveness of the factor have been addressed by Scheerens (1993) who defines cohesiveness in the line of "school climate factors".

The pervasive, intuitive stress on the importance of a cohesive faculty has also been part of school improvement programs. Levine and Lezotte (1990) provide nine guidelines that have emerged from the research on effective schools. These guidelines provide direction in creating an effective school. Two of these guidelines illustrate the time and commitment essential for the communication that characterizes cohesive groups. The two guidelines are: (a) time allocated for staff development and (b) the importance of focused goals.

School effectiveness and school improvement literature clearly illustrate that the ability of the faculty to function as a successful group is an essential component

associated with a school's level of effectiveness. The emphasis on the faculty conceptualized as a cohesive group engaged in a schooling process has consistently emerged throughout the history of school effectiveness and school improvement research either as variables under investigation or incorporated into school improvement plans.

School improvement plans often incorporated strategies for organizing the faculty as a whole group and for providing techniques for decision making and group participation (Taylor & Levine, 1991). Case histories of school improvement efforts often indicate the first step towards improvement is the formation or the "re-formation" of the faculty as a group (Taylor & Levine, 1991). This action intuitively underscores how critical the faculty is as a unit of change, often in conjunction with strong leadership.

Joyce, Hersh and Mckibbin (1983) in The Structure of School Improvement suggest that school improvement has not had the expected effect and one major reason is that we have focused on attributes ("If effective schools have good principals, then legislate requirements for good principals") instead of the social characteristics at work within the school. Sergiovanni (1992) has described school improvement efforts as "low-leverage improvement strategies". A "low-leverage" strategy "requires a lot of effort but produces meager results" (p. xii). "Low leverage strategies tend to focus on "attributes" and not processes at work.

Though the conceptualizations and operational definitions for specific variables within the categories of "mission", "culture", or climate" vary and often even overlap between categories, it is the reoccurring perception of a cohesive

faculty that consistently appears to differentiate schools. The variables identified within a school effectiveness research tradition, such as cohesiveness, school mission, and focused goals, parallel the characteristics which have been identified as the characteristics of successful small work groups.

In addition to the correlates from the SESI research tradition conceptually supporting a connection between faculty cohesiveness and level of effectiveness. Evans and Dion (1991) used meta-analysis to empirically review the relationship between group cohesion and performance. They combined the results of 27 studies on the relationship between group cohesion and performance. Their findings, though reported with caution based on the biases of the study design, suggest "a robust relationship between cohesion and effectiveness of group performance." They describe this relationship, within the limitations of the study design, as indicating a stable and positive correlation. Evans and Dion conclude that their findings support further study on this relationship.

Little (1982) found that the norms and patterns of the interactions themselves were different in successful and unsuccessful schools. She suggests that there are seven dimensions to interactions: range, focus, inclusivity, reciprocity, relevance, concreteness and frequency (p. 336). Many of the dimensions suggested by Little are classic sociometric descriptions and are appropriate for network analysis.

As a parallel to school effectiveness research, Clark (1985) has described current organizational theory and research as an "emerging paradigm" moving away from a prior Weberian ideal bureaucracy model. Lincoln (1985) suggests that this development of the paradigm, incorporates a focus on the complexity of

organizations, and the interactive nature and multiplicity of organizational systems. The results of the extant research from school effectiveness are consistent with these recent organizational effectiveness research findings and the drive towards theory construction. School effectiveness and organizational effectiveness research converge on three dimensions related to effectiveness and leadership:

1. Effectiveness results from a complex interactive process (Guba, 1985).

2. There is not a definitive definition of what an effective leader is, should be, or could be within all group contexts, but leadership does make a difference in the outcomes of the group. (Fiedler, 1967, 1971; Good, & Brophy, 1986; Murphy, 1988; Teddlie & Stringfield, 1993; Weick, 1988).

3. There is support for understanding effectiveness within the context of group structure (Weick, 1988; Palazzolo, 1981).

The findings from school effectiveness and school improvement research have consistently drawn attention to the importance of the leadership of the principal and the cohesiveness of the faculty in achieving effectiveness. Both: (a) the characteristics of leadership associated with the principal and (b) behaviors, processes and activities associated with a spirit of togetherness, have consistently been a factor in differentiating between effective and ineffective schools. What appears as divergent or even conflicting theories of leadership and faculty cohesiveness are a compilation of what Homans (1987) calls "explanations" and are not actually conflicting theoretical propositions. This study suggest that the "explanations" are contextual and/or examples descriptive of the components working within a larger process model or framework. The contextual aspects of effectiveness and the specific

examples of general components can be placed within a broader framework, and therefore understood more specifically, by focusing on the structure of the process and the communication relationships which describe that structure.

Communication Context

The importance of the communication structure of a school faculty has been illustrated by the characteristics associated with effective communication, such as faculty cohesion, a faculty sense of mission, academic goals, and coordinated curriculum and instruction (Hallinger & Murphy, 1986). Though an analysis of the content of communication interactions was not explored within this study, the characteristics associated with differentially effective schools would indicate that communication about academic matters takes place within the school. Goals are achieved, the curriculum and instructional practices are coordinated, and faculties are perceived as cohesive because some component of communication is taking place. A communication structure provides the framework within which principals operate as leaders within the faculty network. Two parameters of a communication structure were defined in this study, the position of the principal within the faculty network and the cohesiveness of the faculty as a group.

Communication Theory

Communicating in schools is more than the exchange of files and folders, the filling out of reports, and the sending of memos. Though the content of communication was not explored in this study, a specific communication theory was utilized. Rogers and Kincaid (1981) in their definitive text on communication networks, define three models of communication: the linear, the relational, and the

convergence. The linear model has been the traditional classic model for communication investigations. Based on the linear model, communication is defined as occurring in a linear path with the source, the receiver, the channel of communication, and the message comprising the main model components and manipulated as the independent variables. The components are aligned in a directional relationship affecting the attitude, behavior and knowledge of the receiver as a result of the communication process (Rogers & Kincaid, 1981, pp. 32-35). As an example, if we viewed schools as formal bureaucracies, with the principal as the authoritarian leader, we would define communication as: the process of the principal, through some channel of communication such as memos, faculty meetings, handbooks, etc, relaying information (messages) related to the operations and practices of schooling to the faculty. These messages would affect the attitude, behavior and knowledge of the receivers, the faculty, as intended by the principal.

In the relational model, the communication act is significant within the context of a specific relationship. Also, the direct causal relationship of the linear model is replaced with the interactive relationship of source and receiver. For example, in addition to the above scene, the memos sent from the principal are left unread because teachers are busy with discipline problems within the classroom that have not been addressed by the administration and the teachers feel unsupported. The principal would only address the issue of the unread memos, however, in the next memo to the teachers, and they in turn ignore the communicated message.

Rogers and Kincaid (1981) build a rationale for the convergence model of communication based on their identified "biases" of the linear and the relational

models. Communication is defined "as a process in which the participants create and share information with one another in order to reach a mutual understanding" (Rogers & Kincaid, 1981, p. 63). The convergence model of communication, as defined by Rogers and Kincaid, is therefore a model of movement, dependent upon the interaction between receiver and sender. Convergence is always between two or more persons. In the scene with the principal and the teachers, in the convergence model, the principal and teachers would address the need for administrative support and what the principal wanted also. "The model compels us to study relationships, differences, similarities, and changes in these relationships over time..." (Rogers & Kincaid, 1981, p. 66). The "interactions" of the receiver and sender, both directly and indirectly, form a communication network.

Unlike the linear and the relational communication theories, in a convergence theory of communication the components (individuals) and the characteristics of the components are not the unit of analysis. The unit of analysis is the link between the components. According to Rogers and Kincaid (1981) "...the unit of analysis is usually the information-exchange relationship between two individuals, or some aggregation of this dyadic link..." (page 70). The analysis is not of the characteristics of the components, but of the relationships between the components. On the basis of this theoretical foundation, this study explored the communication networks of elementary school faculties, through the application of network analysis.

Communication Networks

The communication network has been identified as an important, if not the one vital component, necessary for a group to succeed at attaining goals (Rogers &

Kincaid, 1981). Bennis and Shepard (1974) describe the internal communication system of the group as the avenue for moving a group through successive stages of development. Burgoon (1974) describes "functional" communication within the group as structured such that there are "links" for both transmitting information and for obtaining feedback (p. 6). Rogers and Kincaid define communication "as a process in which the participants create and share information with one another in order to reach a mutual understanding" (p. 63). Goldhaber (page 5) points out that the metaphor used to describe organizational communication underlines its importance to organizational success. Metaphors such as "the life blood of the organization," the glue that binds the organization, the oil that smooths the organizations's functions, the thread that ties the system together, the force that pervades the organization, and the binding agent that cements all relationships." (p. 6).

Control over information, or power within the network, has been described as the "sixth source of social power" (Marsden & Friedkin, 1993). The three variables of power, status and leadership can be utilized to define the position of an individual within a network. This position, reflecting the power, the status and the leadership of a person, indicates the availability an individual has to obtain a resource (communication) and conversely, the control an individual has over the availability of the resource to others (Blair, Roberts, & McKechnie, 1985). The status of the individual reflects the power of that individual as a leader in a communication network.

The need to communicate has been alluded to, referred to, hinted at, talked around, and assumed to be important in study after study within the SESI traditions.

This study, *The Application of Network Analysis to the Study of Differentially Effective Schools*, linked a theoretical framework for communicating with two communication components, principal leadership and faculty cohesiveness (identified from prior SESI research), through the application of network analysis. Rogers and Kincaid (1981) define communication network analysis as "a method of research for identifying the communication structure in a system, in which relational data about communication flows are analyzed by using one type of interpersonal relationship as the unit of analysis" (p. 75). Network analysis is the methodology for describing and analyzing the patterns of relationships within and between networks. Network analysis investigates the structure formed by the pattern of contacts, directly and indirectly made by the members of a network. The following chapters describe the research design employed to accomplish this and the results.

Chapter Three: Methodology

Chapter Three describes the research design for the two parts of this study.

This chapter includes:

1. An overview summarizing the study design
2. A summary of the sample and procedures for Part I, the Pilot
3. The sampling design and procedures for Part II, the Field Study
4. The instrumentation for Part II
5. The collection, recording, preparation, processing and analysis procedures for Part II.

Overview of Study Design

There were two research goals developed for studying the structure of differentially effective schools. The study was conducted in two parts, corresponding to the two goals.

1. The goal of Part I was to develop a Centrality - Cohesiveness Model of School Effectiveness, with prototype sociogram definitions of the structural characteristics of differentially effective schools and then to select the network measures that would best fit the operational definitions of the model. (The development of the Centrality - Cohesiveness Model is described in Chapter Four.)
2. The Goal of Part II was to test the Centrality - Cohesiveness Model with a new sample of schools. (Analysis and results from Part II are described in Chapters Five and Six)

This study followed a causal-comparative design (Borg & Gall, 1989) utilizing the application of network analysis methodology. Rogers and Kincaid (1981)

describe network analysis as a structuralistic approach. They further describe the basic strength of this structuralistic approach as:

"...particularly valuable to social researchers because it allows them to trace specific message flows in a system, and then to compare this communication structure with the social structure of the system in order to determine how this social structure is interrelated with the communication network" (p. 82).

The two parts of this study systematically built a framework for studying differentially effective schools through a structural perspective and through the utilization of both quantitative and qualitative paradigms. This study merged both quantitative and qualitative applications of network analysis within a framework of a merged paradigm investigation, with the purpose of using methods from each paradigm to sharpen and clarify the product of analysis. Therefore each paradigm was viewed as a means to discover different information in answer to the same research questions and in the process develop a richer understanding of network structure.

The analysis of network data has traditionally been quantitative in nature. Wasserman and Faust (1994) emphasize that there are three distinct, but related, components utilized in the analysis of networks. All three components are necessary in order to fully understand a network: (a) the graph that describes the relationship between two actors, (b) the matrix or matrices that outline the network relationships into a format for graph theoretic, matrix and algebraic manipulation, and, (c) the sociograms, that have traditionally been used to depict the network relationships resulting from both the graphs and the products of matrices manipulations.

Hamilton (1994), in his exploration of the foundations and traditions of qualitative research, called full attention to the distinctions between qualitative and

quantitative knowing. Particularly salient to this study are the distinctive characteristics of "perception" and "understanding" that form the basis for defining the methods and techniques found in qualitative traditions. Morse (1994) compared a variety of qualitative strategies based on perspective, or "perception" and the method of "understanding", or knowing, and included social network diagrams (sociograms) as a source of data. Harper (1994) describes the use of the visual representation of reality through films, videos and photographs as at the crossroads between being an instrument for clarification and recollection and being a separate unique data source. In the same note, sociograms are also at a crossroads. Sociograms visually represent the structure of graphic representations and are often generated from quantitative network analysis. The sociograms, in this study, were also treated as data, and analysis was conducted within the traditions detailed by Miles and Huberman (1994), specifically, developing a matrix for analyzing contrasts and comparisons between sociograms. Therefore in this study, qualitative research refers to the analysis of sociograms as data.

Review of Part I: Pilot Study

In Part I, a model was developed which explained the relationship between the two structural components related to a school's level of effectiveness:

1. The principal's leadership is defined as his status within the network and measured by centrality. The status of the principal reflects the power the principal has to direct, control, and/or influence communication because of his location within the communication network of the faculty.

2. The cohesiveness of the faculty as measured by the density of the network. Density describes the connectedness of the faculty.

Part I consisted of two phases: (a) defining the structural model and (b) determining through statistical analysis which measure of centrality best differentiated between the defined model types. The model was then evaluated with a Pilot Study of 16 schools.

The 16 schools studied in Part I were from the Louisiana School Effectiveness Study, Phase IV (LSES) (Teddlie & Stringfield, 1993). For the analyses in this study, schools were dichotomously classified by effectiveness status (effective or ineffective). The classification was based on the school's longitudinal classification and resulted in 9 schools classified as effective and 7 schools classified as ineffective. The sociometric data for this study were collected during the fourth phase of the LSES, during the Spring of 1990. The model development, the instrumentation, the data collection procedures and the results of Part I are reported in detail in Chapter Four. The results of Part I directed the choice of measures for Part II, the Field Study.

Sampling Procedure - Study Population

The Location of the Study

Part II of this study took place in the state of Alabama. There are 67 public county systems and 61 public city systems for a total of 128 school systems and 1,357 schools (1994 Alabama Education Statistics: A Summary) in this state. Of this total number of schools, 1,015 (78%) were classified as elementary. Schools were classified as elementary if they served any combination of grades K through 6 configuration, though the actual grade span configuration for a specific school may be larger, such as a K-12 school, or smaller, such as a K-4 school.

Study Population

The sampling design for the selection of schools was a multi-stage stratified outlier design (Cochran, 1963). Sample schools were selected through a two step process. In the first step, a study population was defined and selected from the total population of elementary schools; in the second step the sample was selected from this study population. The study population included all schools in the state of Alabama that meet four criteria (configuration, size, program bias, and principal stability). These four criteria will be described later in this Chapter.

In addition, each school in the study population was classified by effectiveness status and stratified into four socio-economic clusters. The following section describes the creation of the three data sets that were merged to form the final study population.

The first step in identifying the study population within the total population of elementary schools, was to determine a composite academic z score for each school, for the effectiveness classification. The second step was to identify schools meeting configuration and size requirements. Third, schools were then sorted into one of four socioeconomic clusters, and ranked by the composite academic z score. At this point, sample schools were selected from this ranked list and program bias, and principal stability were verified at the time a school was contacted about participating in the study. As a general rule, in the overall design for selecting the study population and then the sample, schools meeting the criteria at one level were then included in the next level of the sampling scheme.

The order the criteria were applied (configuration, size, program bias, principal stability) was based on: (a) efficiently sorting large sets of data from multiple sources and (b) sorting by the most common criteria to the more specific. The two stage sampling process lead to 364 schools in the study population, of which 115 were selected for possible participation. Of these 115, 25 schools participated in the study and are referred to in Part II of the study as the sample.

Effectiveness classification procedures

The dependent variable (DV) for school effectiveness classification was a combination school level z score, aggregated at the student level over two years for the reading, math, and language subtests on the Alabama Basic Skills test. There have been problems identified with using student achievement as a measure of effectiveness and other measures, such as retention, have been suggested, (Coleman and Collinge, 1991, p. 263). However, achievement was considered the most appropriate measure to use in this study in order to establish a consistent connection to (a) traditional school effectiveness methodology in general and (b) specifically, the methodology utilized in the Pilot Study for school effectiveness classifications. Z scores at the student level were calculated using:

1. The total reading, total language, and total math raw scores on the Alabama Basic Competencies Test for grade 3 for years 1992-1993 (fall test date) and 1993-1994 (fall test date).

2. The total reading, total language, and total math scores on the Basic Competencies Test for grade 6, if grade 6 was part of a school's configuration, for the years 1992-1993 (fall test date) and 1993-1994 (fall test date).

An academic school score was calculated following a procedure utilized by Crone and others (Crone, Franklin, Caldas, Ducote, & Killebrew, 1992; Crone, Lang, & Franklin, 1994) as follows:

1. Transforming all student level raw scores by student, by test, by year, by grade, to z scores using the standardization procedure available on SAS, with the mean = 1, and standard deviation = 0. For the 1992-1993 school year, student total scores on each subtest (total correct) were calculated for each subject by summing the total number of correct responses on each test for each student, and then transforming this score to a z score. Raw score tapes were provided by the Alabama State Department of Education. The total score for each sub-test was provided on the tapes for the 1993-94 school year.

2. The three z scores for each student were then summed to obtain one z total score, by student, by year ($z_r + z_m + z_l = z_{92}$ and $z_r + z_m + z_l = z_{93}$)

3. The mean z score was then calculated for each school for each year, resulting in a Z_{mean2} (1992-93 school year) and a Z_{mean3} (1993-1994 school year) score for each school. ($\sum z_{92} \div n = Z_{mean2}$) and ($\sum z_{93} \div n = Z_{mean3}$).

4. Three data sets were then merged: (a) a data set selecting all schools with a total enrollment of between 200 and 600, on the first month's enrollment for the 1994-1995 school year, for grades K-4th, and (b) the two Z_{mean} sets. This resulted in a data set of schools meeting the configuration and size requirements and with effectiveness criteria scores for two school years.

5. Schools were then selected for the study population if Z_{mean2} and Z_{mean3} were either both positive or both negative.

6. The two means were summed for each school ($Z_{mean2} + Z_{mean3} = Z_{MEAN}$), and schools were then sorted by cluster.

7. Schools, within each cluster, were ranked by the new ZMEAN score.

Configuration and size parameters

Schools were selected with a K-4, K-5, or a K-6 configuration. The K-6 configuration was selected as it is supported as an appropriate choice for study by current school effectiveness theorists (Slater & Teddlie, 1992), and provides continuity with the sample from Part I.

Schools were sorted by configuration, then size. Schools in the study population were selected if the enrollment for grades 1-4, for the school year 1994-1995, was between 200-600 students. Grades 1-4 were used to determine enrollment because all schools selected for the study population had, at a minimum, these grades included in the school configuration. The criteria for school size eliminated schools that would have had a very small or a very large faculty.

Controlling for a faculty size of around 25 full time faculty equivalent positions was included in the design for two reasons: (a) research on groups suggests that the most appropriate size for a small group is around twenty (Palazzolo, 1981; Rogers & Kincaid, 1981), and (b) it appeared from a visual scan of elementary school enrollments in the state of Alabama (State of Alabama Department of Education, Fourth Month Enrollment, 1993-94, and First Month Enrollment, 1994-95) that several counties had schools with unusually large enrollments (above 1000). It was anticipated that because of the variety of grade configurations and actual class sizes there would still be variation in the faculty sizes in the sample.

From a network analysis perspective, accounting for the size of the faculty was considered important for several reasons: (a) if the faculty group is very small then proximity alone may affect how frequently the faculty relate and the kinds of interactions that take place; (b) if the faculty size is too large, then proximity, physical location, or building layout may affect how frequently or infrequently group members can interact and the potential for members of a faculty to interact; and (c) size consistency is important in the analysis of the data across schools. When the size of the group increases, there is a disproportionate increase in the number of possible relationships, such that $y = x(x-1) \div 2$, where y = the number of dyadic relationships, and x = number of people (Nixon, 1979; Palazzolo, 1981). Additionally, as the size of the group increases, the potential for members of a faculty to interact with all available members decreases because of natural constraints such as the time needed to access all members. Research findings indicate that variations in interactions do take place within groups as the size of the group increases (Palazzolo, 1981). In addition to controlling for size in the sample selection procedures, measures were normalized during analysis to limit the bias from size. The mean faculty size for the sample schools was 37, with a standard deviation of 9 and a range of 21 to 57.

Socioeconomic Classification Parameters

Though there are pockets of high economic communities throughout the state, for the most part Alabama is a poor rural state. The urban population distribution for the total state is 60.4%, with 8 counties having no urban population and 46 counties with less than 50% urban populations. (Alabama County Data Book, 1992-93).

Following standard methodological procedures within a SESI research framework, this study used socioeconomic status as the dependent variable to classify

schools. A "System Cluster List", developed by the Alabama State Department of Education in 1988 for the purpose of equatable comparisons across school systems (R. E. Lockwood, Ph.D., personal communication, December 28, 1994), was used to form four socioeconomic status (SES) strata. The data were reviewed again in 1992 to determine if there had been any significant changes in the classifications of schools. There were no significant changes and the original designations were kept.

The Alabama State Department of Education used two variables, aggregated at the system level, to rank the schools; one was an estimate of personal wealth and one an estimate of real property wealth. The personal wealth variable was an average of per capita income and the percentage of students eligible for free or reduced-priced lunches. The estimate of real property wealth was based on the yield per mill per student in average daily attendance of the district tax. Four SES clusters (strata) were formed at quartile cut off points, and each cluster was divided into large and small systems. In Alabama, several systems are very small (one, two, three, or four total schools) and systems tend to be segregated by wealth, so clusters at the system level seem appropriate.

In strata one, the wealthiest cluster, there are 10 city school systems and 4 county systems. Four of the city school systems are located in one county, which is the largest metropolitan area in Alabama. These fourteen total systems account for 11% of the total public systems in Alabama.

The second strata is the next highest in economic wealth and includes 25 city school systems and 21 county schools systems. Strata Two accounts for 36% of the total public systems in Alabama. Strata Three is next to the lowest economically, but has 35% of the total school systems with 22 city school systems and 23 county

school systems. The lowest strata accounts for 19% of the total school systems, 5 city and 19 county.

The study population consisted of 364 schools, sorted within four socioeconomic strata, each of which meet configuration, size and effectiveness status selection criteria. Both the population and the study population demographic characteristics are detailed below in Table 3.1.

Selection Procedures - Sample Schools

Schools for the sample were selected as extreme cases (in terms of achievement) within socioeconomic strata from the study population of schools. Schools meeting the criteria at one level were then included in the next level of the sampling scheme to be evaluated for selection.

Table 3.1.

Study Population Parameters

Alabama Public Schools				
128 Total Systems (67 county & 61 city)				
1357 Total Schools				
1015 (78%of total) Elementary Schools				
Socioeconomic strata	<u>Strata 1</u>	<u>Strata 2</u>	<u>Strata 3</u>	<u>Strata 4</u>
Percent of total systems	11%	36%	35%	19%
Number of total schools	254	513	428	162
Percent of total schools	19%	38%	32%	12%
Study Population				
Number & Percent of Schools (by strata) selected for Study	67	170	109	18
Population based on:	26%	33%	25%	11%
1. Configuration				
2. Enrollment size				
3. Effectiveness status				

The original study design specified the selection of 64 sample schools, 16 from each socioeconomic strata with 8 classified as effective and 8 as ineffective. The selection of sample schools was made within each of the four socioeconomic strata. Except for the bottom strata, the sampling population contained a minimum of 1½ the expected sample size. Schools were selected in rank order, from the lowest ranked school up and from the highest ranked school down.

The process of selecting schools for the sample encompassed several stages. The first 16 schools for each strata, were selected with 8 from the lowest ranked school up and 8 from the highest ranked school down. After the sample of 64 schools was selected, the principal stability and program bias for each of the 64 schools was verified, as described in the following sections. Through the continued process of confirming principal stability and program bias, and because participation was voluntary, as individual schools were eliminated from the sample, the next ranked school (within strata and from the direction of the excluded school) was included in the sample. Through this process, a total of 115 were selected for potential participation in the study.

Numerous schools were eliminated through the continual process of utilizing the sampling scheme criteria. The final sample consisted of 26 schools, who received surveys. One school did not complete and return the survey and analysis was conducted on a final sample of 25 schools, 8 ineffective and 17 effective.

Principal Stability

The third criteria for selection was based on principal stability. The criteria specified retaining schools where the principal had been employed at the school as

principal for the prior two school years (1993-1994 and 1992-1993) before data collection in the Spring of 1995. Principal stability was verified at the time of selection and again at the initial contact with the school. Verification of the sample was accomplished by comparing the principal listed in the Alabama Education Directory for the school year 1992-1993, with the current listing for school year 1994-1995, a range of 3 years. If a school, selected for the sample, had a principal who had continued to be employed in the selected school, then that school was retained in the sample. Schools with a new principal in 1994-1995, had the middle year (1993-1994) verified and were retained if the principal had been employed at the school during that school year. If a principal was new, the sample school was dropped and the next school in the ranked roster was selected as a replacement. Of the total 115 schools selected, 21 schools had new principals.

Program Bias

The third criteria limited schools in the study population to those not completing the Alabama Effective Schools Program (AESP) training. This program, directed through the State Department of Education, consists of school level staff development based on the standard five correlates. Each school is instructed to develop a school improvement plan to be implemented during the following three years. Schools complete a five day training session outlining the steps needed to implement a staff development and achievement test score improvement plan within a school.

About 300 schools (23% of all schools) have gone through the training during the past three years. Approximately 60% (about 180) of these school were

elementary schools. Removing these school reduced the threat of a school's "history" affecting the internal validity of the study. This bias might lead to an artificially high cohesive structure due to formally defined staff development procedures and may not reflect the actual structure that would exist in a naturally occurring schooling process.

Program bias was determined at the time of initial contact because no comprehensive list of participants in the AESP is currently available. When possible, verification from the State Department of Education was used to eliminate systems that had participated as a staff development endeavor. One such system was eliminated. Otherwise, schools were asked on the initial phone contact if their school had participated or was currently participating in the school improvement program. Eight schools were eliminated. Although it was initially thought that this was an important criteria in the selection process, interaction with the schools suggests that it may not be as influential as originally anticipated. In some cases principals were unclear if their school had participated or was currently participating in the program.

The four study population criteria were applied sequentially and some schools could have been excluded on multiple criteria. Configuration and size criteria were applied during the study population selection stage; program bias and principal stability were applied during the sample selection stage, before schools were contacted. The next section describes the procedures for contacting the schools during the sample selection process.

Contact Procedures

The following is the procedure for contacting each school requesting participation: (a) an initial letter was sent explaining the study, asking for the

school's participation, and preparing the principal for a follow-up call within a few days; (b) each principal (if possible) was contacted and the purpose for the study and the requirements for a school's participation were reviewed, (return a faculty list, complete the survey school wide, and return it); (c) principals were asked if they had any questions about the study and requesting their participation; (d) if the principal returned the faculty list, the survey was developed and mailed to the school, with return postage; (e) if the school was eliminated or chose not to participate, another school was selected from the ranked study population and a letter was sent or if a school could not be contacted, a replacement school was also selected and contacted. Through this process, a total of 115 schools were selected from the study population, the initial 64 schools and 51 replacement schools. Twenty-one of the initial 64 sample schools selected were participants in the study. Of the 51 replacement schools, 5 participated in the study. The response categories for the total 115 schools are summarized in Table 3.2., followed by detailed explanations for the categories.

Table 3.2.

Sample Schools Response Summary

115 Total Sample Schools Contacted				
29 Eliminated	25 Yes	13 Yes/but	18 No	30 No response
I - 19 E - 3	I - 8 E - 17	I - 9 E - 3	I - 10 E - 8	I - 15 E - 15

The final sample contained 25 elementary schools from across the state of Alabama, sorted by effectiveness status within SES strata. These are the 25 schools in the "Yes" column of Table 3.2. The other columns in Table 3.2. summarize the

results of the sample selection process. This includes all of the schools that were eliminated from the sample or who chose not to participate.

Column 1. (Eliminated) These schools were eliminated from the sample based on principal stability or program bias before contact was made with the school. Twenty-one schools were eliminated from the sample because principals were new during the study year. Of the original 64 sample schools, 11 had new principals and 10 of these schools were eliminated from the sample. The principal stability of one school was not verified until the actual day of data collection when it was discovered that the principal had retired and this change had not been made in the directory nor was it corrected during phone conversations setting up the study details. The assistant principal for the past five years was the new principal. This school was not eliminated from the data collection at this point because of the continued stability of the assistant principal and because the school was prepared to participate in the study.

Column 2. (Yes) The principal agreed to participate and returned the requested faculty list.

Column 3. (Yes/but) The principal agreed to participate, but did not return the faculty list. Schools were sent follow-up letters and were prompted with phone calls. Thirteen schools said yes, but did not return the faculty lists, 9 were ineffective, and 3 were effective.

Column 4. (No) The principal refused to participate in the study for a variety of reasons from time constraints to disinterest. A total of 18 out of 115 school refused to participate, 10 ineffective and 8 effective.

Column 5. (No response) At 30 schools, the principal could not be contacted with repeated and varied prompts such as phone calls, a second follow-up letter, and messages left. Several schools were classified as "no response" when no initial phone contact could be established due to busy lines or unanswered phones. Fifteen of these schools were classified as ineffective (I) and 15 were classified as effective (E).

Schools in the sample population were drawn from a total of 20 systems across the state of Alabama. The range of systems for the sample schools included: (a) eighteen systems that had 1 school selected; (b) one system in strata 1 that had 3 schools (classified as effective) selected; and (c) one system in strata 3 that had 4 schools (classified as ineffective) selected. Table 3.3. summarizes the sample distribution by effectiveness status and strata.

Table 3.3.

Part II - Sample Schools - Distribution by Effectiveness Status and Strata

Strata 1	Strata 2	Strata 3	Strata 4
Total = 8	Total = 3	Total = 8	Total = 6
<u>Ineffective</u> <u>Effective</u>	<u>Ineffective</u> <u>Effective</u>	<u>Ineffective</u> <u>Effective</u>	<u>Ineffective</u> <u>Effective</u>
2 6	1 2	4 4	1 5

Instrumentation

Sociometric Survey

There were two sets of instruments used in Part II. Set one consists of the sociometric surveys, which are described in detail in Chapter Four. Set two consists of the criterion referenced achievement tests used in Alabama.

A sociometric survey was used to collect the network data in both Parts I and II. A description of the instrument format and the contents of the survey is found later in Chapter Four. Though faculty in Part II were asked the same two questions in the sociometric surveys as faculty in Part I, in Part II several technical innovations were incorporated into both the survey and the data collection procedures. The differences in the two sociometric surveys included:

1. The printed format of the demographic information collected with the test
2. The procedures for participants responses, and
3. The use of computer answer sheets in Part II.

In Part I, all responses were recorded by faculty on the sociometric survey itself. In Part II, teachers used computer readable forms to record responses. Because of the differences in format, the instructions for Part II were rewritten specifically to prompt for answering with a machine readable form, incorporating suggestions from both the University of Alabama Test Services and the Project Director of the Capstone Poll, the Institute for Social Science Research, at the University of Alabama.

There are unique concerns associated with answering sociometric questions with a computer readable answer sheet. One concern is how to accommodate both the selection of an individual as a link and the ranking of the top three links on the same form without undue confusion for the respondent or multiple responses on the computer form. This issue was resolved by reordering the procedures subjects followed for the selection of links. Subjects were instructed to choose the top three individuals first, then to go back and choose all other links.

Criterion-referenced Tests (CRTs)

The Alabama Basic Competencies Test was used in this study as a measure of school effectiveness. The Alabama Basic Competencies Test is a test which describes the student's performance in relation to criteria established for a specific grade level. The content for the criteria is considered "basic" for that grade level and scores are reported to parents as mastery or non-mastery performance, and includes the number correct. The content is based on (a) the Minimum Standards and Competencies for Alabama Schools for reading, language and mathematics; (b) the Alabama Course of Study: Mathematics; and (c) the Alabama Course of Study: Language Arts. The Test is multiple choice and untimed (Utilization Guide for the Alabama Student Assessment Program. Bulletin 1992, No. 3).

Data Collection Procedures

In Part II, almost all data collection was conducted through the mail. Five schools were personally visited and the surveys were dropped off and collected in person. There were two stages to the data collection process: the first was the initial contact with the schools (described above in the sample selection procedures above) to obtain the faculty list, and the second was the actual data collection process. The second stage included preparing the sociometric surveys for each school: (a) preparing school packets with distribution instructions, survey collection instructions, mail back instructions; and (b) preparing the individual teacher packets.

Each individual teacher packet contained a letter explaining the project, instructions for completing the survey, a coded computer answer sheet, and the survey. Each teacher's packet was individually addressed. This assured both privacy

for the teacher and simplicity of matching each teacher with coded answer sheets. Anonymity was guaranteed in the sociometric survey through the coded answer sheets. Each school packet contained instructions for distribution, all of the individual teacher packets, and a large postage paid, addressed envelope for returning the surveys. The instructions in both the school and individual teacher packets were printed on colored, highly visible paper to differentiate them from the actual survey. A total of 916 teachers and principals were sent surveys. The overall response rate for these individuals was 69%. The response rate for effective schools in the sample was 74% and for ineffective schools was 60%.

Data Recording and Processing Procedures

Data processing for network analysis proceeded through 4 stages. The first stage was the recording of data into the Word Perfect files. Before entering the data for each school, each individual was assigned a code number which was used in place of names. The complete faculty roster, which included teachers who were absent, or did not return the survey, was used to define the network. Entering the sociometric survey data consisted of aligning each code number along the left side of a square matrix and listing each individual's code number, again, across the top, in the same order. An individual's choices were entered across the row. The choices made by the row individual were written in the matrix square corresponding to the chosen individual's column.

As the data were prepared for scanning in Part II, each teacher's scantron was hand checked for completeness and scanability. This included (a) checking and replacing codes when teachers had removed school codes or teacher codes; (b)

completing information that teachers had not completed if the information was available from the faculty list, such as the grade level taught; and (c) removing random or incompletely erased marks. The surveys were then scanned into one master file, and were then separated out by school and prepared for analysis using UCINETX. Of a total of 637 surveys returned, 4 surveys were unusable from Part II.

The second step in data processing was to import the data sets into UCINETX (Borgatti, Everett, & Freeman, 1992a; 1992b) to calculate the network analysis measures, the third step was to construct data files for SPSS, and the fourth step was to export the original matrix data sets into Krackplot 3.0 (Krackhardt, Blythe, & McGrath, 1994, 1995) for constructing the sociograms. Network sociograms for each school were constructed with dichotomous, directional data based on the top three choices each individual made to question 1 (whom did you speak with about academically related matters?).

Sociograms were constructed using Krackplot 3.0 (Krackhardt, Blythe, & McGrath, 1994, 1995) through the following procedures: (a) the graph of each network was imported into Krackplot in a random pattern, (b) the random pattern was then laid out using Quick Multidimensional Scaling, which provides a crude picture of the graph layout based on a two-dimensional solution which is based on the shortest path distances (the geodesic path) between all pairs of teachers (nodes), and (c) this graph was then laid out with a simulated annealing routine.

The defaults for the annealing routine were set to: (a) maximize nodes (teachers) forming clusters determined by connections to other nodes (teachers), (b) separate isolates from the group, and (c) minimize edge (line) length. It is important

to note that though Krackplot 3.0 will lay out the graph of a matrix following specified parameters, each graph is still randomly constructed each time the matrix is imported into the program and the routine is run. This means that each graph will look slightly different each time it is run, except in the Quick Multidimensional Scaling routine. Differences include page orientation and layout, but the general visual structure of relationships will remain the same.

Four baseline networks were constructed from each survey. Two networks were formed on communication choices, and two were formed on leadership choice:

1. Network #1 - all individuals talked with (asymmetric, dichotomous)
2. Network #2 - all individuals talked to, ranked first, second, third choice, and other (asymmetric, valued)
3. Network #3 - all individuals selected for school improvement committee (asymmetric, dichotomous)
4. Network #4 - all individuals selected for school improvement committee, ranked first, second, third choice, and other (asymmetric, valued)

Measures of Principal Centrality

Freeman's normalized indegree, a measure of network activity, was selected, on the basis of the results from the Pilot Study, to measure the principal's centrality within the communication network. Indegree centrality is equal to the number of other members directly linked to i . This measure, $C_{d(i)}$, was created from Network #1. This measure is the number of times the individual was chosen by others. The normalized degree centrality controls for network size. No control for nonrespondents was included in the calculation of the indegree measure.

Nonrespondents were considered as isolates within the network. Normalized degree centrality was calculated as: $C'_{d(i)} = C_{d(i)} \div (n - 1)$.

Friedkin and Slater (1994) have suggested adjusting the network for nonrespondents. They suggest that this adjusts the network to the actual ties made. This suggestion was not followed within this study as the network boundary specified the entire faculty network and removing the nonrespondents would inflate the measures.

Group Centralization Measures

Group centralization measures was also calculated for each network. Group centralization measures indicate the extent to which one individual is more likely to be central within the network. The larger the centralization measure the more likely that one individual is central and the others individuals are around the edges of the network. Two centralization measures were calculated as a function of the individual measures, degree centralization and betweenness centralization. Group centralization measures are discussed more fully in Chapter Four, p. 95.

Cohesiveness Measures

A density score was calculated for each school as a measure of cohesiveness. This measure indicates the extent to which the entire network is connected to each other. It is a measure of the connectedness of the group, within which the principal is positioned. Density is the proportion of possible connections (l) that are actually present. Density is the number of connections in a graph and is expressed as a proportion of the maximum probable number of lines. Density was calculated by:

$$\text{density} = \frac{l}{n(n-1) / 2}$$

Comparisons were made between effectiveness levels using the principals indegree scores as the dependent variable. T-tests were used to determine if there were significant differences in the centrality scores of principals in effective as opposed to ineffective schools. Comparisons were made between effectiveness levels on both the network centralization and network density scores. In addition, a qualitative analysis was conducted on the network sociograms.

Research Goals, Hypotheses and Questions

The hypothesis for this study was that the structure of a school is a function of the leadership position of the principal and the cohesiveness of the faculty and that this structure is associated with effectiveness status of the school. The position of the principal was defined as his/her centrality within a group. Individual centrality is the prominence of an individual in the group. Group centralization is the overall cohesion or connectedness of the members of a group.

This study defined and explored the social structures of elementary schools through the application of network analysis in a two part process.

1. The goal of Part I was to develop a Centrality - Cohesiveness Model of School Structure representative of the structural characteristics of differentially effective levels of schools.

2. The Goal of Part II was to test the Centrality - Cohesiveness Model.

The development of the model and the Pilot Study are described in Chapter Four, the qualitative analysis of the sociograms for Part II is described in Chapter Five, and the quantitative results from both Part I, the Pilot Study, and Part II, the Field Study, are described in Chapter Six.

Chapter Four: Part I - Model Development and Pilot Study

This study, the application of network analysis to differentially effective schools, addressed two main questions. First, are there structural differences in the principals' positions of leadership within faculty networks for differentially effective schools, defined as a principal's status within the faculty network and operationalized as centrality. Second, are there structural differences in faculty connectedness in differentially effective schools, operationalized as network density.

The purposes of Part I, the Pilot Study, were to define a model of school effectiveness and to select the operational definition and measure for centrality that was then utilized in Part II. Specifically, the purposes of Part I were to:

1. Describe the network parameters for explaining differential effective faculty communication networks within a structural model (The Centrality - Cohesiveness Model). The differences in the networks illustrate the multiple combinations possible between (a) levels of principal leadership (high or low) and (b) the levels of faculty cohesiveness (high or low).
2. Match the levels of the Centrality - Cohesiveness model with a set of descriptions of expected sociogram types. Each type describes a representation of the communication network in differentially effective schools based on school effectiveness research.
3. Test the differential capacity of the centrality and cohesiveness measures to the Centrality - Cohesiveness Model using 16 schools from a Pilot Study.

4. And explore the fit of the expected sociograms to the actual representations, using Krackplot (Krackhardt, Blythe, & McGrath, 1994, 1995).

Chapter Four describes the: model development, the sample, the methodology, the data collection procedures, the analysis and results for Part I. Part I was the first step in a sequentially designed exploration of faculty networks. The procedures from Part I were incorporated into Part II, the results lead to the choice of measures utilized, and the conclusions guided the focus and direction of analysis. The development of the Centrality - Cohesiveness model, which was initially described in Chapter One, is further explored here.

Definition of Model

This study hypothesized that there would be differences in the communication structures of differentially effective school faculties. To test this hypothesis, a structural model depicting levels of differentially effective schools was developed. The parameters of the communication structures are represented by the Centrality-Cohesiveness Model of School Effectiveness. The communication structure of a school was defined as a function of the leadership status of the principal (operationalized as the principal's centrality within the faculty network) and the cohesiveness of the faculty (operationalized as the density, or connectedness of the network).

The two parameters, the principal's leadership status and the cohesiveness of the group were ranked as "High" or "Low". A matrix was built with the leadership status aligned on the left and the cohesiveness variable across the top. There were then four classifications, within the four cells of the matrix: high leadership with high

cohesiveness (HH), high leadership with low cohesiveness (HL), low leadership with high cohesiveness (LH), and low leadership with low cohesiveness, (LL).

Additionally, definitions of expected structural representations (sociograms) were developed for each cell of the matrix to match the four classifications. Slater and Teddlie (1992) hypothesized that there are eight stages of school effectiveness ranging from most effective to most ineffective. Guided by (a) the Slater Teddlie TSEL model, (b) the vast amount of qualitative descriptions on the characteristics of effective and ineffective schools, (c) the specific findings from the Louisiana School Effectiveness Study (LSES) (Teddlie & Stringfield, 1993), and (d) appropriate network components for illustrating the model classifications within each cell, six definitions for representative types of communication structures (sociograms) related to the four effectiveness classifications were defined. The six definitions of expected sociograms are not meant to be exact prototypes for each classification, but rather representations that both capture the differential nature suggested in the literature and accommodate the variety of formally defined leadership configurations found in elementary schools. These configurations include grade leaders, committees and other hierarchal patterns.

Methodology for Model Construction

In constructing the model and the six definitions for the expected sociogram types, the intent was to illustrate the main features of the theorized communication networks. These main features of each type relate to the activities and processes that might take place in schools with structural configurations similar to those defined within each cell parameters. The parameters of the communication structures were

the status of the principal and the cohesiveness of the faculty. The qualitative methodology for accomplishing this consisted of analyzing and synthesizing the qualitative results from prior school effectiveness research (such as the correlates) and qualitative descriptions of differentially effective schools and matching the results with structural elements.

These structural elements of a network represent the flow of communication from one individual within the group to another/others. The most common structural elements include (a) dyads, (b) wheels, (c) chains, and (d) isolates. Each of the structural elements describes a communication behavior. For example, dyads represent two individuals engaged in conversation, chains indicate information moving from one individual, through another and onto another. Isolates represent individuals who do not communicate with others. Reciprocal choices indicate mutual agreement about the communication relationship under questions.

The purpose was to match these qualitative descriptions from school effectiveness research to the structural elements that graphically best represent the qualitative description. This process is similar to what Miles and Huberman (1994) describe as matrix analysis. The process was to look for descriptions which would indicate differential structural characteristics on the two parameters (centrality and cohesiveness) and that could then be represented by network components within a sociogram. Miles and Huberman describe matrix analysis as a process for making sense out of qualitative data through (a) summarizing, (b) seeing themes, patterns and clusters, (c) developing explanations, (d) making comparisons and contrasts, and (e) summarizing. The data analyzed were qualitative descriptions of specific behaviors,

activities and processes descriptive of differentially effective schools. This process is also similar to Reitzug's (1989) investigation of the principal-teacher interactions in instructionally effective and ordinary elementary schools.

On the basis of the qualitative descriptions from prior research on schools classified as differentially effective, two types of communication components seem to distinguish between schools classified as effective and schools classified as ineffective. The components summarize the kind of communication environment that characterizes differentially effective schools. The two components are: (a) the inclusion or absence of direct and indirect contact a principal has with teachers and (b) the content and amount of face to face communication that is related to academic matters. The first is an indication of activity and the second is related to the conditions of communication.

These components have consistently been described in the literature through a variety of deferential descriptions. Slater and Teddlie (1992), and Teddlie and Stringfield (1993) describe principals in schools classified as effective as: (a) having formal communication structures through memos and policy books, (b) address problems openly, and (c) have direct contact with teachers as needed to solve problems. Levine and Lezotte (1990) described both the components of activity and condition by effective principals who are frequently in and out of classrooms and who talk to teachers face to face. Murphy (1988) also identified these components by principals who provide feedback about instruction. When principals engage in these types of communication situations, they are in direct contact and often in face to face communication with teachers. Other indicators may link the principal and the

teachers in communication indirectly such as procedures for communicating school wide goals (Murphy, 1988).

In contrast, principals of schools classified as ineffective (a) tend to have little or no contact with teachers (Slater & Teddlie, 1992), (b) tend to "wander around" the school (Levine & Lezotte, 1990), and (c) they are "hesitant, indecisive" leaders (Slater & Teddlie, 1992).

The definitions developed for the six cells of the model include both the principal's leadership status and the group's cohesiveness and are as follows (the uppercase initials represent high or low principal status and high or low cohesiveness):

Type 1. (HH) The principal is the only identifiable leader in a hierarchial chain of command, with high faculty cohesiveness.

Type 2. (HH) The principal is the only identifiable leader within one highly cohesive group.

Type 3. (HL) The principal is an identifiable leader with low faculty cohesiveness.

Type 4. (LH) The principal is not an identifiable leader, there is an identifiable rival, with high faculty cohesiveness.

Type 5. (LH) There is no identifiable leader, with high faculty cohesiveness.

Type 6. (LL) There is no identifiable leader and low faculty cohesiveness.

Faculties with high principal centrality and high faculty cohesiveness are hypothesized to have a Type 1 or a Type 2 structure. (Type 1 accounts for a more formal hierarchial leadership authority structure with defined grade leaders, or a

leader authorized and supported by the principal). Faculties with high principal centrality and low faculty cohesiveness are hypothesized to have a Type 3 structure. Faculties with low principal centrality and high cohesiveness are hypothesized to have a Type 4 or 5 structure, and faculties with low principal centrality and low faculty cohesiveness are hypothesized to have a Type 6 structure. Table 4.1.

illustrates the Centrality - Cohesiveness Model of School Effectiveness.

Table 4.1.

The Centrality - Cohesiveness Model of School Effectiveness

		Faculty Cohesiveness	
		High	Low
Principal Leadership	High	HH (Types 1 or 2)	HL (Type 3)
	Low	LH (Types 4 or 5)	LL (Type 6)

Each cell of the model describes the relationship between the structural variables under investigation - the principal's centrality and the level of cohesiveness of the faculty.

In constructing the model and the six definitions for expected sociogram types for use in this investigation, the intent was to describe and illustrate the main features of theorized communication networks which might portray the cumulative behaviors, actions, and processes that might take place in a school. The purpose of this model was to provide a guide for distinguishing the characteristics of differentially effective schools within the context of a communication network. The intent was not to construct a definitive list of components and associated behaviors,

actions and processes within each component, but rather to depict a general conceptual framework within which to sort a variety of descriptions about how faculties communicate, what this communication looks like, and how the leadership of the principal fits into the overall faculty network. The purpose for this model was to provide a conceptual framework for the analysis of differentially effective school communication characteristics, but not a "one-stop" shopping list of absolute descriptors.

Sample

The 16 schools used in the Pilot Study to test the Centrality - Cohesiveness Model were from the Louisiana School Effectiveness Study, Phase IV (LSES-IV) (Teddlie & Stringfield, 1993). The LSES began in 1982 and continues to be a source of information on the characteristics and nature of differentially effective schools. LSES-III through -V has developed into a historical longitudinal study. An effectiveness status for the original 16 schools was determined prior to LSES - III and this effectiveness status has been monitored throughout LSES-III, -IV, and -V.

The schools for this study were originally selected for LSES-III (1984-1985) based on a matched-pair outlier research design. The same schools selected in LSES-III were also specified in the research design for use in LSES-IV in 1989-1990 and were subsequently also used in LSES-IV in 1995-1996. The sample for LSES-III, -IV, and -V consisted of eight pairs of schools representing the northern, central and southern regions of the state of Louisiana. Sample schools were also selected to represent urban, rural and suburban areas.

The schools for LSES-III were drawn from 13 school systems (12 selected previously for LSES-II, with the addition of one large urban system). The Third

grade school means for the 1982-1983 and 1983-1984 total language arts section of the Basic Skills Test (BST) (a minimal skills criterion referenced test - CRT) were computed. Schools were then considered for inclusion in LSES-III and -IV if the following criteria were met: (a) the school scored above or below predicted achievement for at least one year based on regression models using data on mother's education, father's profession, and student body racial composition as independent variables predicting the mean BST language arts scores, and (b) a school of similar economic and racial composition with opposite directional achievement could be identified within or contiguous to the same system. Nine pairs were then chosen following the additional geographic, urbanicity, and ethnicity restraints, and eight pairs were retained for study in LSES-III. Further details on the research design and the sample selection procedures can be found in Stringfield and Teddlie (1991) and Teddlie and Stringfield (1993).

The 16 total schools were reclassified in LSES-IV as stable effective, stable ineffective, effective declining, and ineffective improving. For the analyses in this study, schools were dichotomously classified (effective, ineffective) using the effectiveness status determined in LSES-IV. Stable effective and ineffective improving LSES-IV schools were reclassified as effective; and stable ineffective and effective declining LSES-IV schools were reclassified as ineffective. The sociometric data for this study were collected during LSES-IV, in the Spring of 1990. LSES-IV data constitute the Pilot Study for the current research. Altogether, 374 staff members in 16 schools completed the sociometric protocol used in the pilot study.

Instrumentation

All full and part time teachers (grades K-6) and principals in each of the 16 schools were asked to respond to a sociometric survey consisting of: (a) a cover sheet with requests for demographic information, an explanation of the survey, directions and a sample question and (b) two survey questions. Full time teachers included music, art, Chapter I, and any other full time teachers housed within the school.

The two sociometric questions were written in paragraph form and each contained two parts followed by a faculty roster. The roster technique provides for unlimited choices for each individual to indicate all interaction; therefore, the total network and the individual links are not limited by a quota. The roster technique also ensures that each individual can access links with the entire network population (Rogers & Kincaid, 1981). The rosters were developed from faculty lists which had been requested as a routine item from each school during the initial contact to setup LSES - IV field visits for data collection. On the survey itself, faculty were also informed they could include any other person who would be pertinent to their answering the survey questions if they were missing from the roster. Faculty were instructed to add the names to the bottom of the roster.

Faculty were asked, in the first part of the first question, to indicate with whom they had talked about academic matters during the past two weeks. The second part of question one asked teachers to indicate the top three individuals with whom they had talked about academic matters. (A sample of the Sociometric Survey used in the pilot is included in Appendix B.)

The second question asked teachers to indicate whom they would chose to be on a school improvement committee (part one) and to rank their choices (part two).

Data Collection Procedures

There were three standard distribution and collection procedures:

1. Surveys were distributed individually to the teachers before school or during lunch and breaks.
2. Surveys were distributed at a scheduled faculty meeting.
3. Surveys were distributed in teachers' mailboxes.

Teachers were asked to return the surveys to one central location in the school, usually to the secretary or to an envelope by the teachers mailboxes, within a few days. In most of the 16 schools, if the surveys were not returned, researchers contacted teachers individually and prompted a return.

Data Recording and Processing Procedures

Data for network analysis proceeded through three stages. The first stage was the recording of data into the Word Perfect files. Before entering the data for each school, each individual was assigned a code number which was used in place of names. The complete faculty roster, which included teachers who were absent, or did not return the survey, was used to define the network. Entering the sociometric survey data consisted of aligning each code number along the left side and across the top of a matrix. An individual's choices were entered across the row.

The choices made by the row individual are written in the matrix square corresponding to the chosen individual's column. In this study each participant was asked to place a check mark by individuals chosen and then to go back and number

the top three individuals. When the data were entered into the matrix, each first choice was coded a 4. second choice a 3. third choice a 2 and each check was coded as 1. This resulted in a weighted, ranked matrix. All data were entered in Word Perfect 6.0 files.

As the data were entered, each file was checked for the following situations:

1. Teachers who selected multiple individuals for one rank. When this occurred, the individual who was ranked first on the roster list was assigned the rank and all other individuals were coded as 1. For example, a teacher might rank two teachers as "2", indicating the teacher selecting had spoken with both teachers the second most amount. It would be impossible to determine which teacher might have been spoken with more, so an arbitrary decision was made to select one. For the purposes of this study, this selection process posed no bias because all matrixes were dichotomized using UCINET prior to analysis.

2. Teachers included individuals who were not on the roster. When this occurred, the individual was added to the matrix if they were (a) a full-time, long term sub (replaced teacher on original list), or (b) if they were new to the faculty and had not been included on the original list from the school. No aides were included on the roster.

These two questions, with two levels each, provide data for four different networks. The data were entered as ranked data and from the ranked data the binary data sets were created using a routine in UCINETX (transform; dichotomize). The first network, from question one, contained the binary connections between all teachers (1 or 0, indicating spoke with or did not speak with). The second network,

from question one, contained the ranked connections between all teachers. The third network, from question two, contained the binary choices between all teachers (1 or 0, indicating individuals selected for a school improvement committee). The fourth network contained the ranked choices for question two.

The first network was used in the quantitative analyses in this study. The sociograms were constructed from the top three choices from the second network. The sociograms were constructed from a subset of the ranked data.

Network Measures

Individual centrality can be operationalized several ways. Each operational model assumes a particular structural relationship between the members of the network. One of the first steps in applying network analysis is to link the operational definition (model) for a structural concept with the specific network characteristics of the groups being investigated. According to Bolland (1988):

Theoretically, the choice of a model should be governed by the compatibility of its assumptions concerning network flow with those of the theory to which it is applied. But more realistically, the empirical behavior of each model must be considered (p. 238).

In line with this framework, the purpose of the Pilot Study was to determine if there were any differences in the operational definitions for determining the principals's centrality.

Centrality Measures

Centrality describes the status, power or popularity of an individual within a group. A central principal is strategically located within a faculty network. In the Pilot Study, the centrality of the principal was defined in three ways. Then through statistical analysis, two measures were selected for use in Part II, the Field Study.

The three measures of centrality calculated using the UCINETX computer software were: (a) Freeman's normalized indegree, (b) Freeman's betweenness centrality and (c) Freeman's closeness centrality.

Freeman's normalized indegree, a measure of network activity, is equal to the number of other members directly linked to i . This measure, $C_{d(i)}$, was created by taking the normalized indegree for a dichotomous, asymmetric network. This measure is the number of times the individual was chosen by others. The normalized degree centrality (Bolland, 1988) controls for network size: $C'_{d(i)} = C_{d(i)} \div (n - 1)$.

Freeman's Betweenness is described as a measure of information control. Betweenness is how much an individual is indirectly linked to other members of the group and is a measure of the extent to which an individual is between two others individuals within the network. The formula (Bolland, 1988) for betweenness is: $C_{b(i)} = \sum \sum b_{ijm}$, across all n 's. Where, $b_{ijm} = g_{ijm} \div jm$; g_{ijm} is equal to the number of geodesics containing i that are linked to both j and m ; and jm is equal to the number of geodesics linking j to m .

It is possible (and generally the case) that individuals can be connected to other individuals through multiple paths. Geodesics are the shortest distances from one individual to another. For this study, this distance was calculated using the underlying graph for the network. This means that the matrix was symmetric, or $ij = ji$. This measure was normalized by taking the betweenness measure divided by the maximum possible betweenness expressed as a percentage:

$$C'_{b(i)} = 2C_{b(i)} \div (n^2 - 3n + 2).$$

The third measure was Freeman's Closeness, (Bolland, 1988) which is a measure of independence from the control of others, or how close an individual is to

everyone else in the network. This measure has also been described as a measure of efficiency, or the ability to get to others without interference, along the shortest possible path available. Persons with high closeness are productive in getting communication to others and getting feedback back to them. Closeness is defined as the shortest path (geodesic) connecting an i to a j . Closeness was normalized and is expressed as a percentage of the reciprocal of farness divided by the minimum possible farness. The formula for calculating closeness is: $C_{c(i)} = (n - 1) \div \sum d_{ij}$, where, d is the length of the path connecting i to j , (a measure of Farness). This measure cannot be calculated yet on asymmetric networks (Freeman, 1996) and the graph is automatically converted to symmetric, such that the larger value of i or j is used, ($l = \text{the larger of } ij \text{ or } ji$).

Group Centralization Measures

Group centralization measures were also calculated for each of the individual centrality measures. Group centralization measures indicate the extent to which one individual is more likely to be central within the network. The larger the centralization measure the more likely it is that one individual is central and the other individuals are around the edges of the network. Scott (1992) describes centralization measures as describing how tight an organization is around its most central point. The maximum measure would be 1, if one individual were connected to all others and all others to this one individual, and 0 if the graph were completely connected (everyone connected to all other).

Two centralization measures were calculated as a function of the individual measures, degree centralization and betweenness centralization. Both measures are

calculated as part of the UCINETX routine calculations for individual centrality. The network degree centralization measure is the sum of the differences between the largest centrality value in the network and all other values ($\sum C_{d(i^*)} - C_{d(i)}$) divided by the theoretical maximum possible sum of differences in actor centrality, taken pairwise, ($\sum c_{\max} - C_{d(i)}$). The maximum occurs for the star graph, where all individuals chose one individual and this one individual chooses all the other individuals in the network. The theoretical quantity is calculated across all possible networks, with a fixed n .

The betweenness centralization is calculated in the same manner. Scott (1991) describes betweenness centrality as complex but "intuitively meaningful" (p. 90). The betweenness centralization measure is the sum of the differences between the maximum betweenness centrality and the betweenness of all the other individuals in the network and the ($\sum C_{\max} - C_{b(i)}$) divided by the maximum value possible, where $C_{b(i)}$ is the betweenness centrality for individual (i). Freeman (1979) demonstrated that this maximum value possible is $(n-1)^2 (n-2)$.

Cohesiveness Measure

Cohesiveness describes how well the group seems to be bound together. According to Rogers (1975, p.125) cohesiveness is "...the strength of the forces uniting the group members. The members of highly cohesive groups are strongly attracted, and committed, to group membership." Cohesiveness has been defined as the attraction of the individual to the group and has been operationalized as empathy, acceptance, and trust in studies of therapy groups, self-help group, and small work groups. Cohesive groups are committed, and have a sense of belonging to the group

(Mudrack, 1989). Definitions of cohesiveness have included the degree to which the members of a group desire to remain in the group. This has been operationalized as a measure of "interpersonal attraction" or a "friendship index", or the total times an individual is chosen. Definitions of this type vary little from definitions of centrality. The particular measure of cohesiveness used in this study was a measure of cohesiveness was network density. This measure indicates the extent to which the entire network is connected to each other. It is a measure of the connectedness of the group, within which the principal is positioned. Density is the proportion of possible connections (l) that are actually present:
$$\text{density} = \frac{l}{n(n-1) / 2}$$

Analysis

Three types of quantitative analysis were performed. First, correlations of the individual scores on the three measures of centrality were calculated to determine how related the three measures were. Second, comparisons were then made between effectiveness levels on the principals indegree and betweenness scores. T-tests were used to determine if the centralization of the principal within the faculty structures showed statistically significant differences between effective and ineffective schools on these two centrality measures. Third, comparisons were made between effectiveness levels on the network centralization and network density scores. In addition, a qualitative analysis was conducted on the network sociograms.

Sociograms were developed for each school using Krackplot 3.0, with dichotomous, directional data based on the top three choices each individual made to

question one, from the sociometric survey. This resulted in a sociogram which was a subset of the total network. The Sociograms were constructed using Krackplot 3.0 through the following procedures: (a) the graph of each network was imported into Krackplot in a random pattern, (b) the random pattern was then laid out using Quick Multidimensional Scaling, which provides a crude picture of the graph layout based on a two-dimensional solution which is based on the shortest path distances (the geodesic path) between all pairs of teachers (nodes), and (c) this graph was then laid out with a simulated annealing routine. The defaults for the annealing routine were set to: (a) maximize nodes (teachers) forming clusters determined by connections to other nodes (teachers), (b) isolates to be separate from the group, and (c) and minimize edge (line) length. The principals connections were highlighted on each sociogram, and the individuals ranking first, second, and third on the indegree centrality measure were coded (A sample set of data for one school is provided in Appendix C). The final sociograms for the pilot schools are illustrated in Figures 4.1 through Figure 4.16.

The next step in the analysis of the sociograms was to classify each school based on the centrality and the cohesiveness measures. Each of the schools was rank ordered by the combination of both the centrality and the cohesiveness scores. This was accomplished through a crude and arbitrary classification. A school was assigned a rank of H (high) if the school was at or above the mean on each of the two measures (centrality and cohesiveness) and a rank of L (low) if the school was below the mean on each of the measures. This resulted in a list of schools with any combination of H and L on the two measures.

Schools were then rank ordered by this combination of H's and L's, with centrality listed first and cohesiveness second, such that HH was ranked first, HL next, then LH and LL. The schools were then sorted into the cells of Centrality Cohesiveness Model according to the matching classifications. This resulted in the classifications depicted in Table 4.2. This table also includes the schools sorted by current effectiveness status and in parentheses the longitudinal classification for the Pilot schools. A discussion of the results follows the sociograms.

Table 4.2.

Pilot schools within Centrality - Cohesiveness Model

<p style="text-align: center;">HH</p> <p><u>Effective Status</u> <u>Ineffective Status</u></p> <p>PB1 (improving) PG1 (improving) PE2 (stable) PA2 (stable) PB2 (stable)</p>	<p style="text-align: center;">HL</p> <p><u>Effective Status</u> <u>Ineffective Status</u></p> <p>PC1 (improving) PA1 (stable) PE1 (improving) PG2 (declining)</p>
<p style="text-align: center;">LH</p> <p><u>Effective Status</u> <u>Ineffective Status</u></p> <p>PH2 (stable) PH1 (stable)</p>	<p style="text-align: center;">LL</p> <p><u>Effective Status</u> <u>Ineffective Status</u></p> <p>PD1 (improving) PD2 (declining) PF2 (stable) PF1 (stable) PC2 (declining)</p>

The following sociograms illustrate, graphically, the position of the principal within each school's network. The sociograms were constructed from the top three choices each individual spoke with on question one (whom did you talk with about academically related matters). The principal's connections were then highlighted. The individuals in circles are the top three ranked individuals on Freeman's Indegree

Centrality. The sociogram key with each sociogram indicates the rankings for these individuals. Multiple individuals for a ranking indicate tied scores. The scores on the indegree measure were calculated on all individuals within the network. The measure was calculated on the network scores and the sociogram illustrates a subset of that overall network. The 16 schools are sequentially listed from PA1 through PH2.

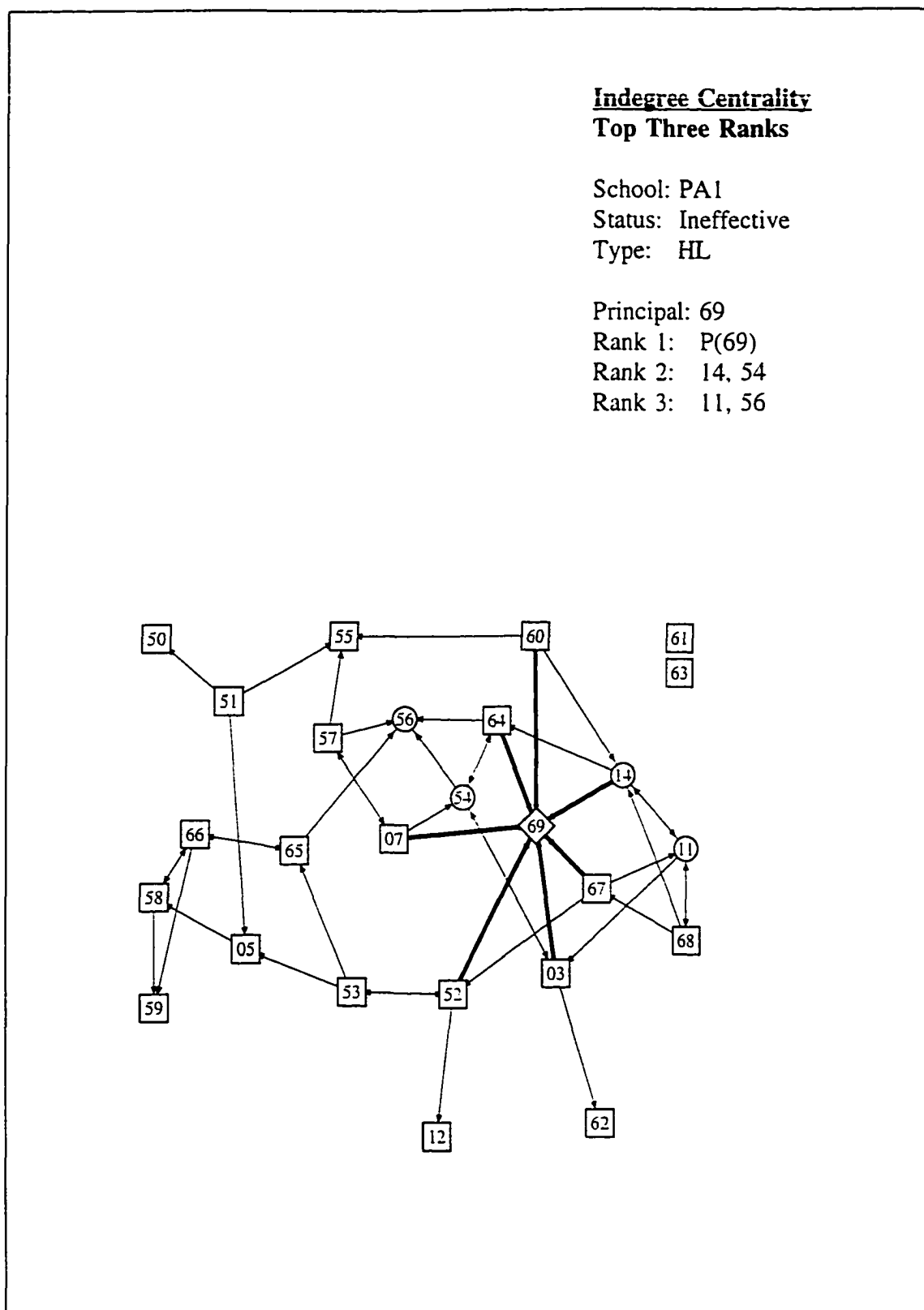


Figure 4.1. School PA1

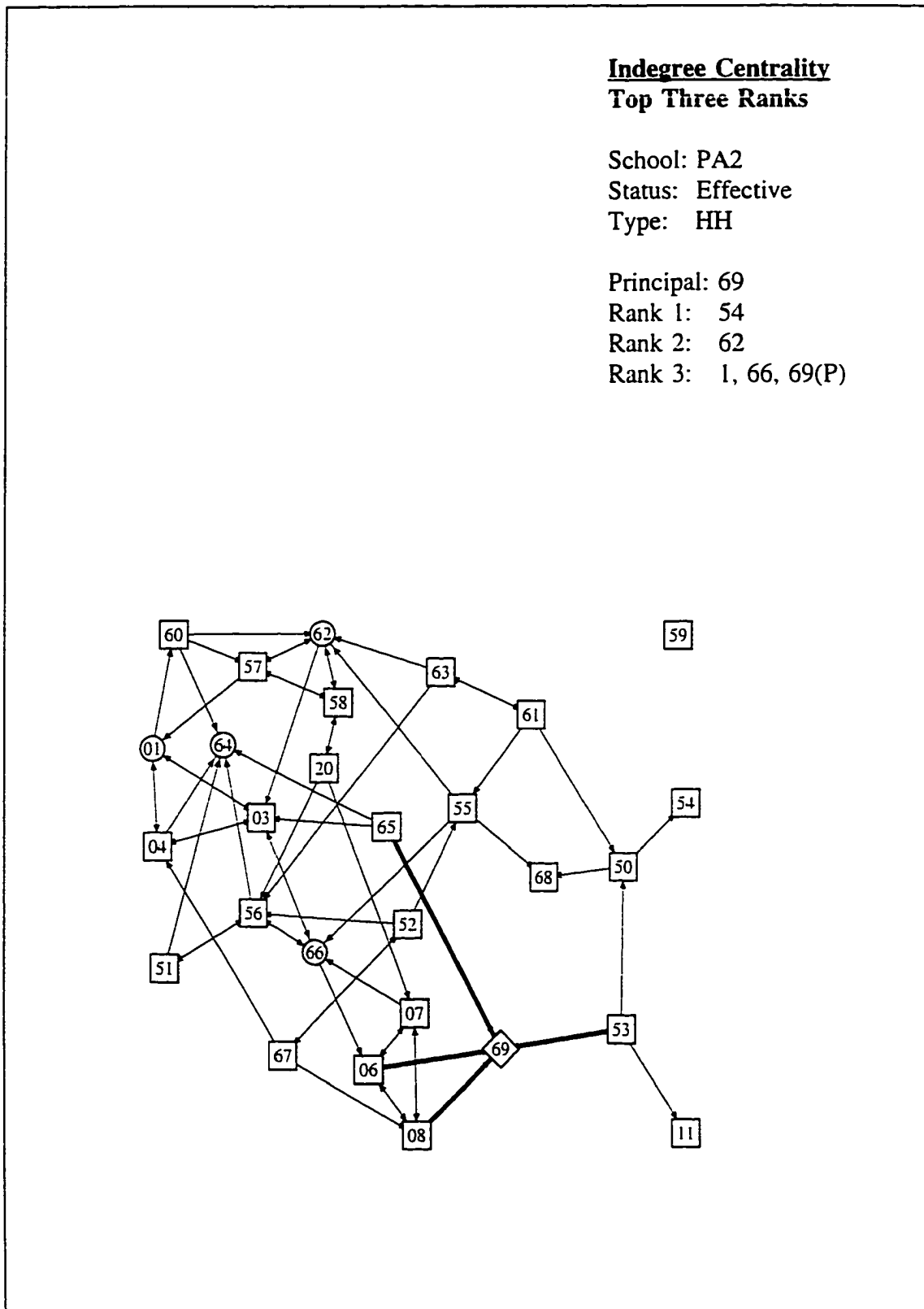


Figure 4.2. School PA2

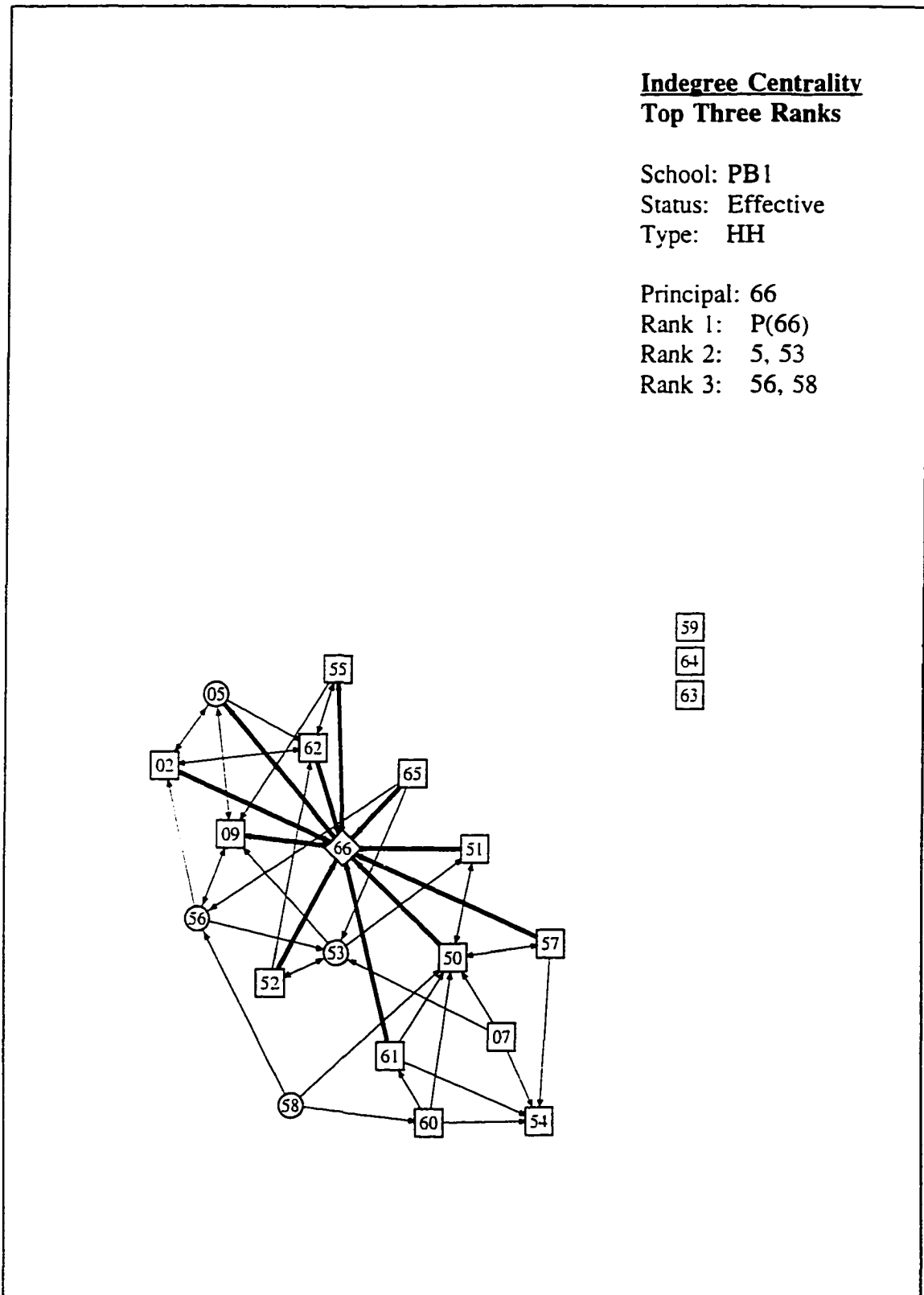


Figure 4.3. School PB1

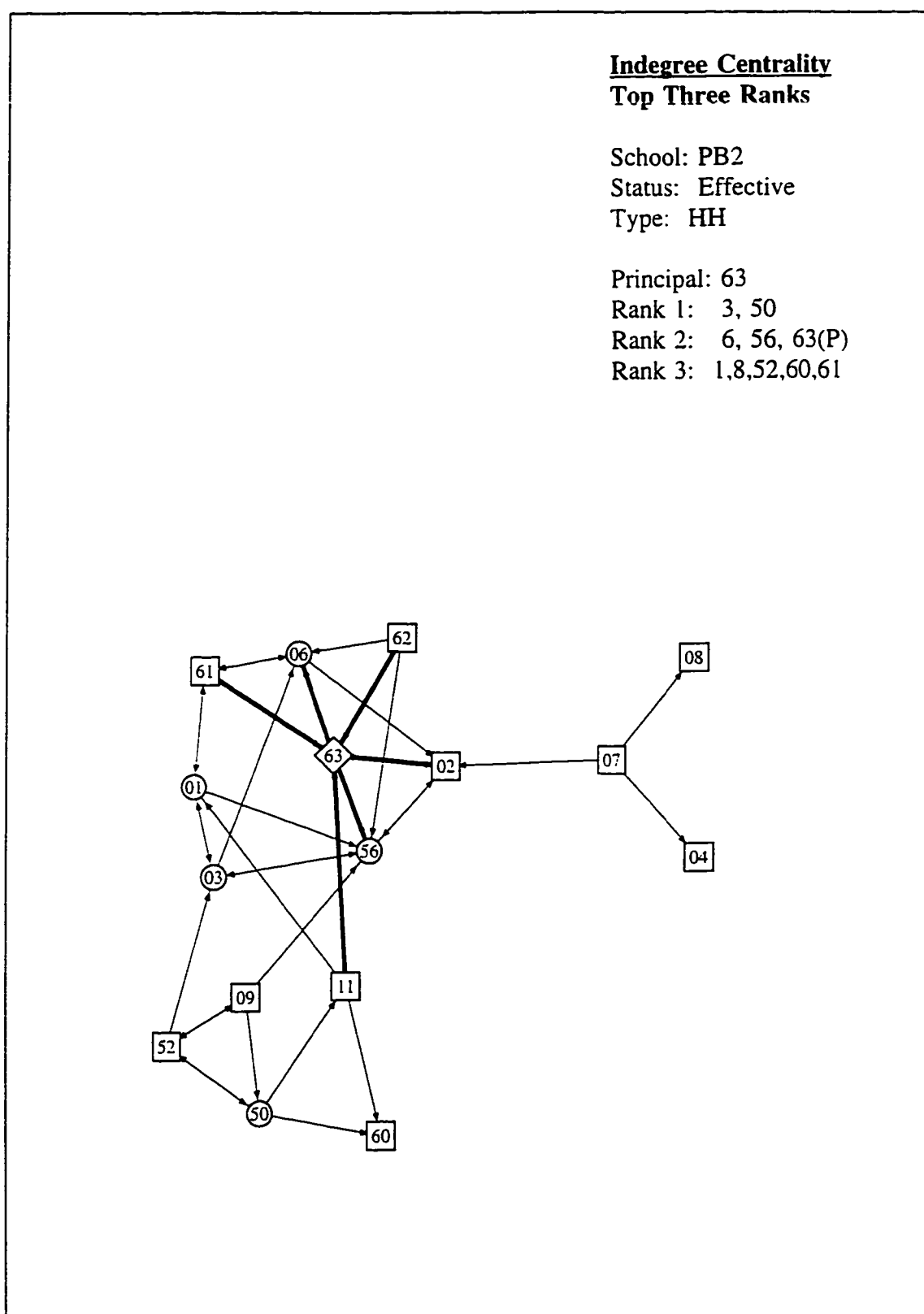


Figure 4.4. School PB2

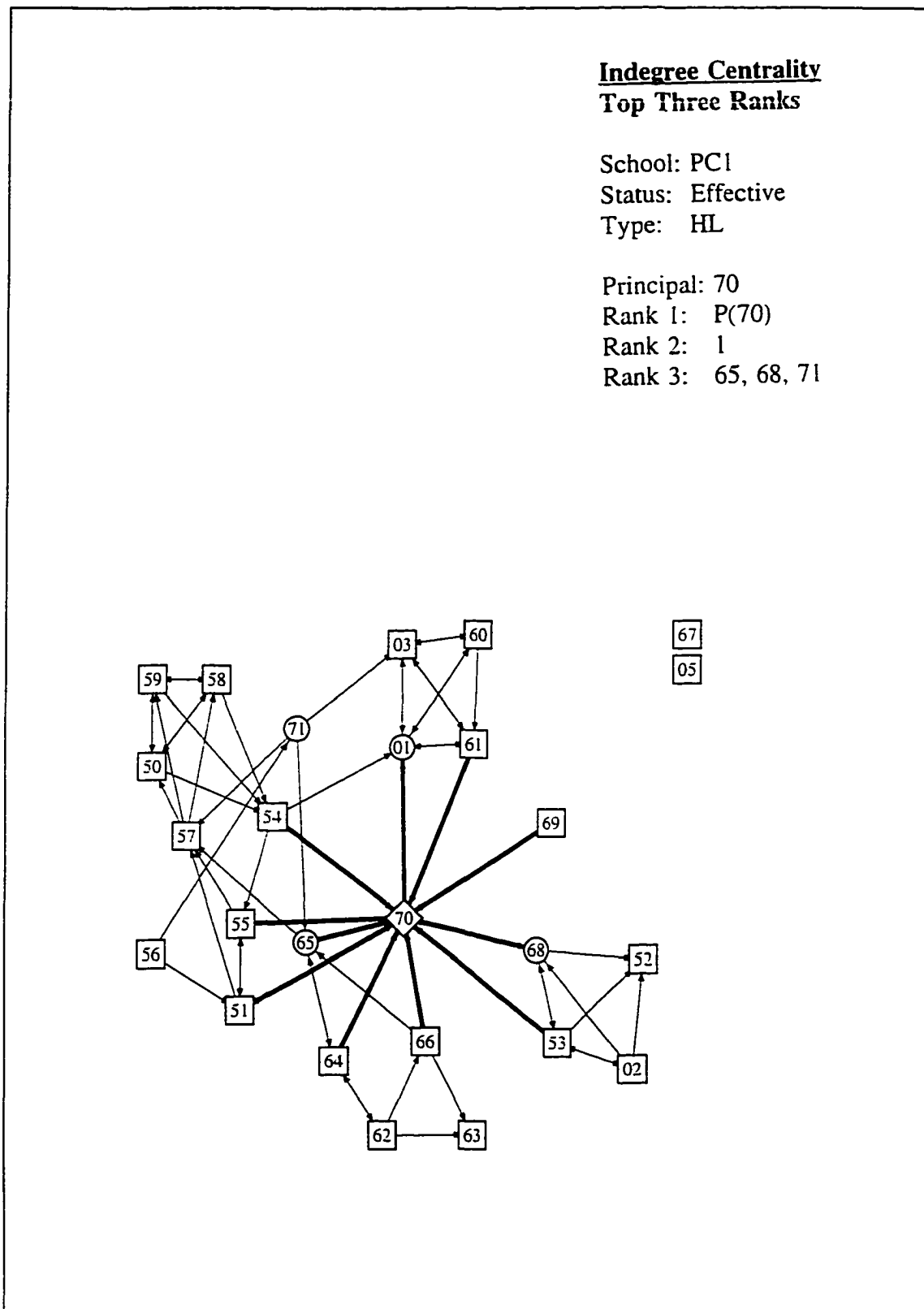


Figure 4.5. School PC1

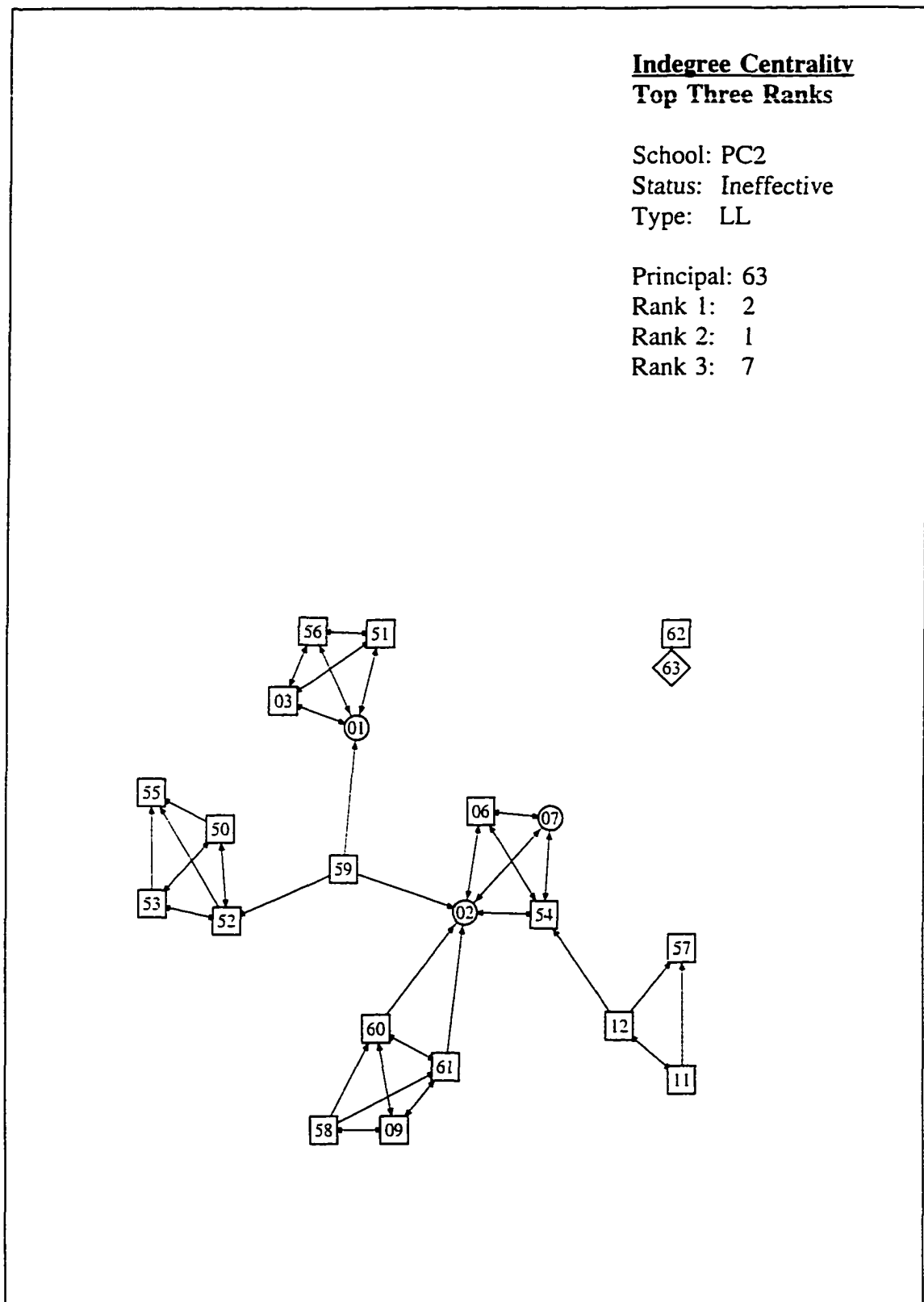


Figure 4.6. School PC2

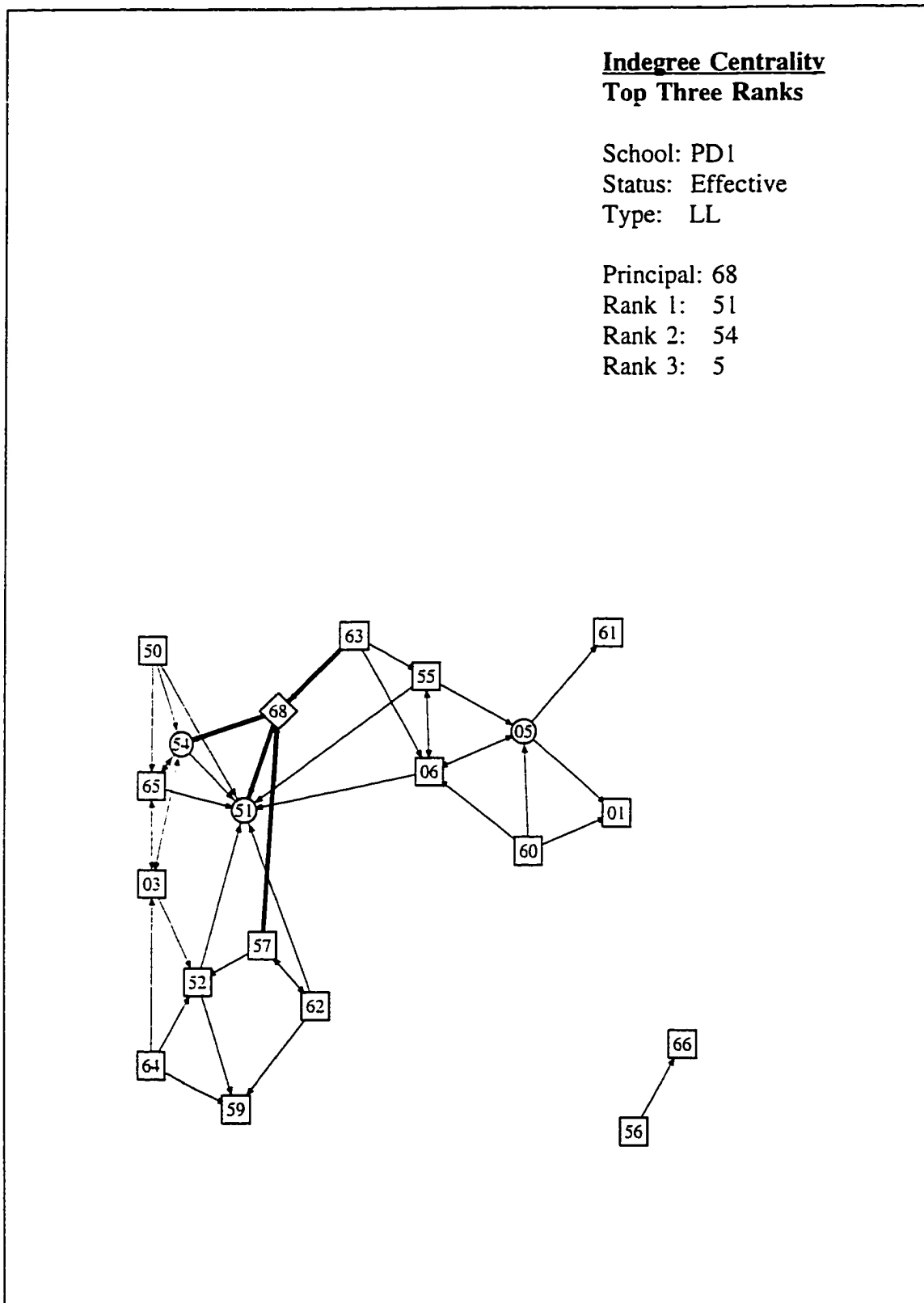


Figure 4.7. School PD1

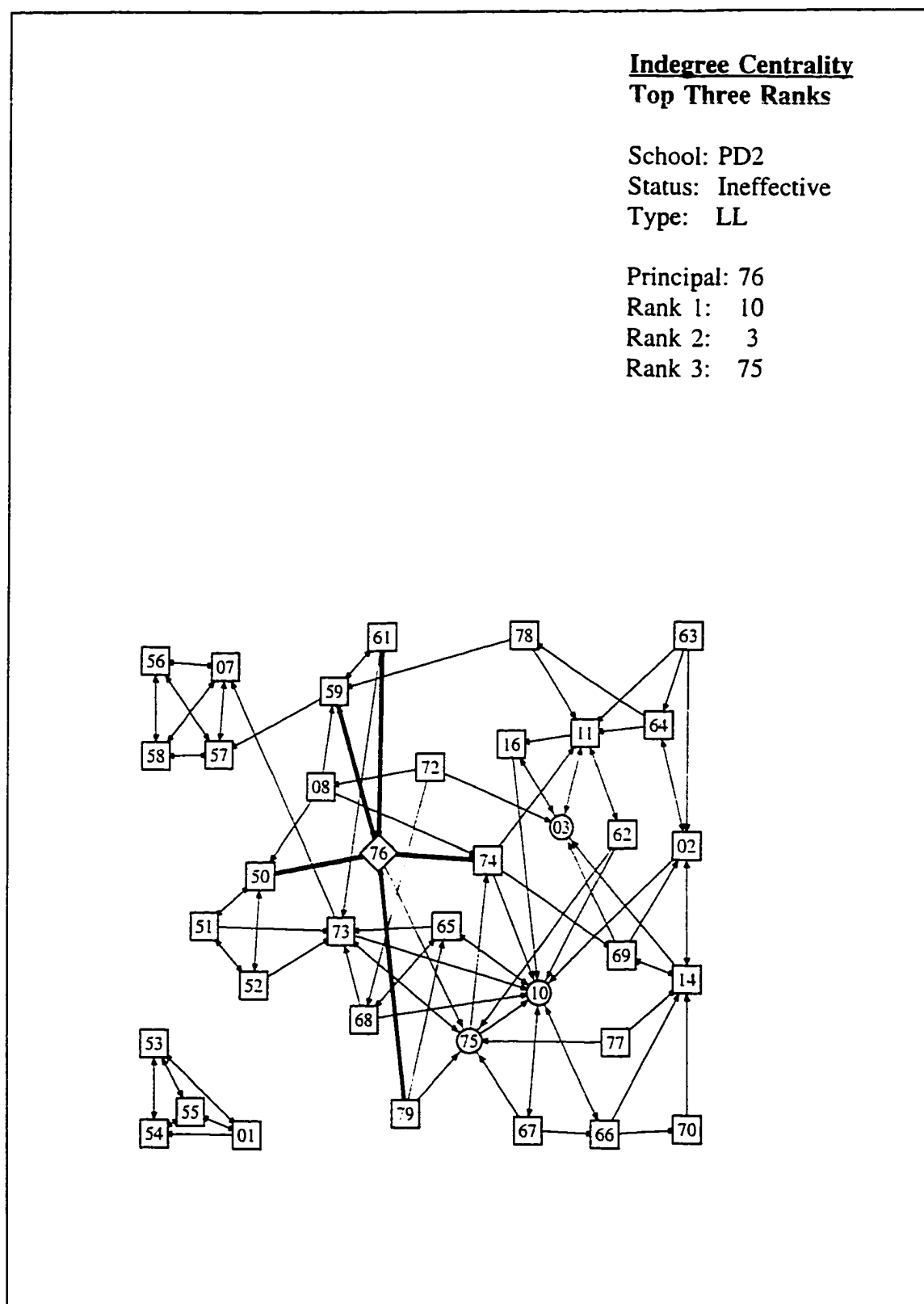


Figure 4.8. School PD2

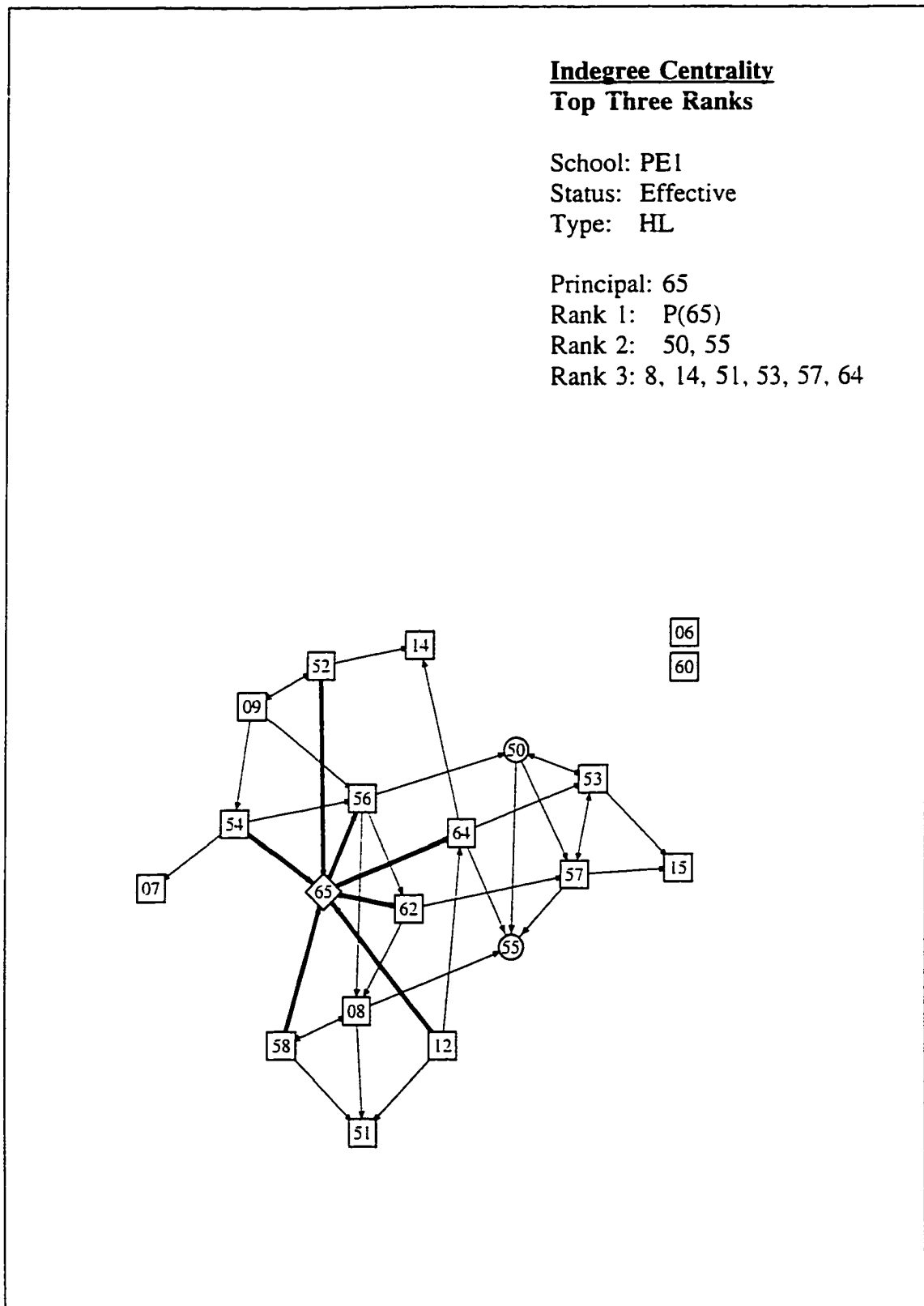


Figure 4.9. School PE1

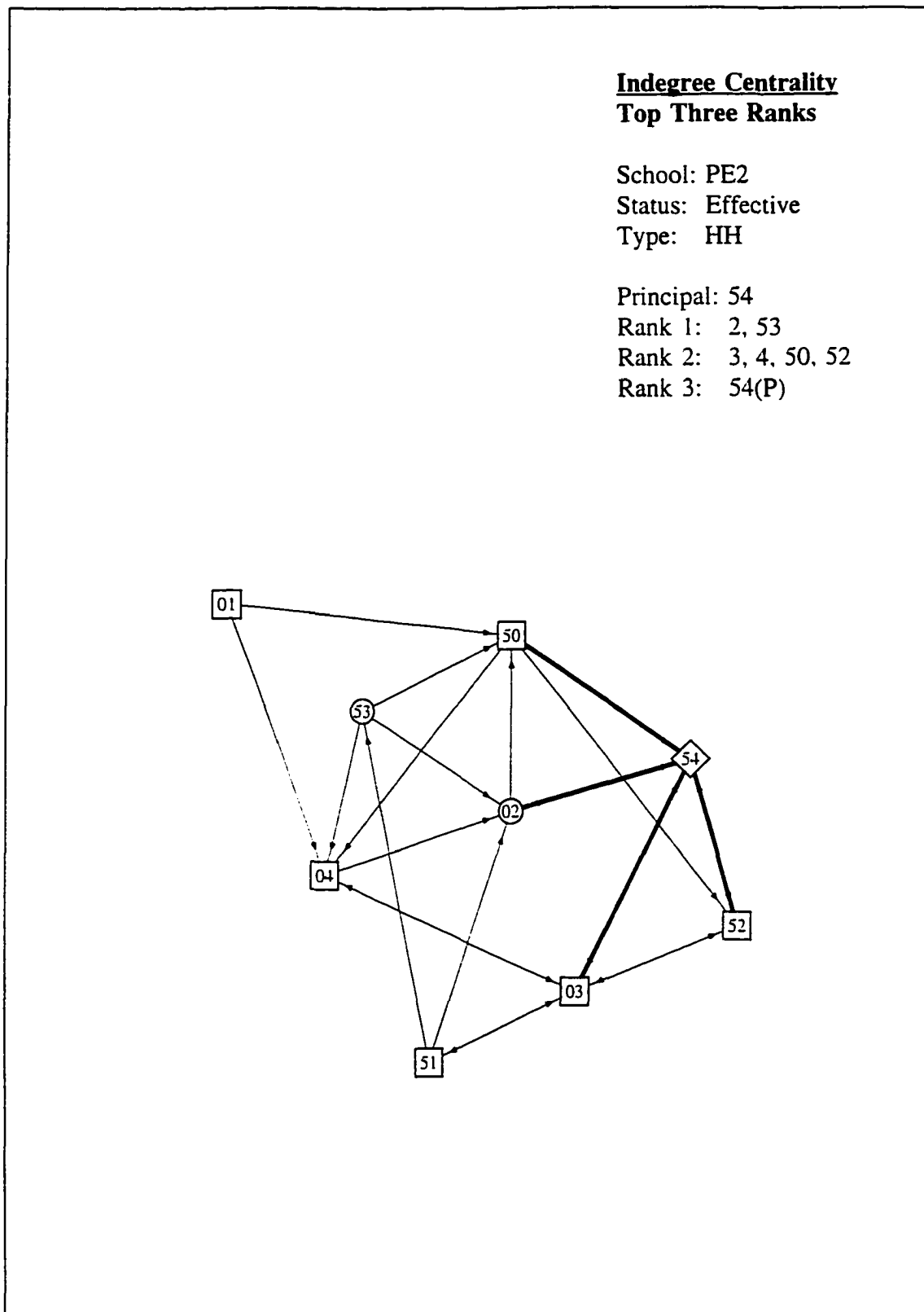


Figure 4.10. School PE2

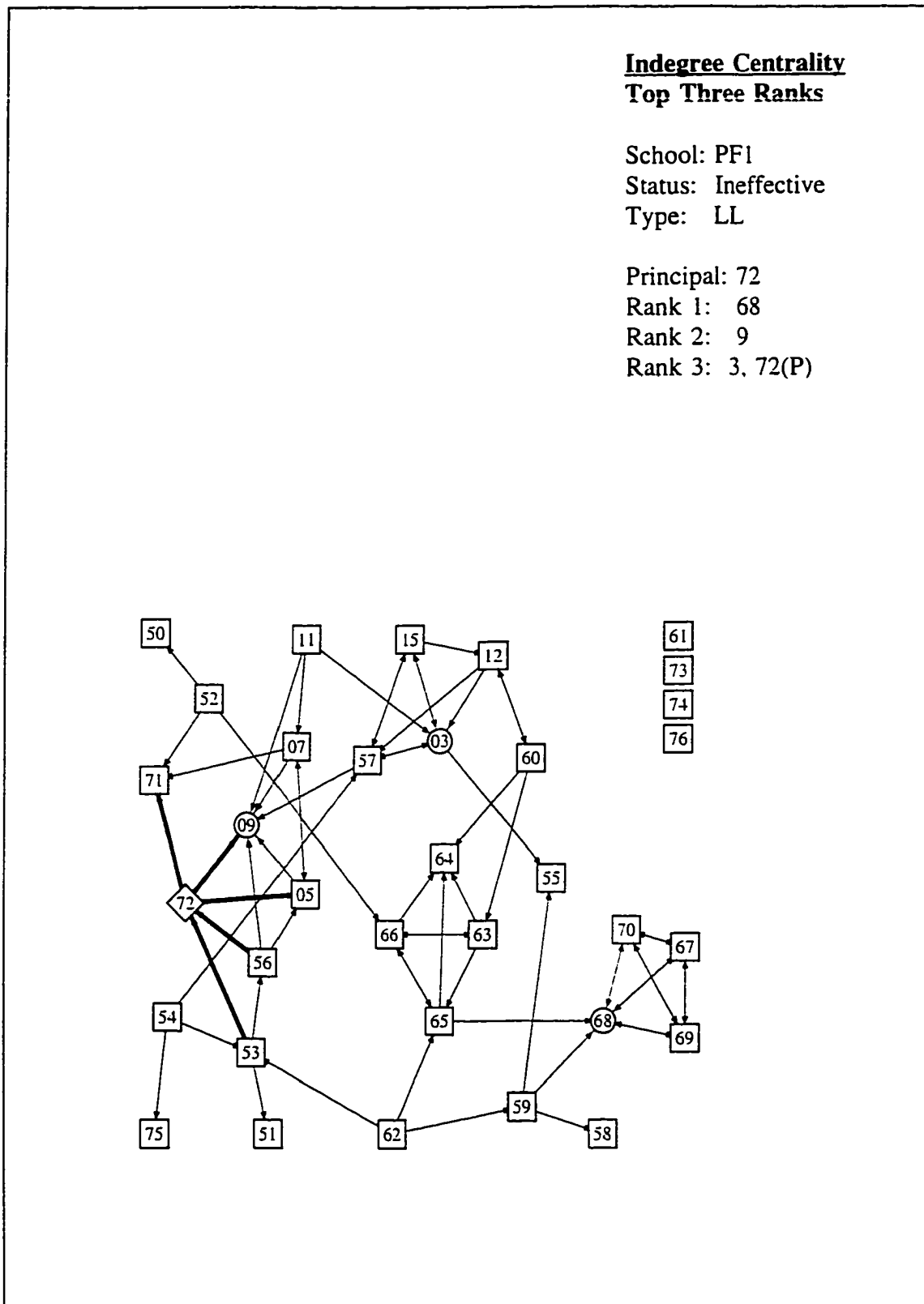


Figure 4.11. School PF1

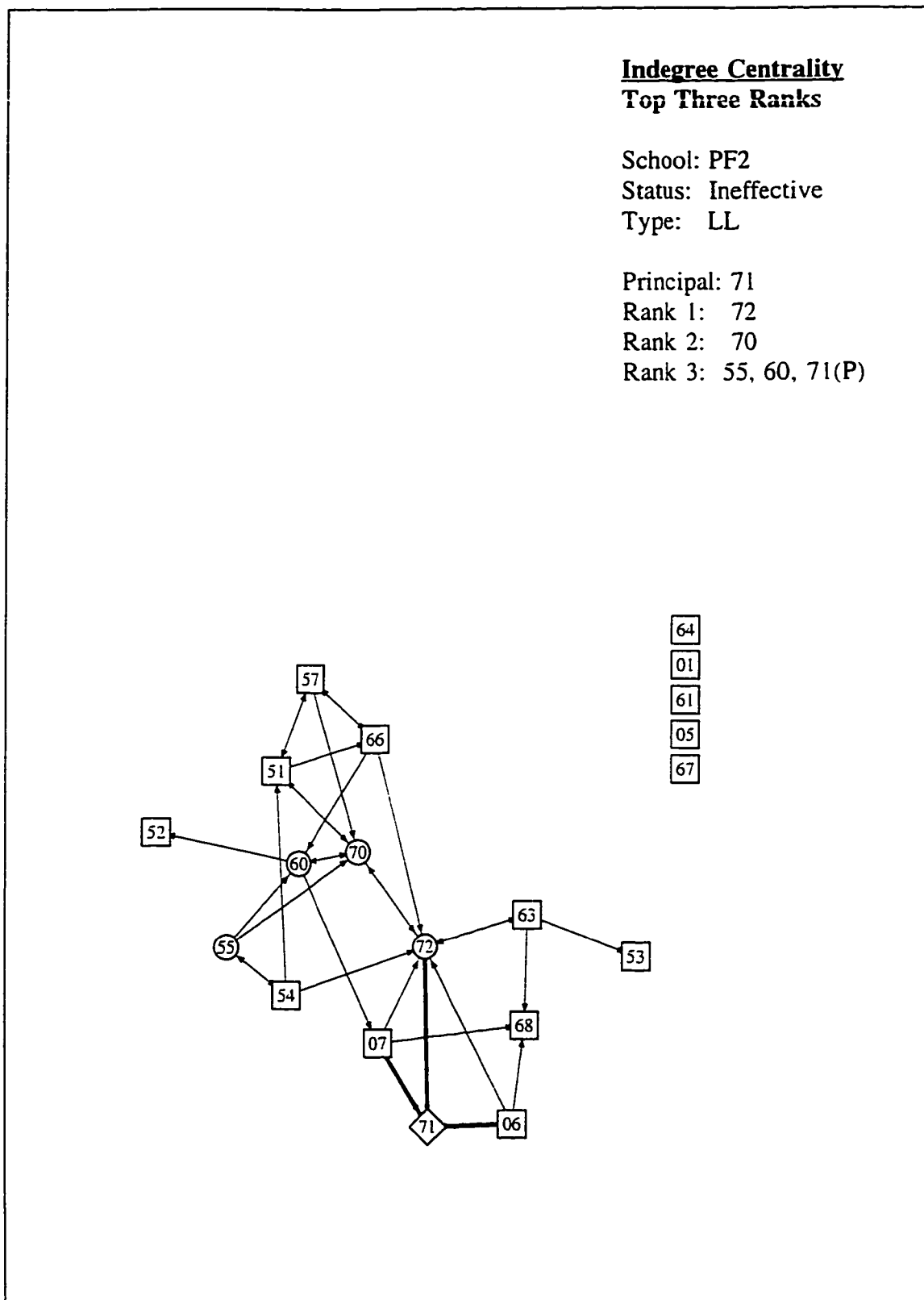


Figure 4.12. School PF2

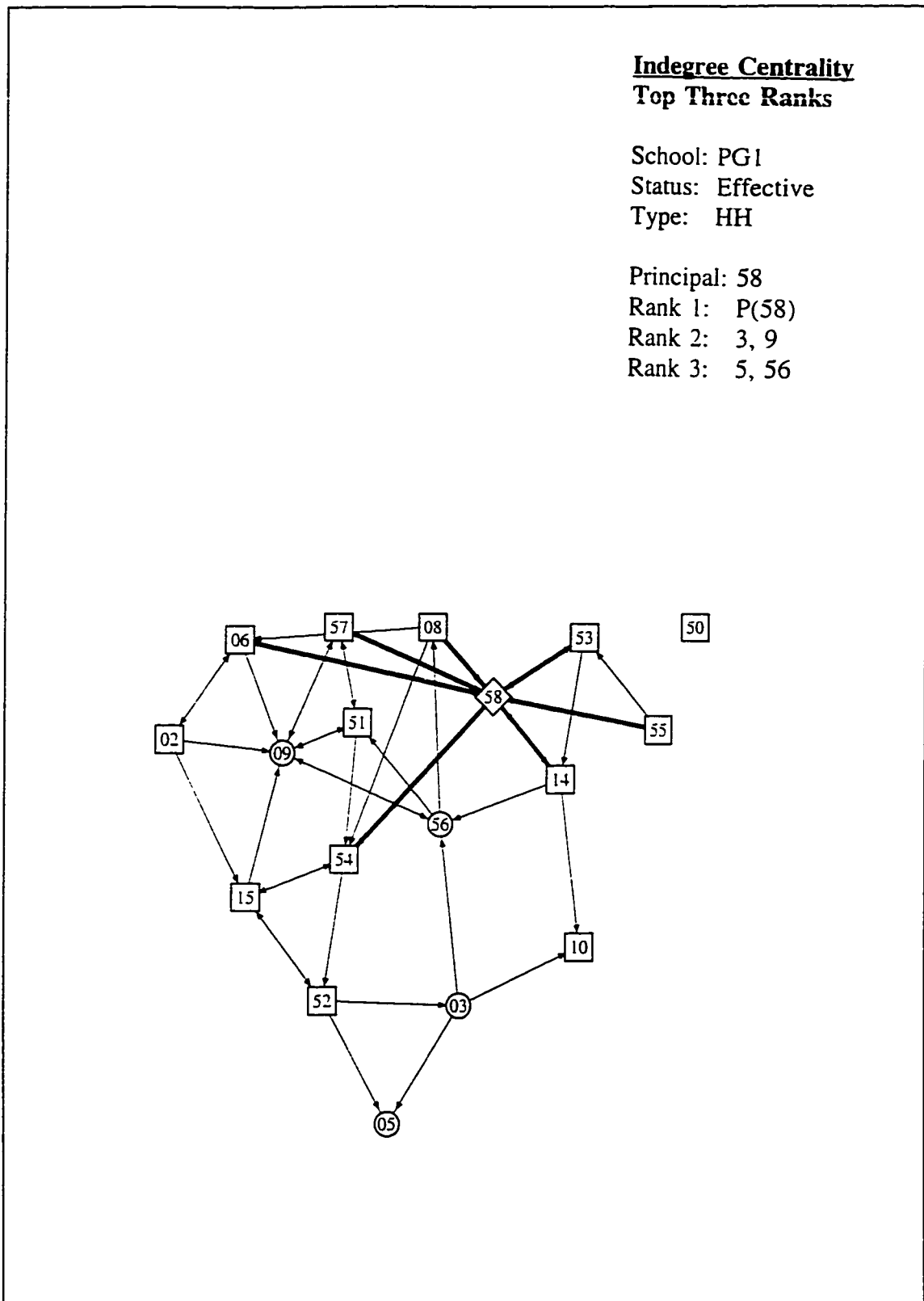


Figure 4.13. School PG1

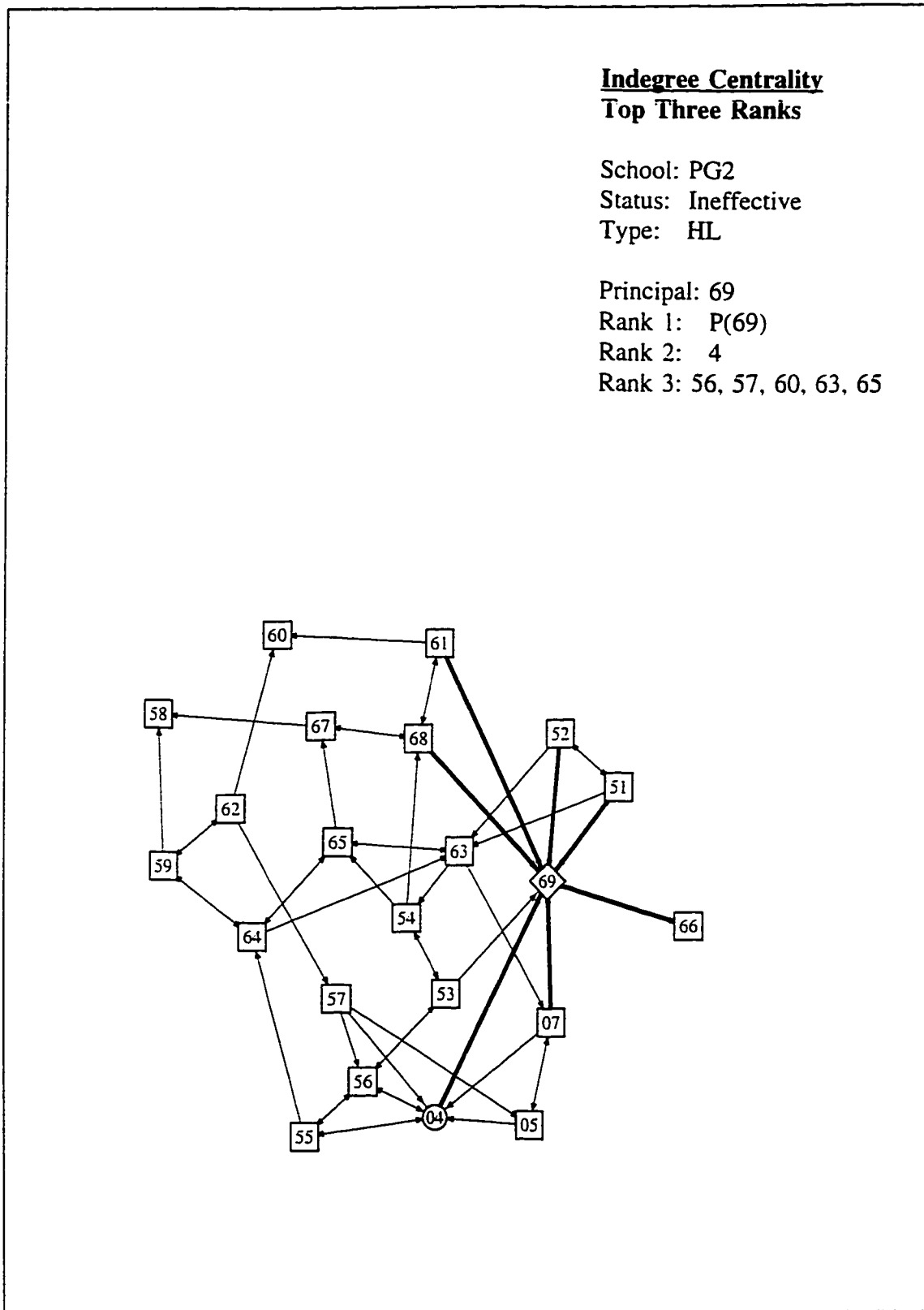


Figure 4.14. School PG2

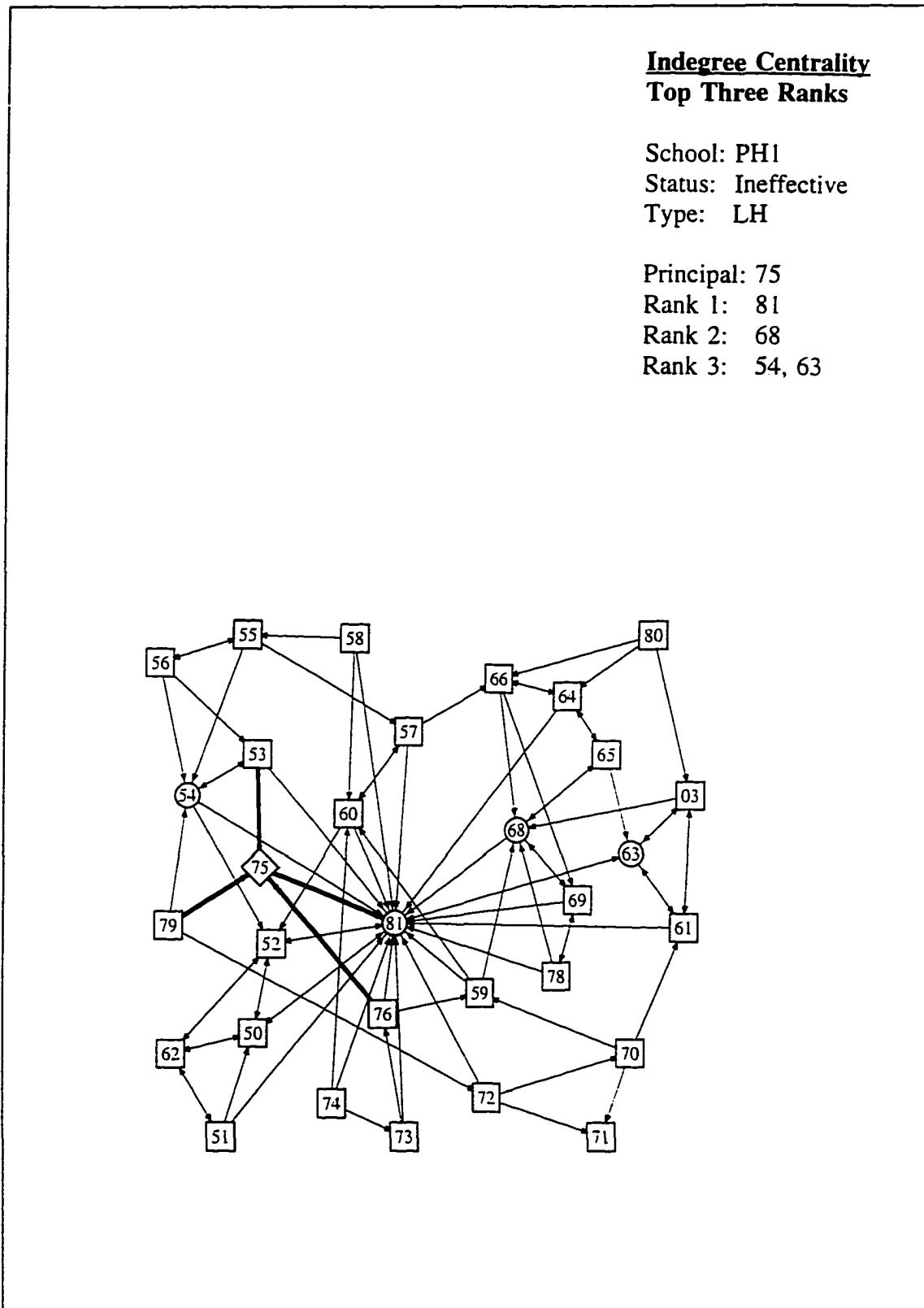


Figure 4.15. School PH1

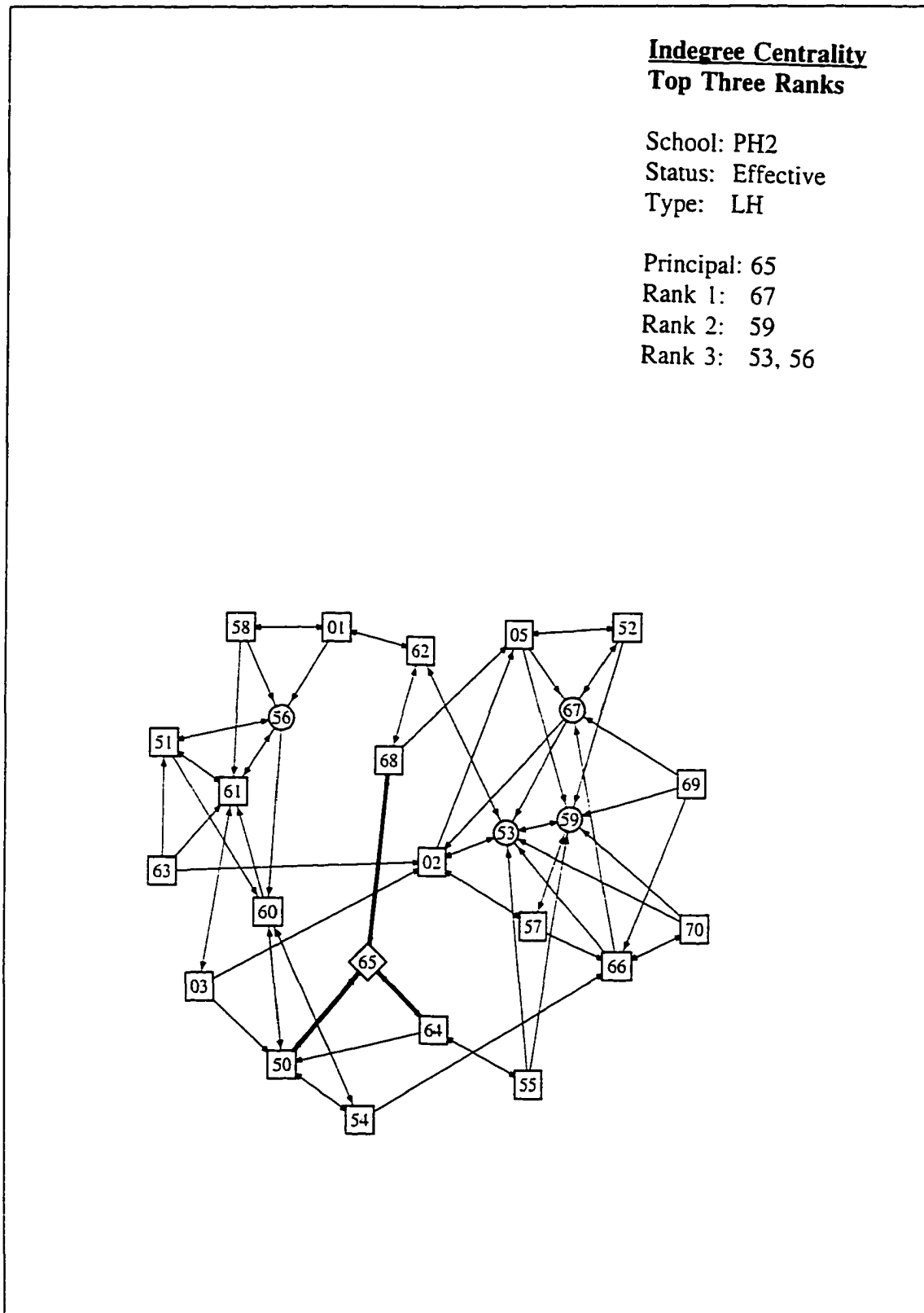


Figure 4.16. School PH2

Results and Discussion - Pilot Study

The goal of Part I was to test three measures of individual centrality. There were two questions addressed. First, do the three measures of individual centrality tap different properties of the network, and second, would the measures indicate different types of communication structures for differentially effective schools.

Correlations between the three measures (analyzed per school, for all individuals) indicated the same pattern of correlations for 14 of the 16 schools. In these 14 school, the highest correlations were between normalized closeness and normalized betweenness, the next highest were between closeness and the normalized indegree, and the two least correlated measures were normalized betweenness and the normalized indegree.

Two of the 16 schools had the highest correlations between the normalized closeness and the normalized indegree, then the closeness and normalized betweenness. In these 2 schools the betweenness and the indegree correlations were also the least correlated.

These overall patterns of correlations, in all 16 schools, seem to indicate that closeness and betweenness may be measuring similar conceptualizations of connectedness, and betweenness and indegree may be measuring two different conceptualizations of connectedness. Closeness and indegree appear to be measuring similar patterns of network connections and betweenness and indegree may be measuring different patterns.

This overall correlational pattern between the three measures (the pairs of closeness/indegree and closeness/ betweenness more highly correlated than

betweenness and indegree) is similar to that found by Bolland (1988). (The correlations for the current study ranged from .9810 to -.3070.) Bolland describes the intercorrelation among the measures as "redundancy" (p. 251). In his analysis on the performance of four centrality models Bolland reviewed the theoretical constructs underlying the models and provided suggestions for the selection of a model. On the basis of the differential patterns observed from the correlations in this research, indegree and betweenness were chosen as the initial measures to use to explore the centrality of the principal in Part I, the Pilot Study, and Part II, the Field Study.

Results are reported for the following hypothesis and questions for Part I, the Pilot Study.

Results for Hypothesis One

Principals of effective schools will be more central to the leadership of the school than principals of ineffective schools as measured by their centrality scores.

Two separate independent samples *t*-tests were conducted on the means of the indegree centrality and the betweenness centrality measures to test the hypothesis that principals of effective schools would be more central to the leadership of the school than principals of ineffective schools. Comparison of differentially effective principals on the normalized indegree centrality proved to be significant: the mean of the principals in schools classified as effective was 47.15 and the mean of the principals in schools classified as ineffective was 27.47 ($t = 2.56$, $df = 14$, $p = .022$, for equal variance). The normalized betweenness centrality comparisons were not significant. The mean of the principals in schools classified as effective was 16.95 and mean of the principals in schools classified as ineffective 12.46.

Neither comparison of differentially effective groups on the network indegree centralization or on the betweenness centralization measures proved significant. On the indegree centralization measure, the mean of the effective group was 32.7 and the mean of the ineffective group was 32.31. On the betweenness centralization measure, the mean of the effective group was 19 and the ineffective group 24.5.

The results on the individual centrality measures indicate that there are differential characteristics in the patterns of communication in differentially effective schools. Principals in effective schools are more often indicated as leaders than the principals in ineffective schools. This is combined with the results for the network centralization measures which were not significantly different. Therefore, there was no indication from the centralization measure that differentially effective networks are more centralized around one individual. Both classifications of networks appear to be centered the same, but there is a significant difference in who the most central individual is.

Though the difference between the means on the betweenness measure was not significant, the direction of the means suggests that principals in less effective schools are more often seen as the link between other individuals rather than as connected to the entire network. This may be the case for several reasons. In less effective schools the principal may be a gatekeeper, or someone trying to hinder communication. The same pattern could also indicate positive aspects such as building alliances or pulling faculty together. These structural characteristics and parameters highlight the importance of the contextual nature of network analysis and point out the importance of understanding network characteristics and parameters within a specific contextual framework and in conjunction with other measures.

Results for Question Two

Can effective schools be differentiated and characterized by a Type 1 or 2 configuration; ineffective schools by Types 3, 5, or 6 configurations; and changing schools by Types 4 or 5 configuration? The classification of schools based on the sociogram patterns outlined in the Centrality - Cohesiveness Model fit the expected patterns. The patterns (HH, HL, LH, and LL) and types are:

Type 1. (HH) The principal is the only identifiable leader in a hierarchial chain of command, with high faculty cohesiveness.

Type 2. (HH) The principal is the only identifiable leader within one highly cohesive group.

In this first classification, High leadership - High cohesiveness, five schools classified as effective, matched this pattern. No ineffective schools were classified as High leadership - high cohesiveness. No quantitative analysis was made at this time to determine, from the data available, if the patterns indicated a hierarchial chain of command, this will be discussed in the combined results in Chapter Six.

Type 3. (HL) The principal is an identifiable leader with low faculty cohesiveness.

In the HL (High leadership - Low cohesiveness) category, there were four schools, two classified as effective and two as ineffective. In each of the effective schools, the principal is clearly the leader. One school (PC1) appears from the sociogram to have more cliques than the schools in the HH classification which may affect the overall density measure.

Type 4. (LH) The principal is not an identifiable leader, there is an identifiable rival, with high faculty cohesiveness.

Type 5. (LH) There is no identifiable leader, with high faculty cohesiveness.

In the Low leadership - High cohesiveness category were two stable schools, one effective and one ineffective. One school (stable ineffective) has a clearly identifiable "rival" to the principal.

Type 6. (LL) There is no identifiable leader and low faculty cohesiveness.

In this lowest categorization, Low leadership - Low Cohesiveness, there was one effective school. Based on the longitudinal classification from LSES IV, this school was an improving school. Four schools, classified as ineffective, also fit this categorization. Two of these schools had stable ineffective classifications and two were declining schools.

Results for Question Three

Do faculties of effective schools form a more cohesive group than faculties of ineffective schools as measured by density?

Independent samples t -tests were conducted with the density measure means to test the hypothesis that faculties of schools classified as effective would be more cohesiveness than faculties of schools classified as ineffective. Comparison of differentially effective groups on the density measure proved to be significant: the mean of the effective group was .28, and the mean of the ineffective group was .19 ($t = 3.04$, $df = 14$, $p = .009$, for equal variance).

Results clearly support the hypotheses and the research questions. Principals in effective schools are more central within the communication structure than principals in ineffective schools and effective schools are more cohesive than ineffective schools. The results of the Pilot Study further indicate:

- (1.) the choice of measures of centrality for Part II should be degree and betweenness; and
- (2.) further analysis of the sociograms would be appropriate and necessary to more fully understand the structure of differentially effective schools.

Chapter Five: Qualitative Analysis of Sociograms - Field Study

The sociograms for the sample schools in the Field Study were also qualitatively analyzed to explore their predicted fit to the Centrality - Cohesiveness Model, in conjunction with the quantitative results of analysis. The results of both the quantitative analysis and the sociogram analysis are discussed in Chapter Six.

As in the pilot, each of the schools was rank ordered by the combination of both the centrality and the cohesiveness scores. Each school was assigned a rank of H (high) if the school was at or above the mean on the measure and a rank of L (low) if the school was below the mean on the measure. Schools were then clustered by the combination of H's and L's, with centrality listed first and cohesiveness second, such that HH was ranked first, HL next, LH next, and LL next. The schools were then sorted into the cells on the Centrality Cohesiveness Model according to the matching classifications. This resulted in the classifications depicted in [Table 5.1](#). This table includes the schools sorted by effectiveness status.

The sociograms for each school are listed following [Table 5.1](#). The sociograms were constructed from the top three choices each individual spoke with on question one (whom did you talk with about academically related matters), with the principal's connections highlighted. The individuals in circles are the top three ranked individuals on Freeman's Indegree Centrality. The sociogram key with each sociogram indicates the rankings for these individuals. Multiple individuals for a ranking indicate tied scores. The scores on the indegree measure were calculated on all individuals within the network. The measure was calculated on the network scores and the sociogram illustrates a subset of that overall network. The 25 schools are

sequentially listed from SA1 through SY1. The key includes the school code, the effectiveness status of the school (effective or ineffective), the Centrality - Cohesiveness Model type (HH, HL, LH, or LL), the location of the principal within the sociogram, and the locations of the top three ranked individuals on the indegree centrality measure. If there are tied ranks all individuals are listed.

Table 5.1.

Sample Schools, by Effectiveness Status, Within Centrality - Cohesiveness Model ²

HH		HL	
<u>Effective Status</u>	<u>Ineffective Status</u>	<u>Effective Status</u>	<u>Ineffective Status</u>
SC1 SH1 SG1	SR1	SM1 SX1 SO1 SL1 SV1	SQ1 SK1
LH		LL	
<u>Effective Status</u>	<u>Ineffective Status</u>	<u>Effective Status</u>	<u>Ineffective Status</u>
SY1 SN1 SW1 SF1 SP1	SB1	SU1 SE1 SJ1 SD1	SA1 SI1 SS1 ST1

² HH - High Principal Centrality and High Faculty Cohesiveness
 LH - Low Principal Centrality and High Faculty Cohesiveness
 HL - High Principal Centrality and Low Faculty Cohesiveness
 LL - Low Principal Centrality and Low Faculty Cohesiveness

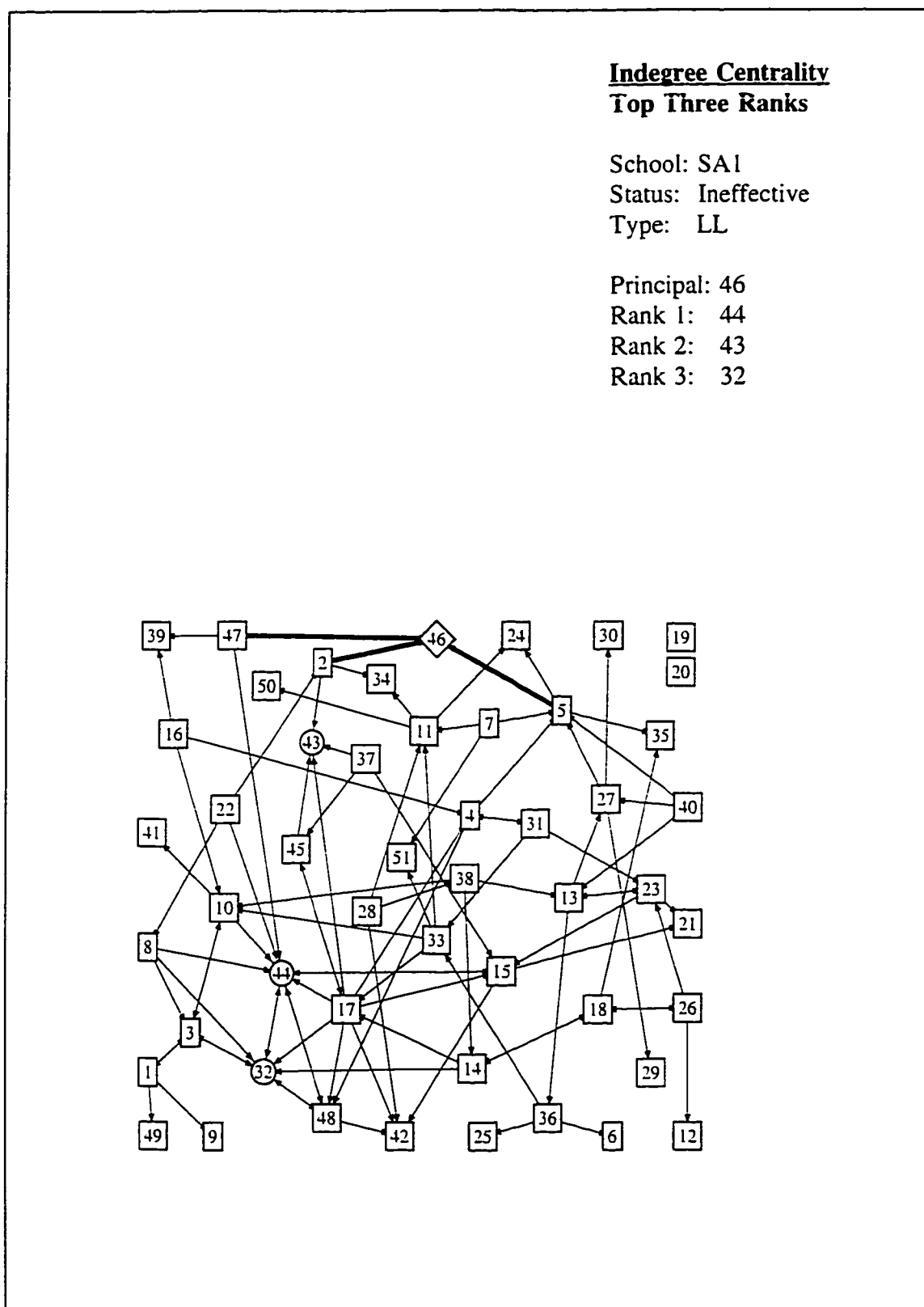


Figure 5.1. School SA1

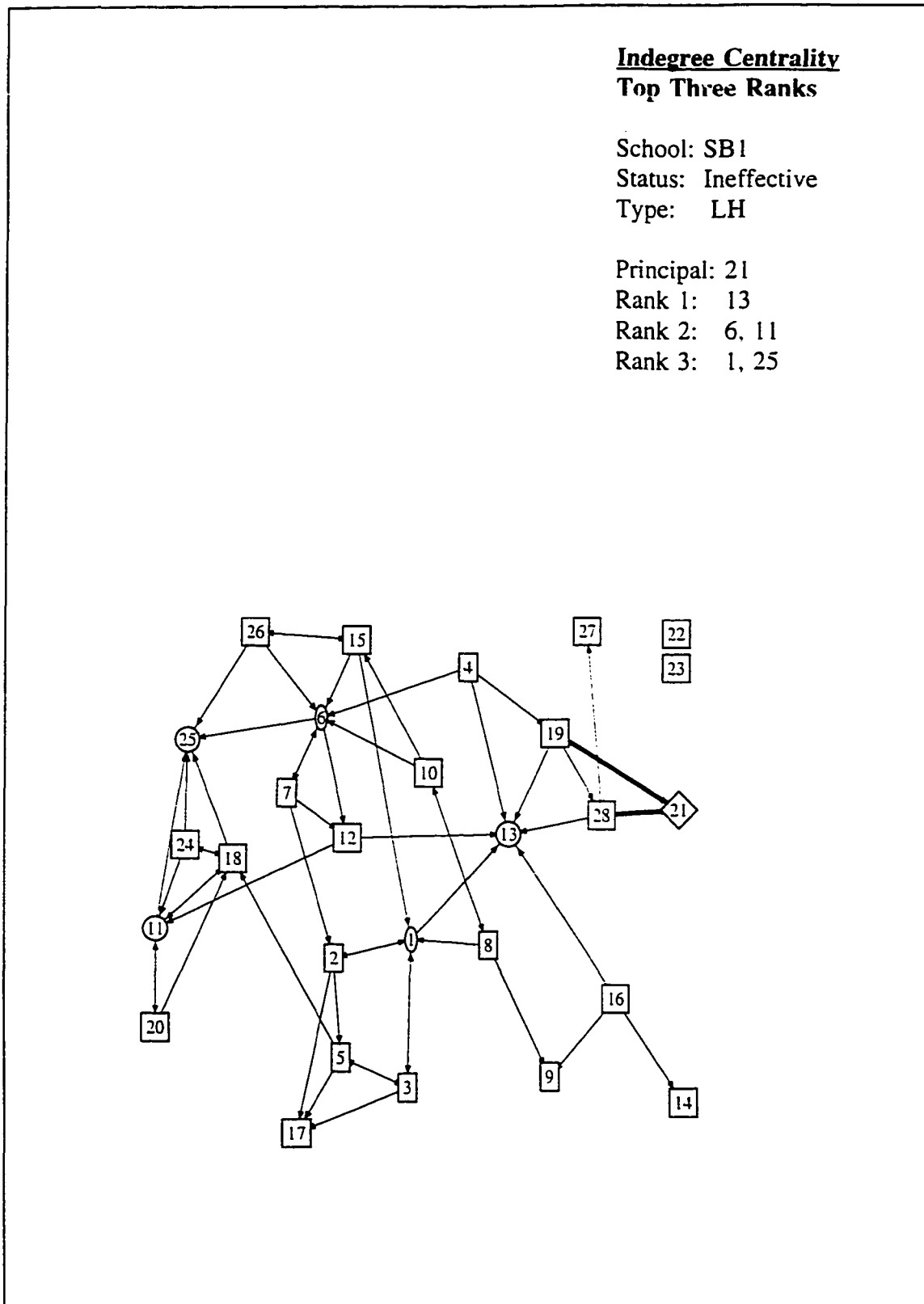


Figure 5.2. School SB1

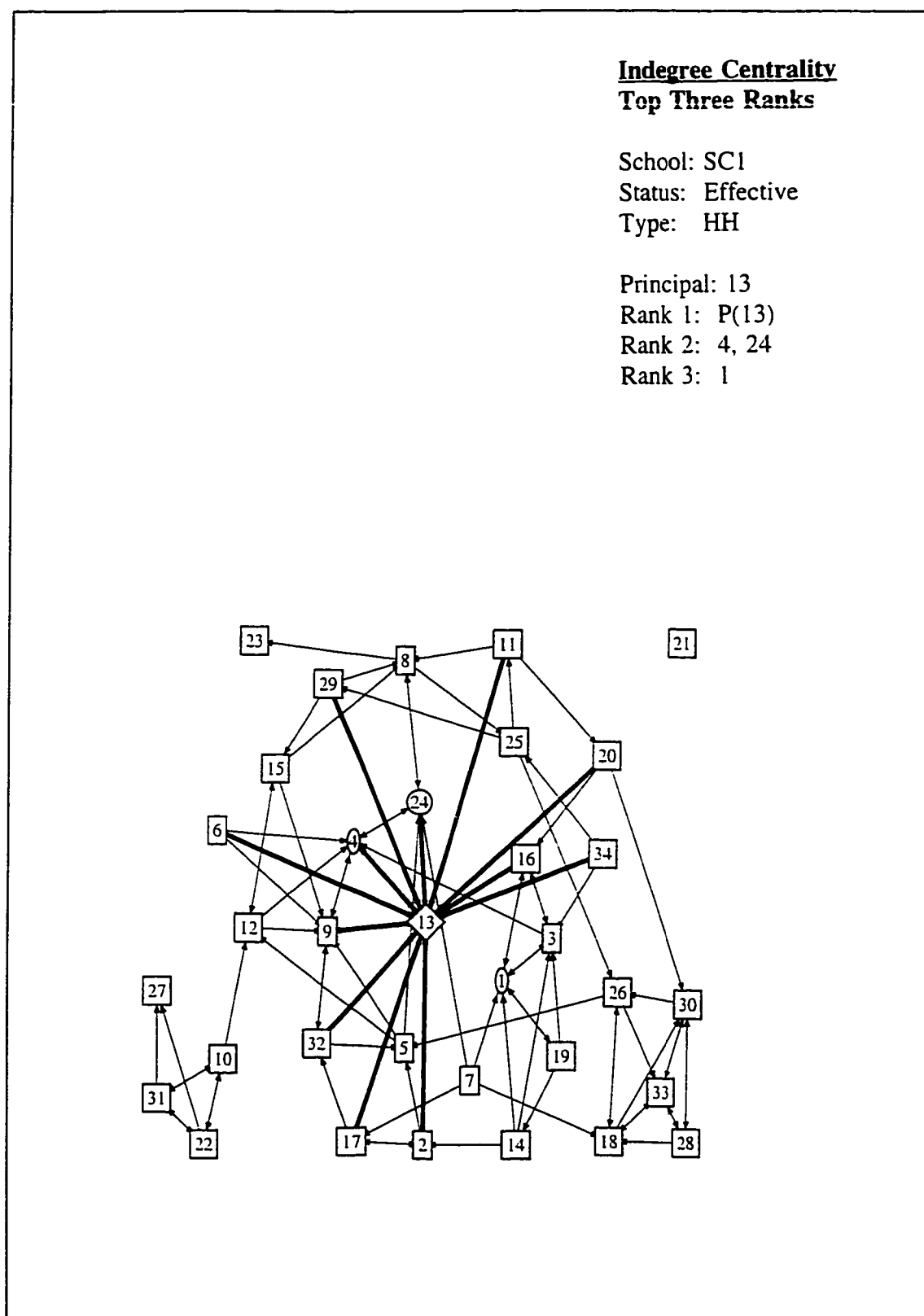


Figure 5.3. School SC1

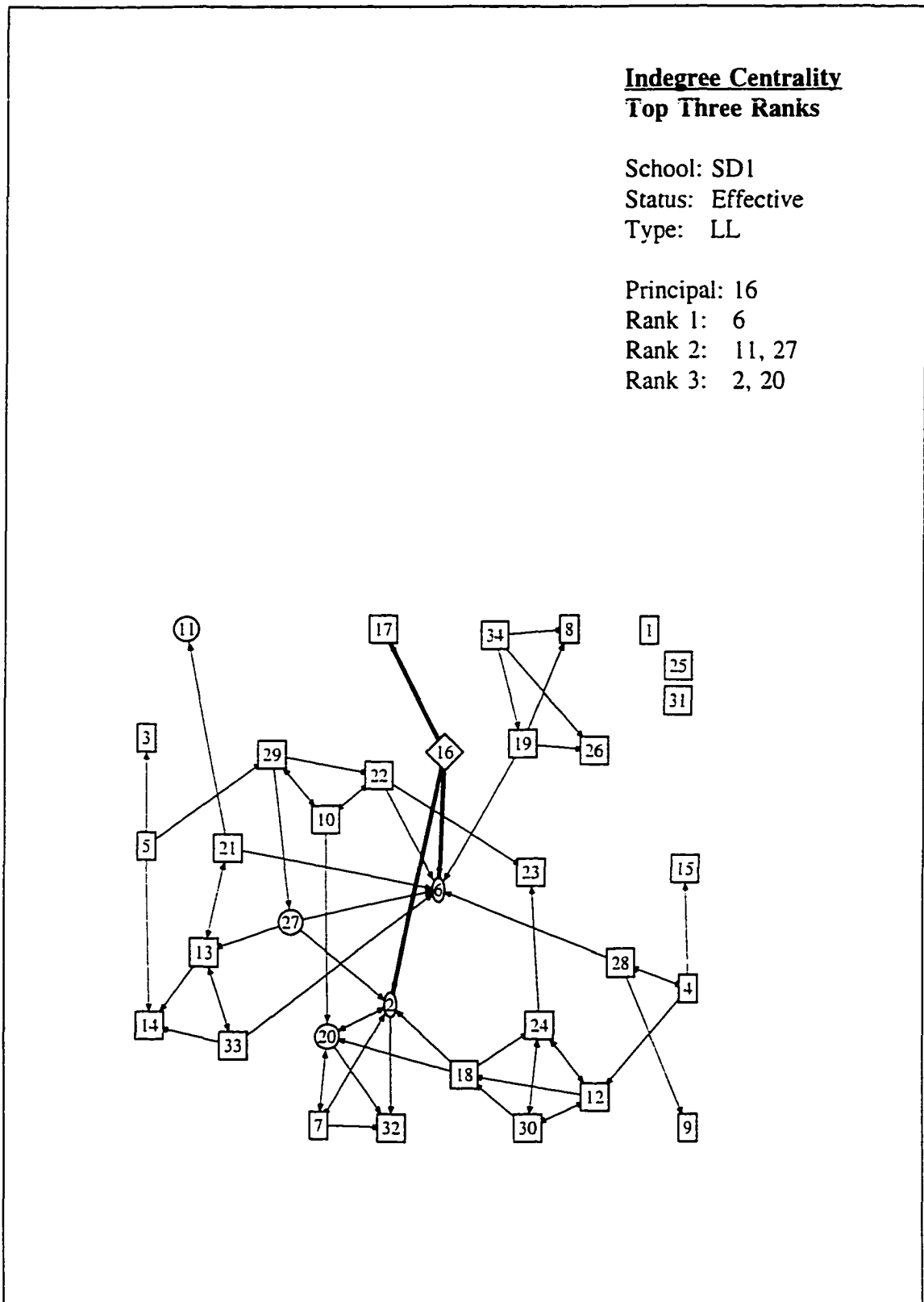


Figure 5.4. School SD1

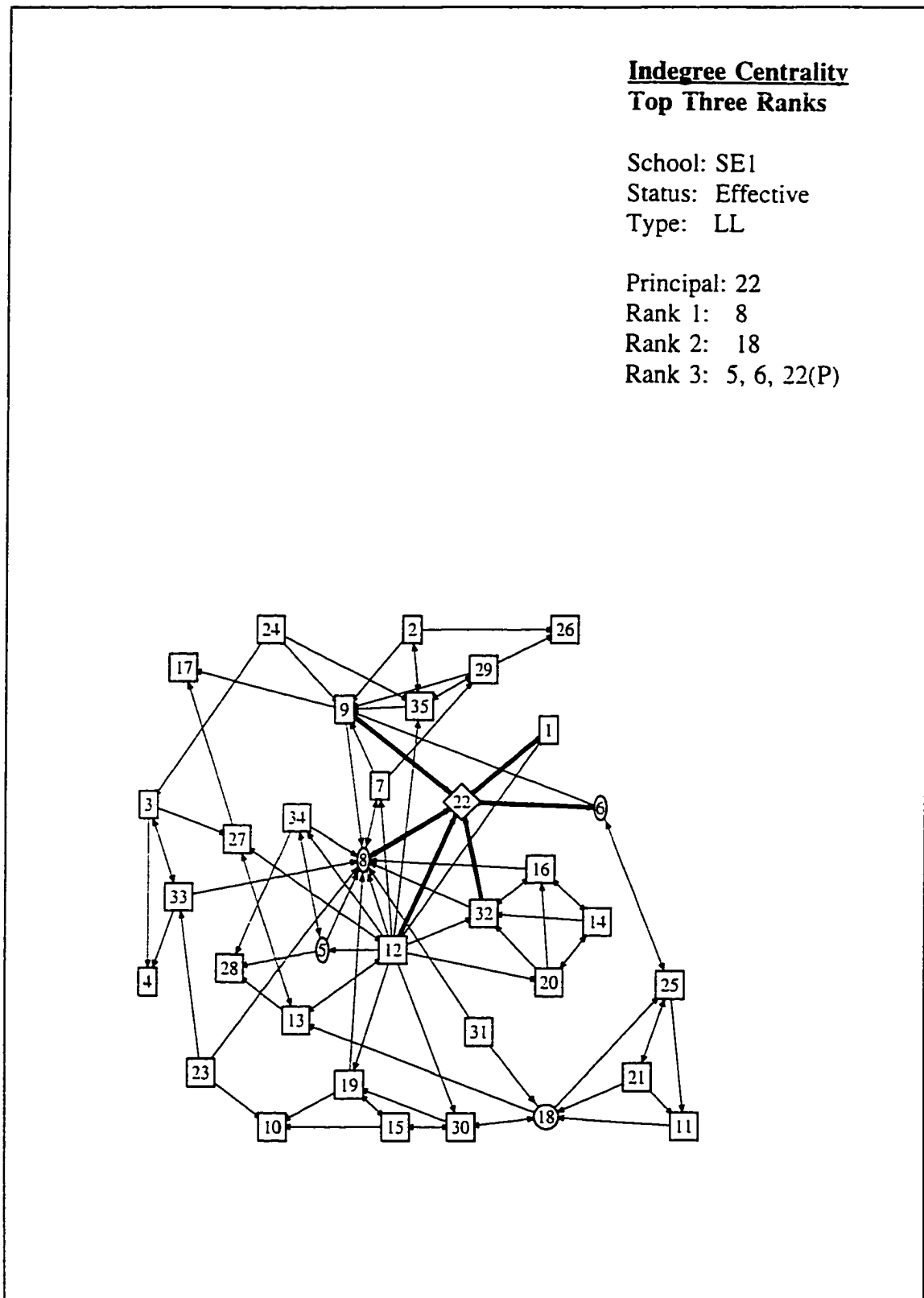


Figure 5.5. School SE1

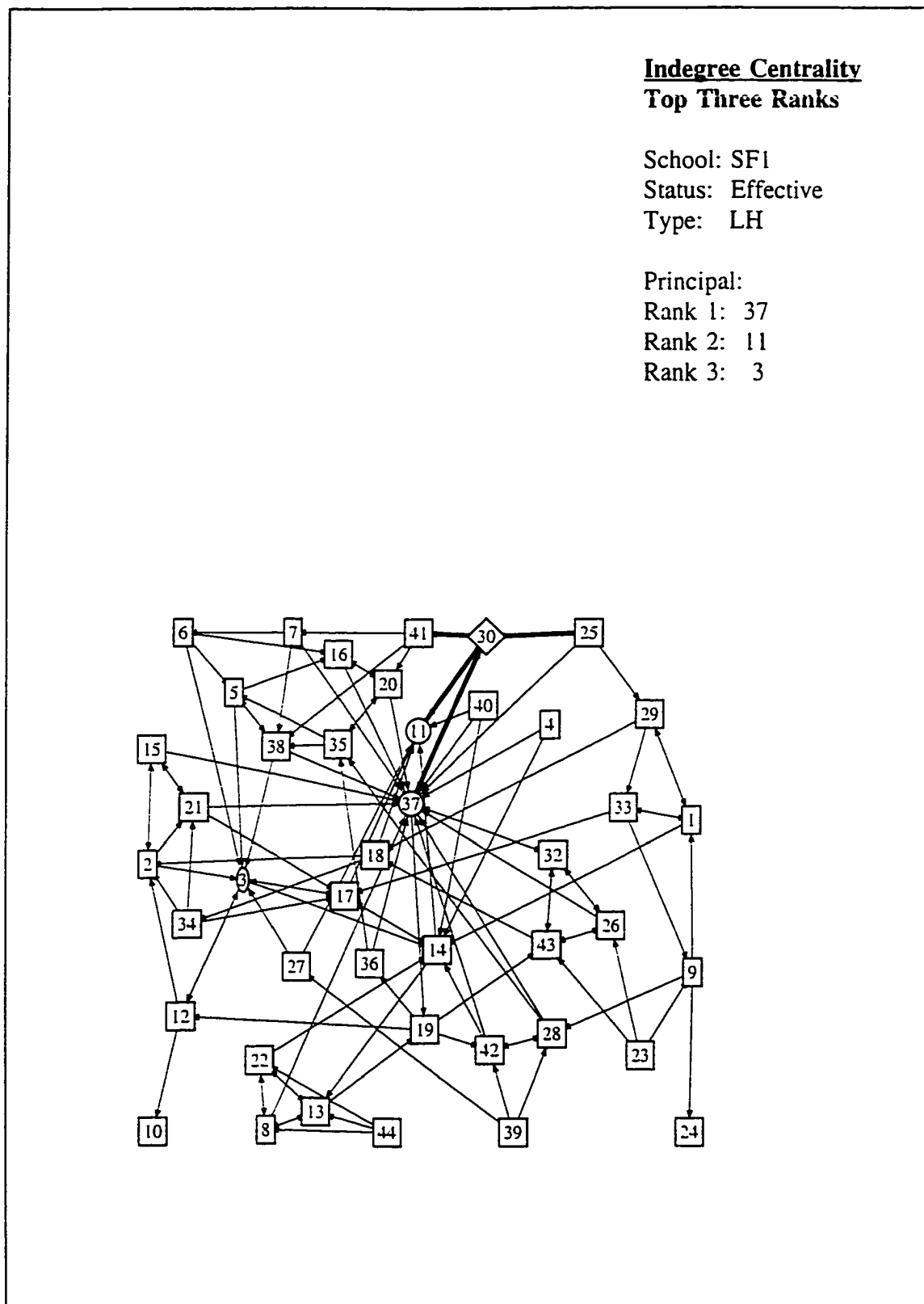


Figure 5.6. School SF1

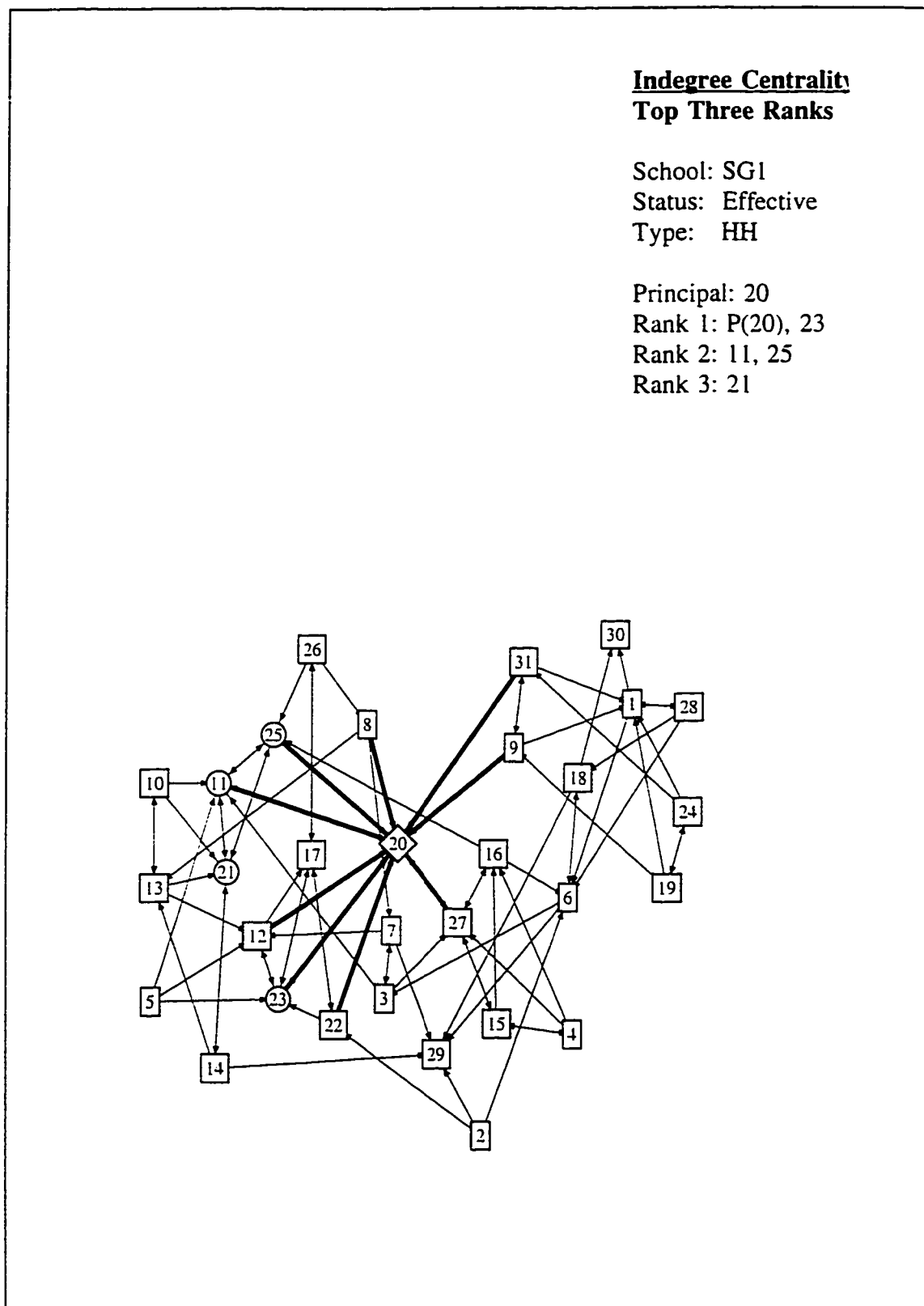


Figure 5.7. School SG1

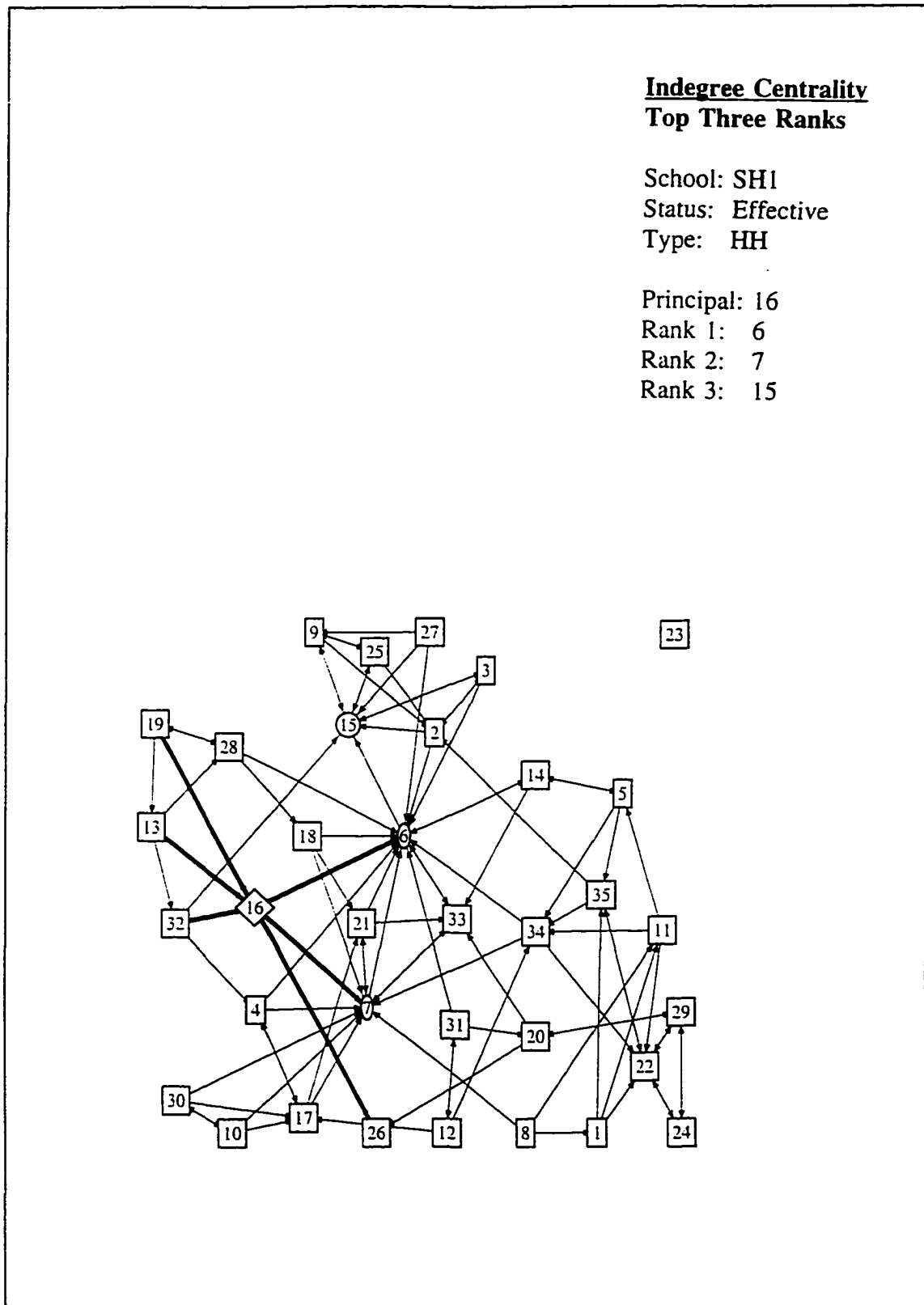


Figure 5.8. School SH1

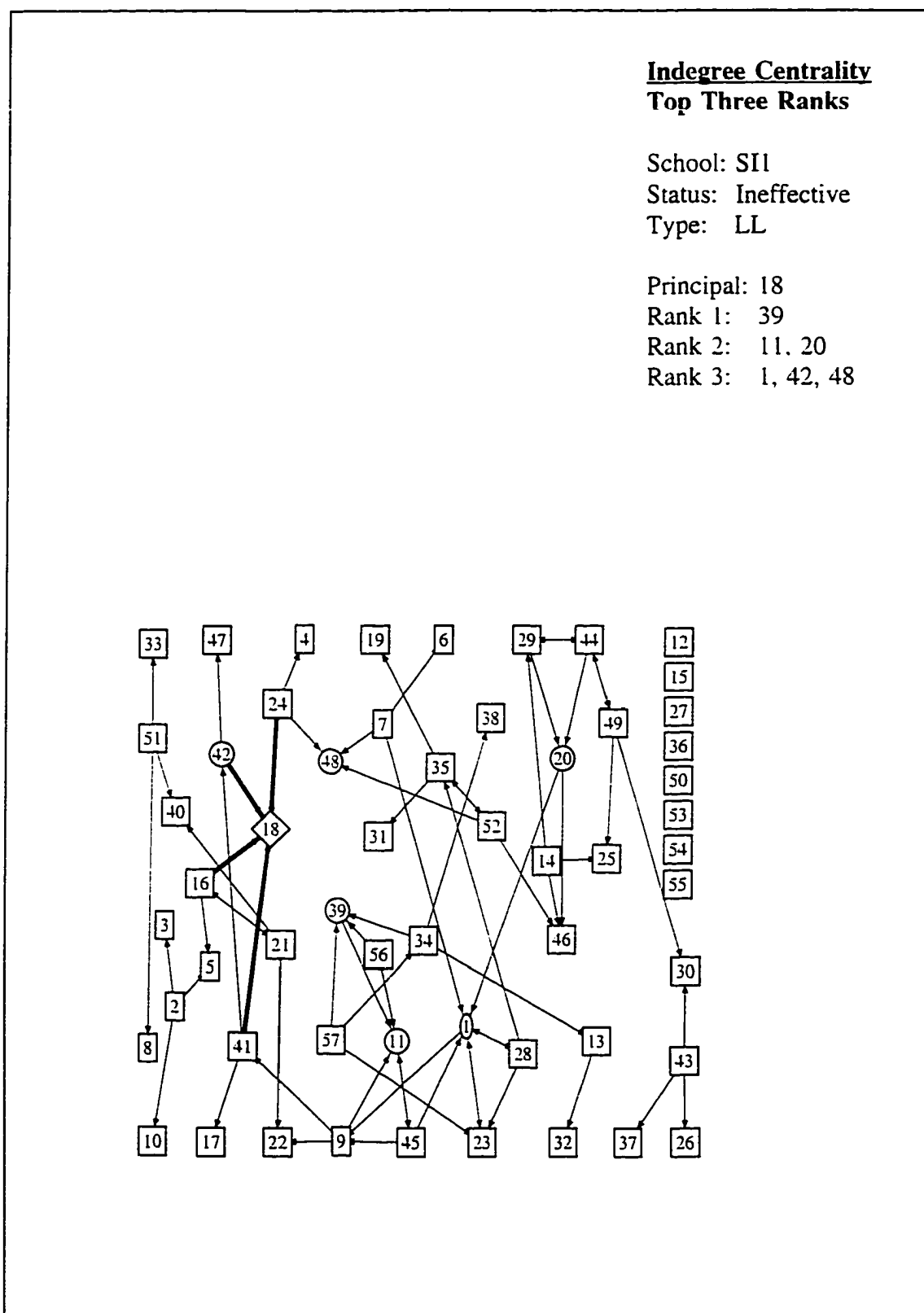


Figure 5.9. School SII

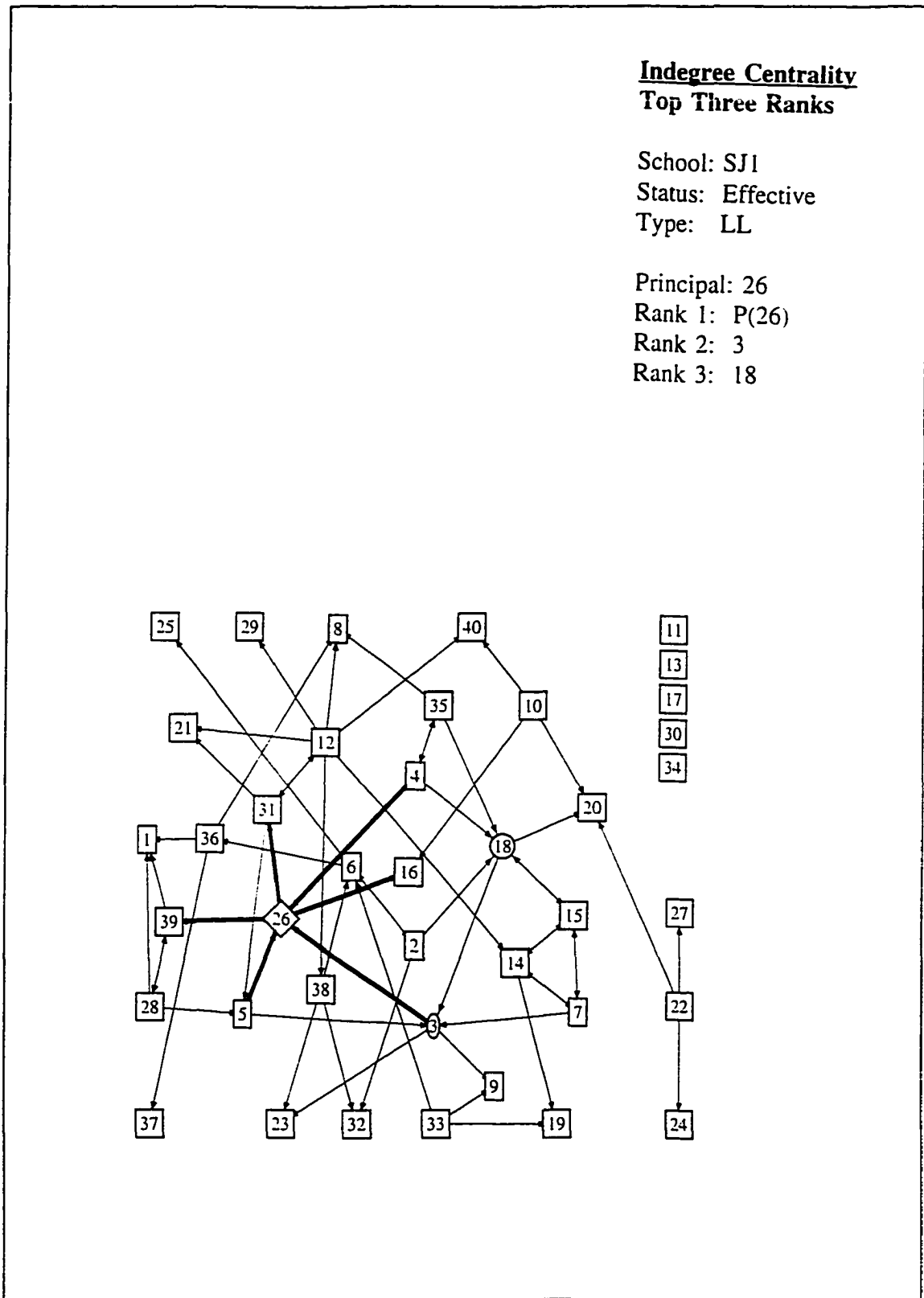


Figure 5.10. School SJ1

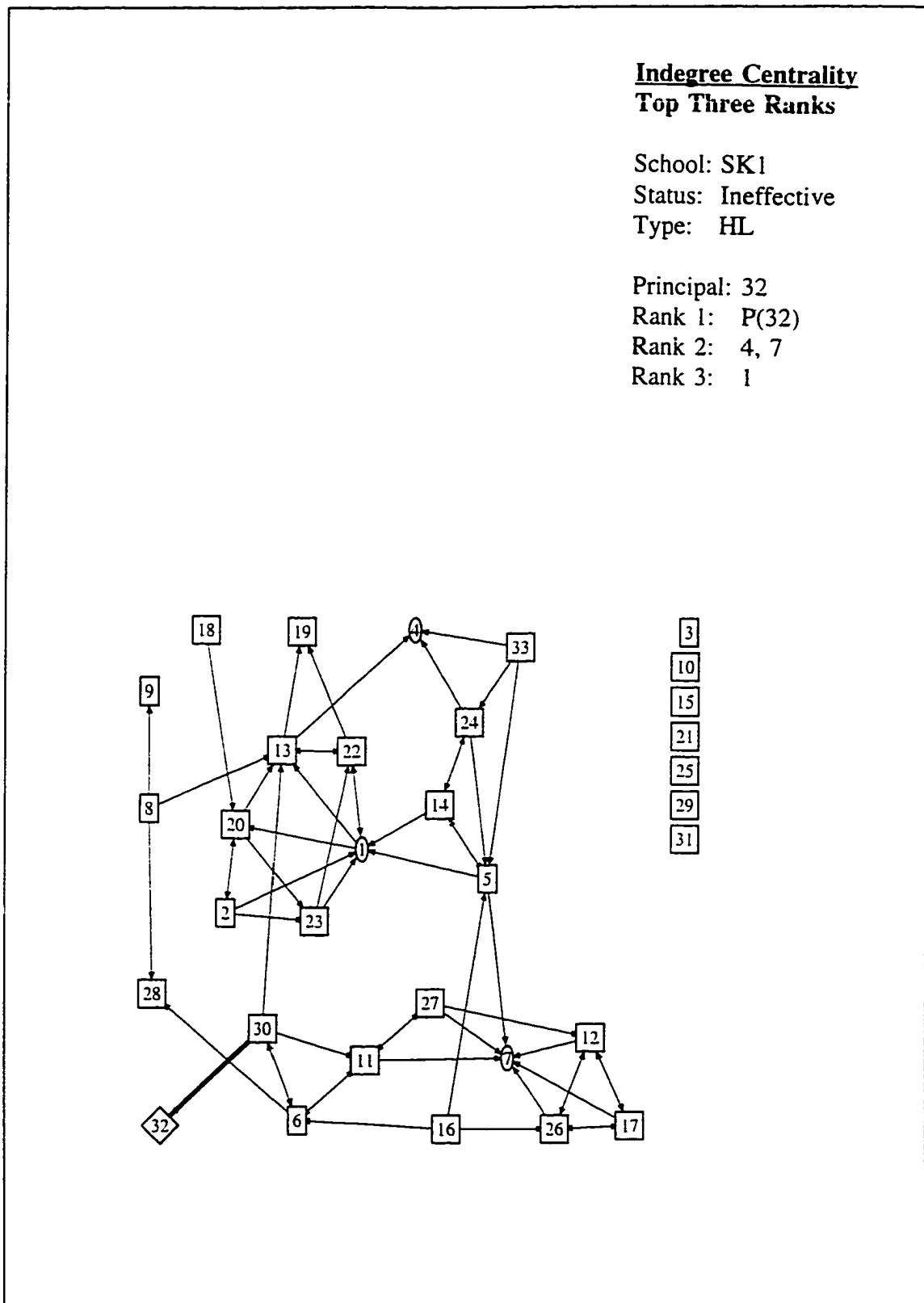


Figure 5.11. School SK1

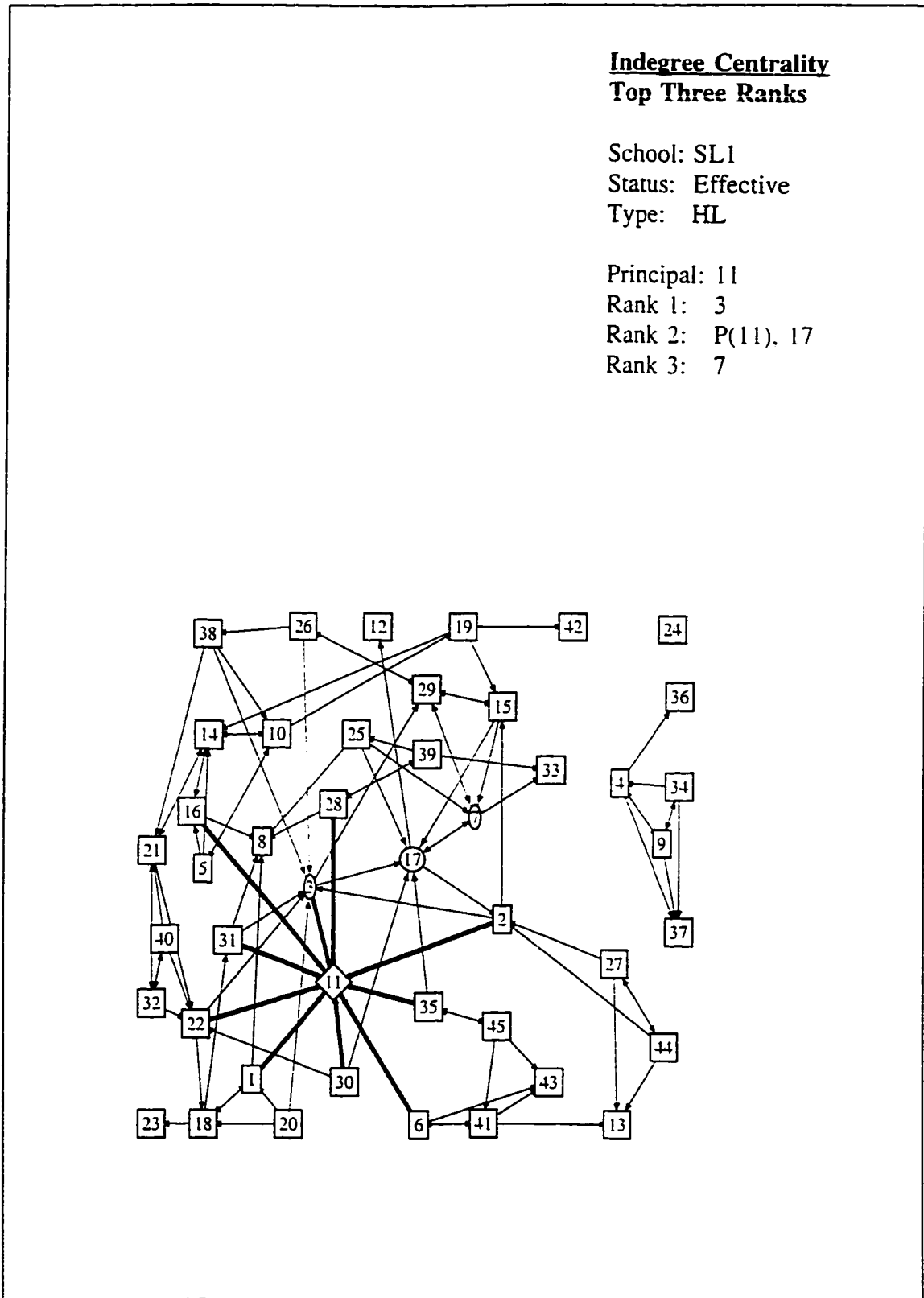


Figure 5.12. School SL1

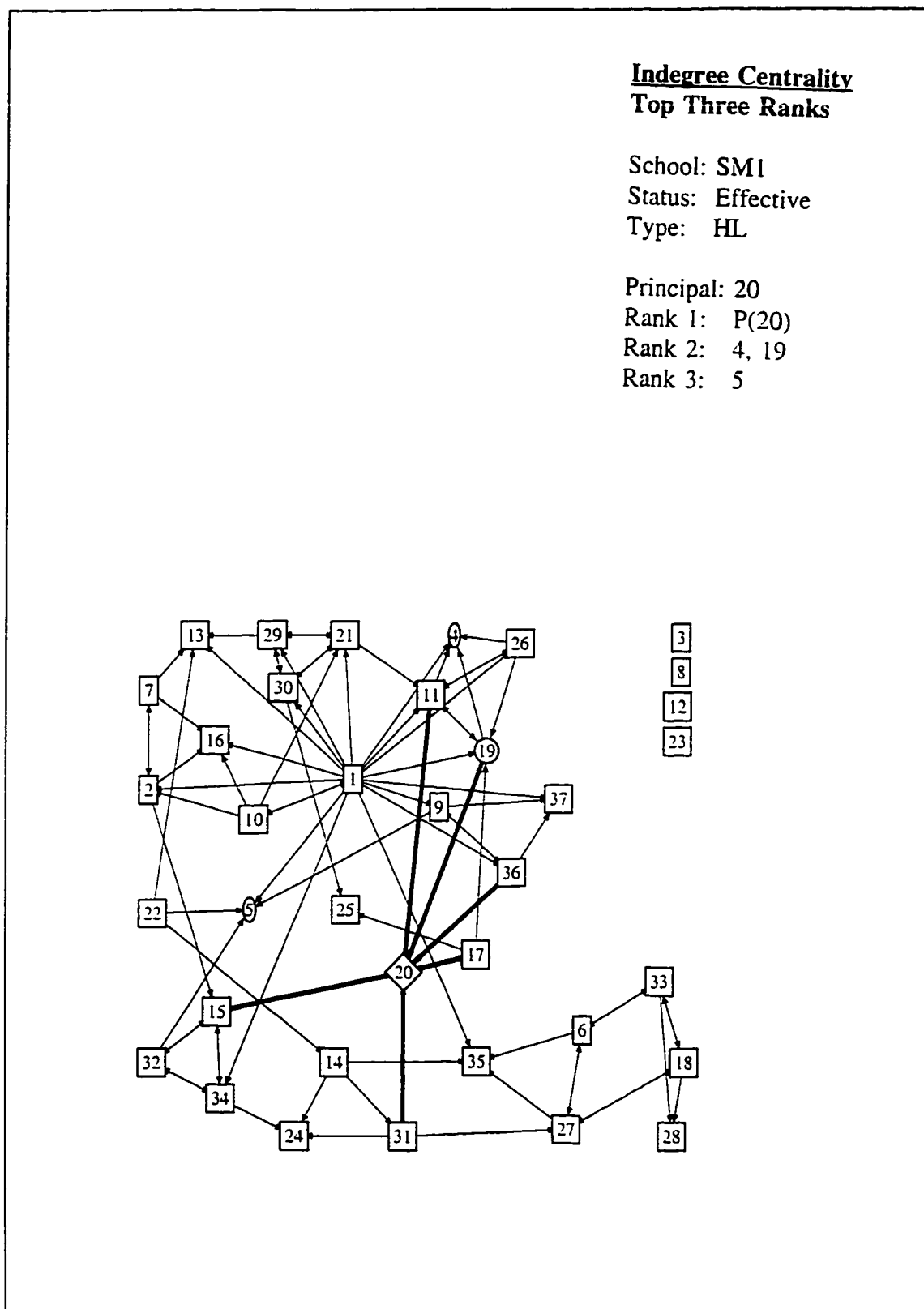


Figure 5.13. School SM1

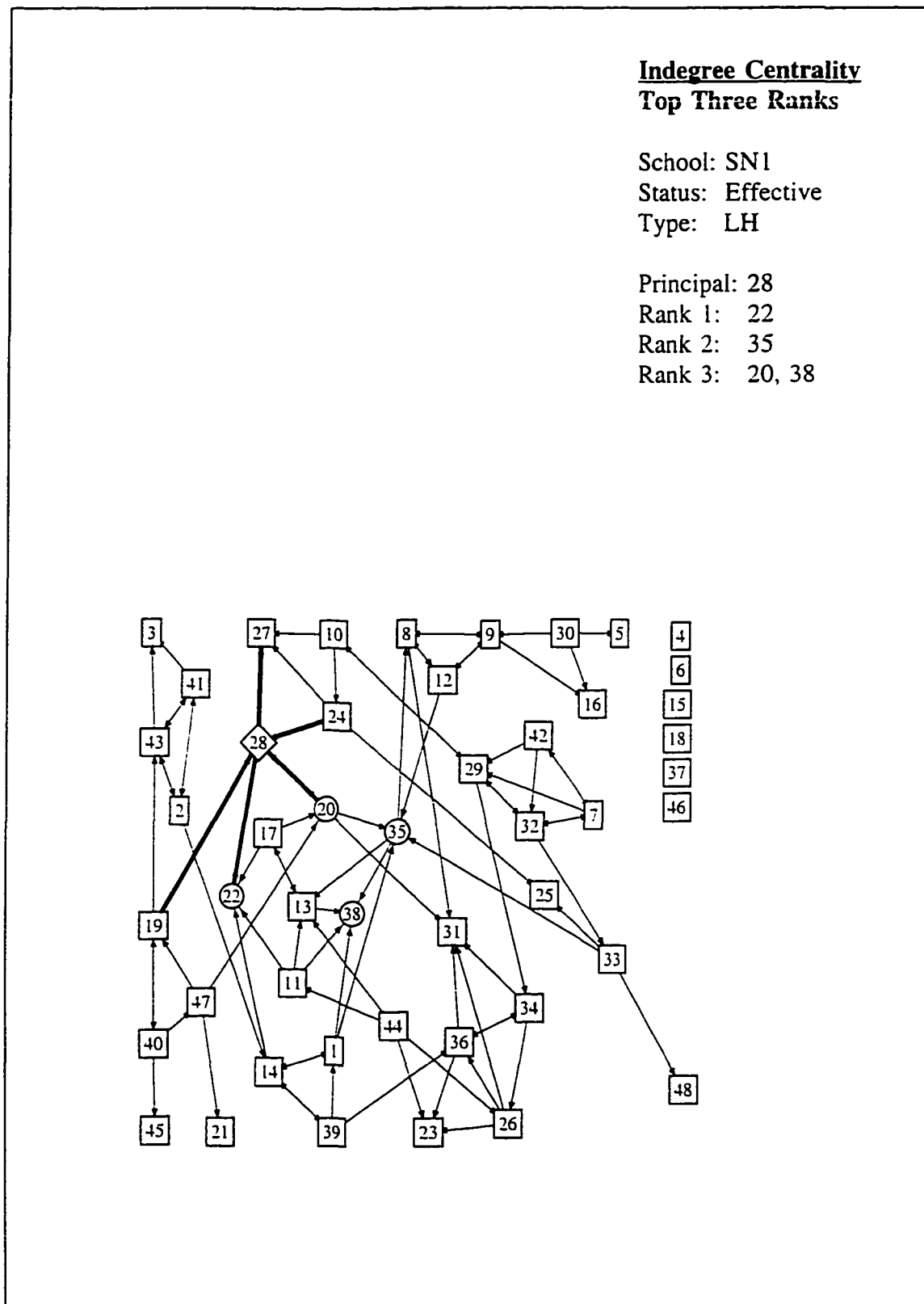


Figure 5.14. School SN1

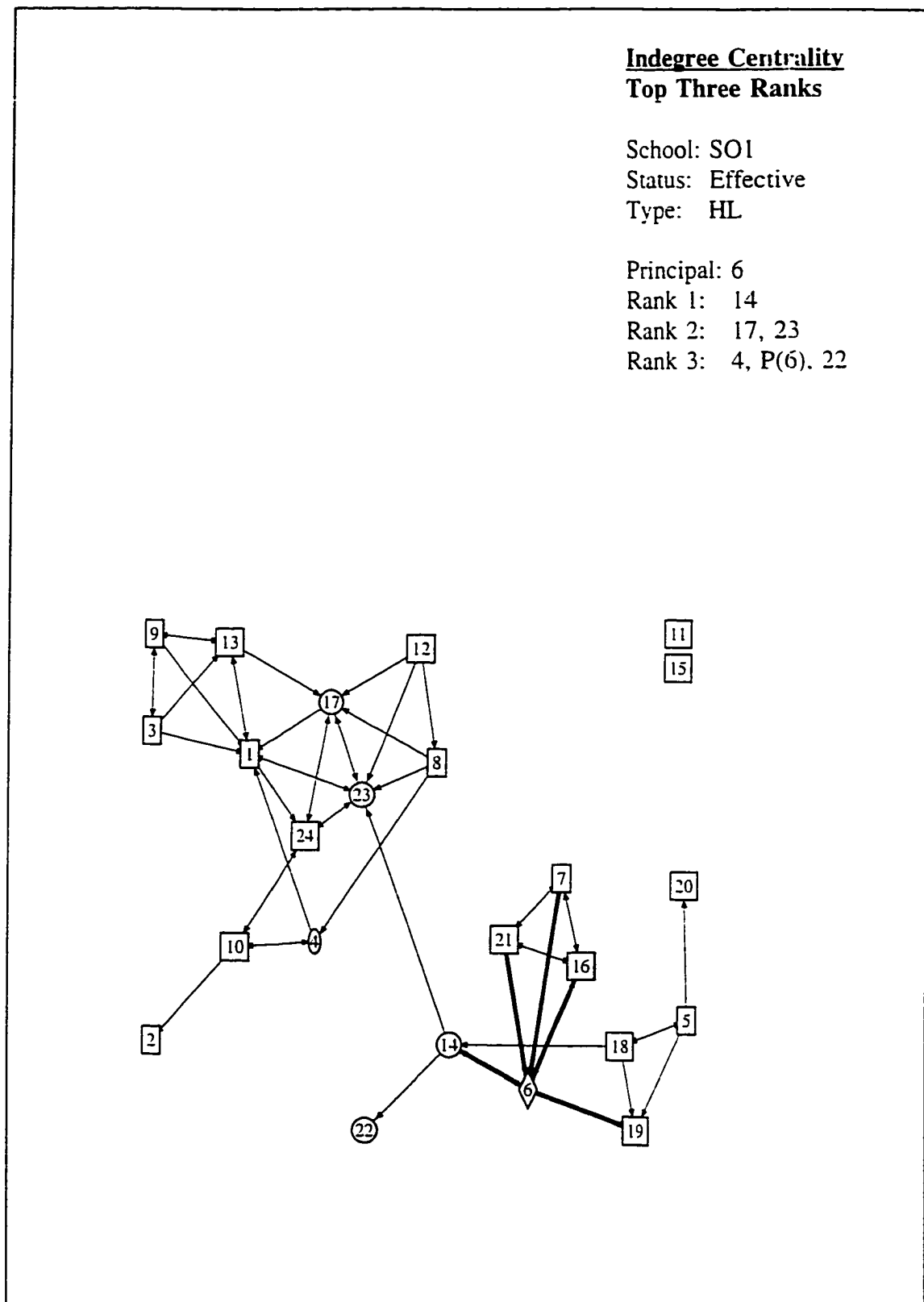


Figure 5.15. School SO1

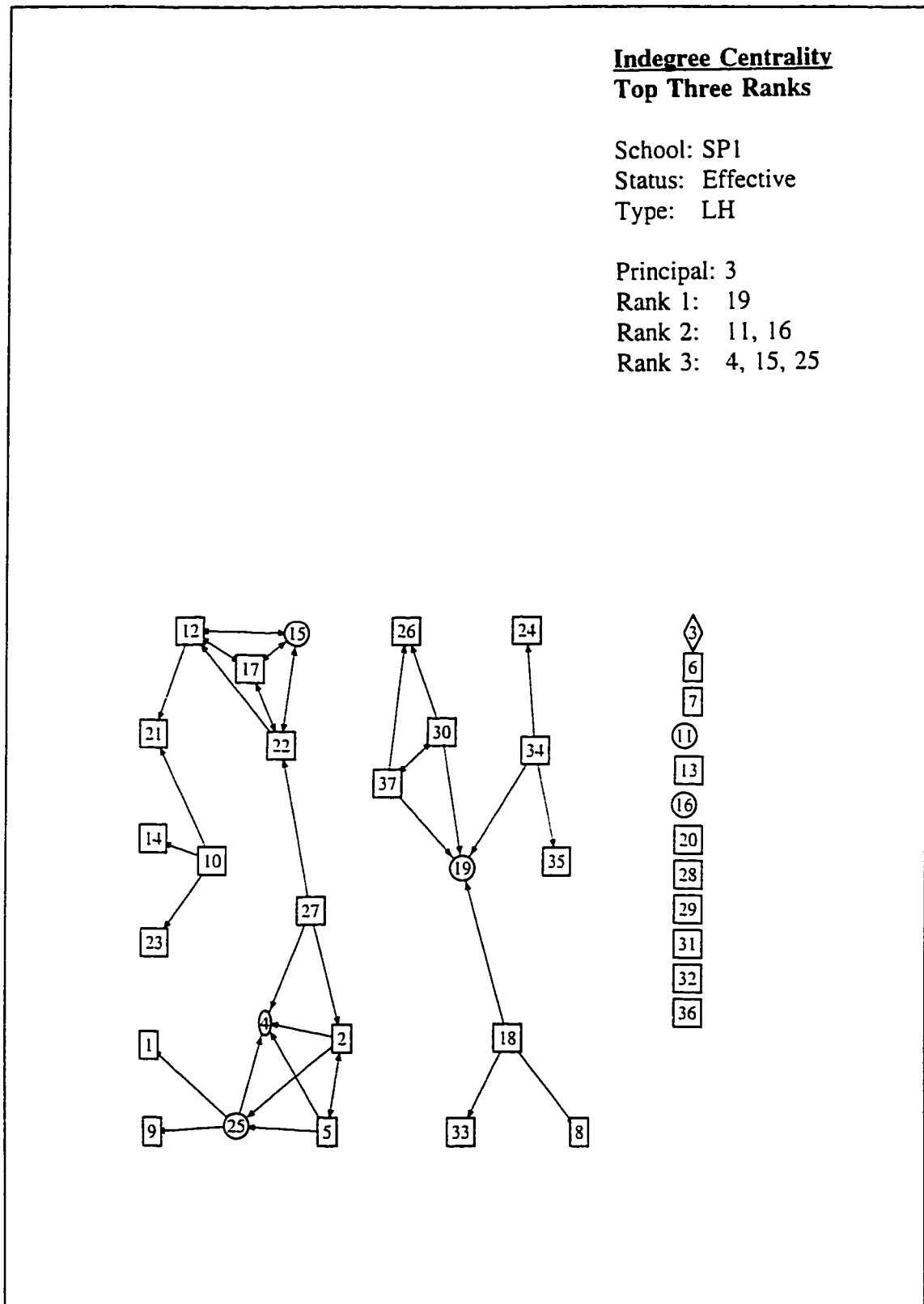


Figure 5.16. School SP1

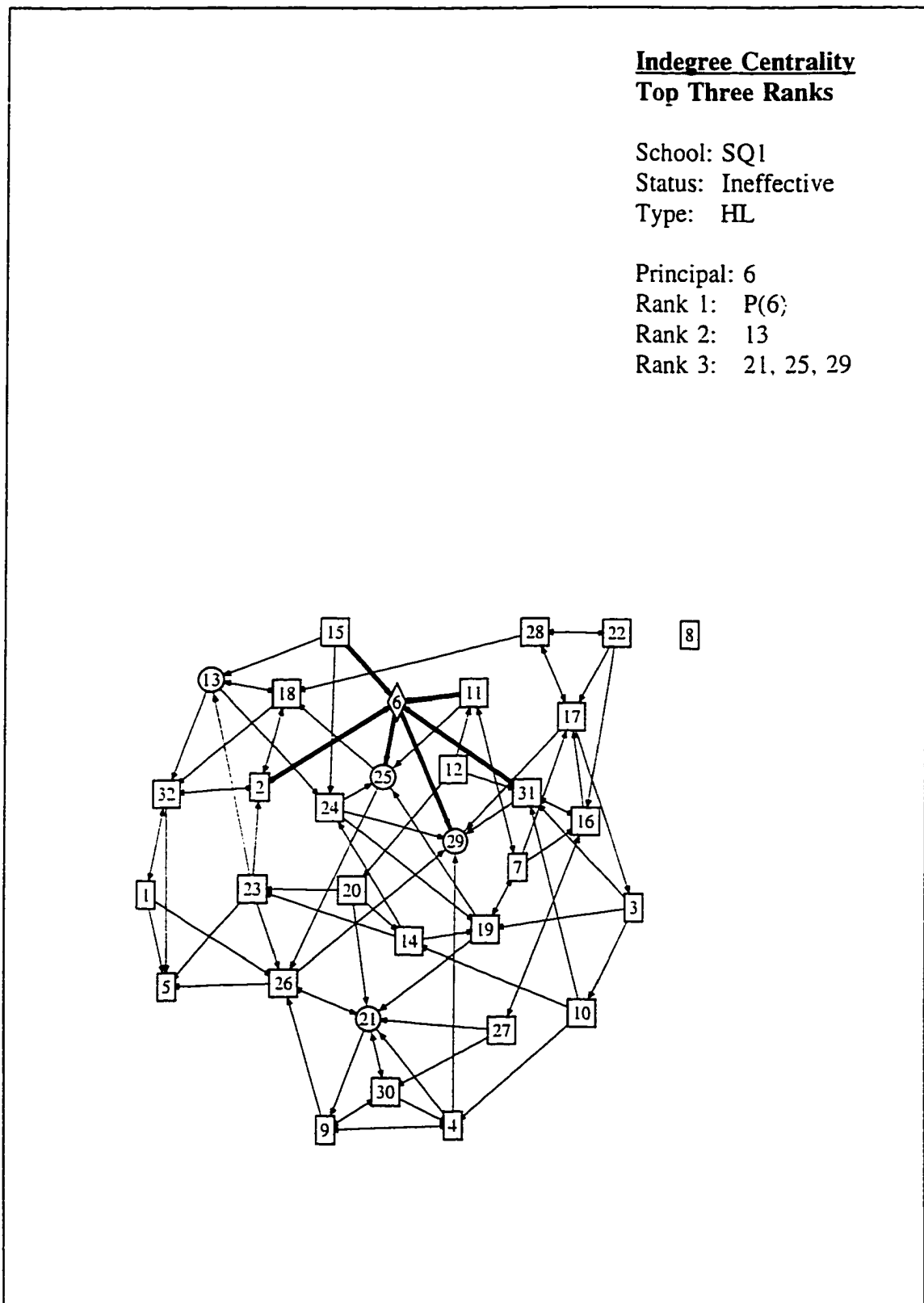


Figure 5.17. School SQ1

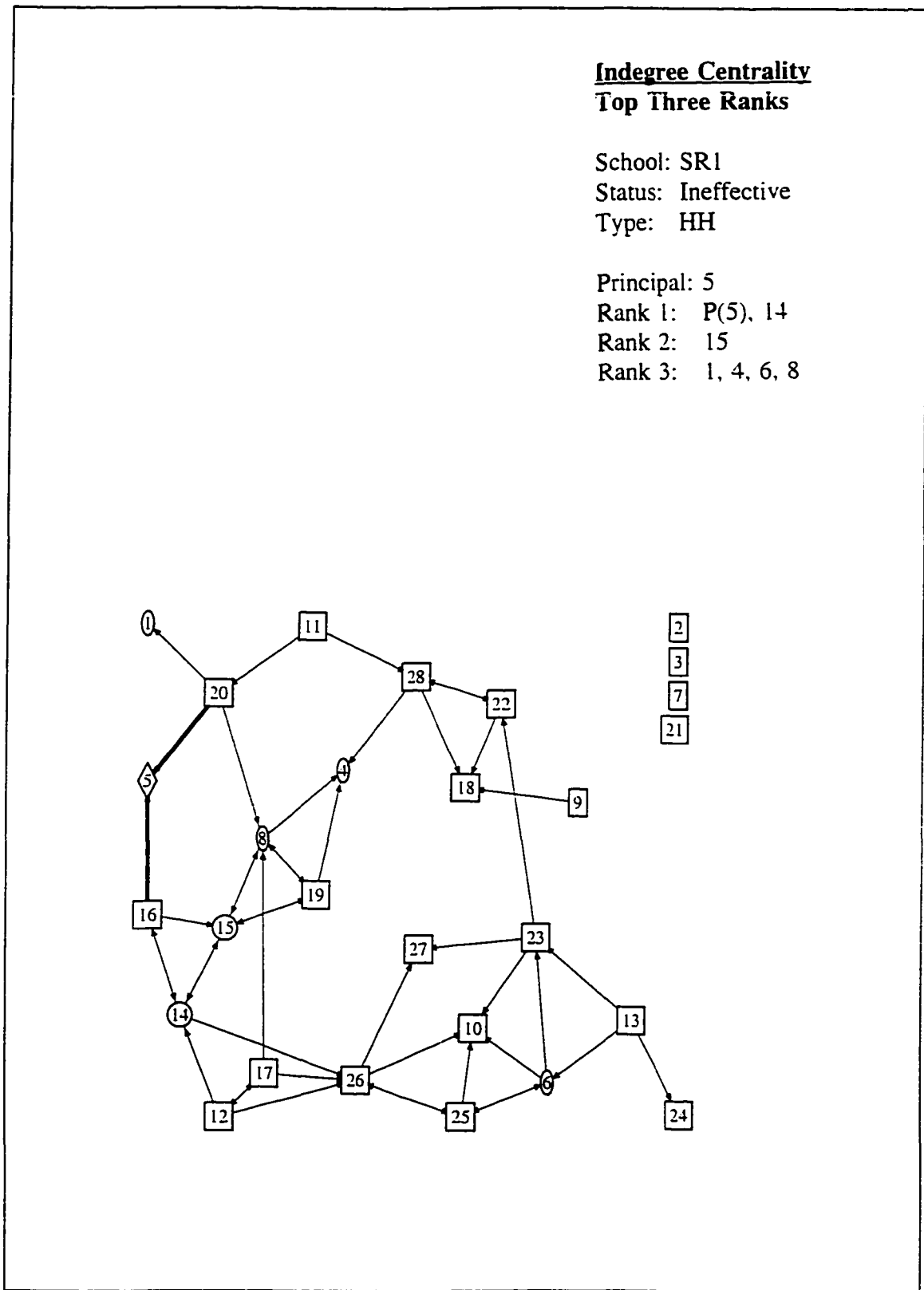


Figure 5.18. School SR1

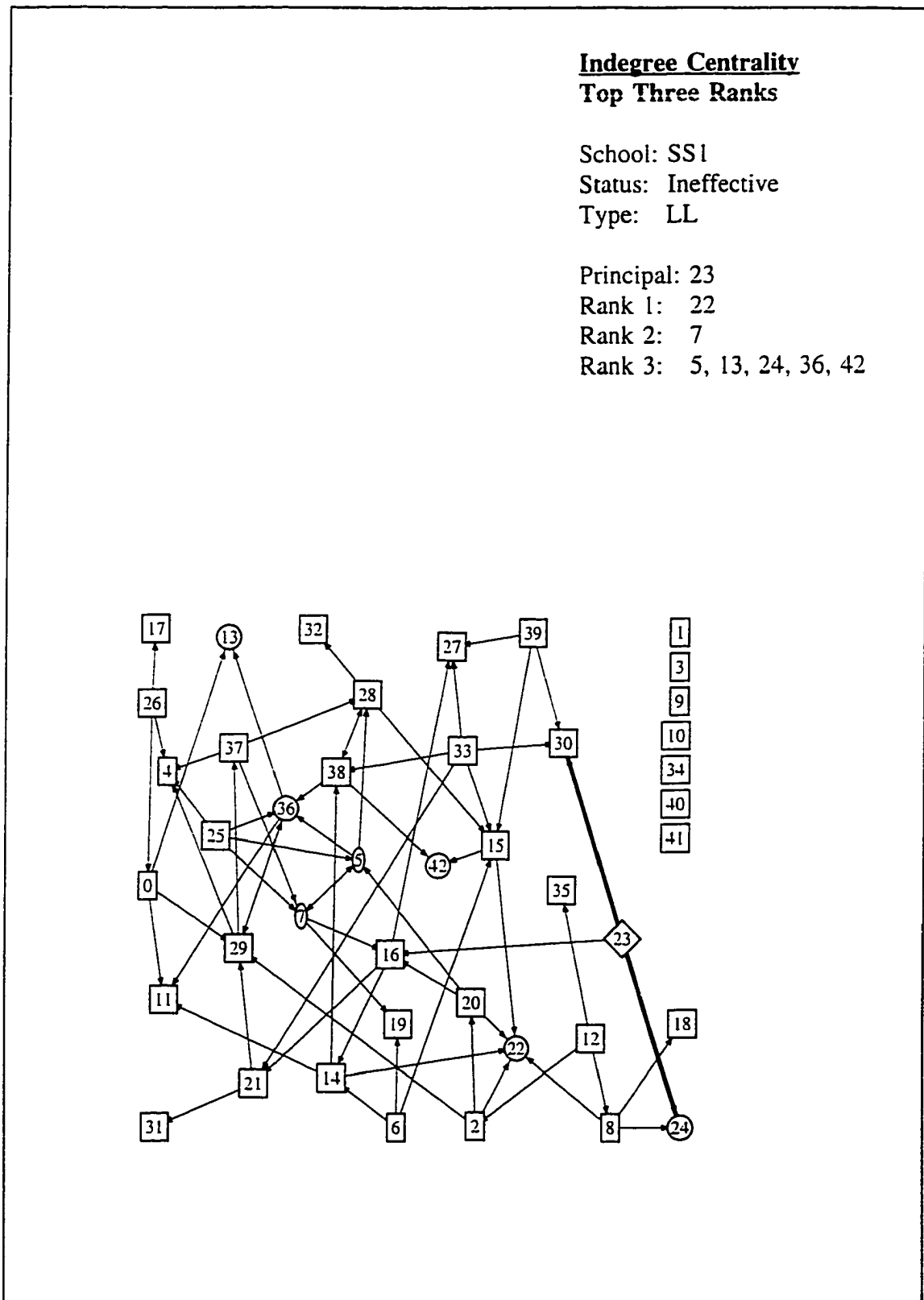


Figure 5.19. School SS1

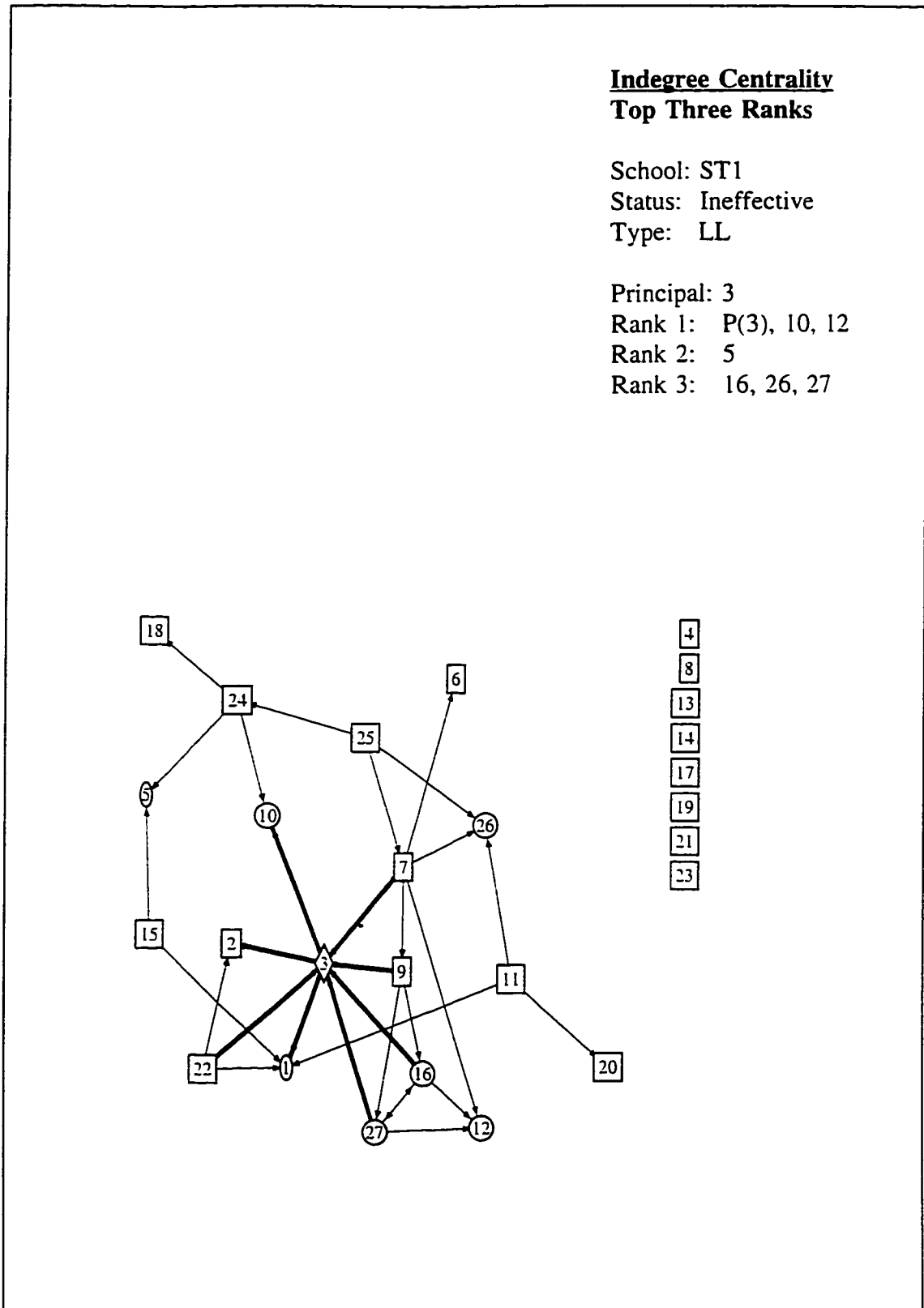


Figure 5.20. School ST1

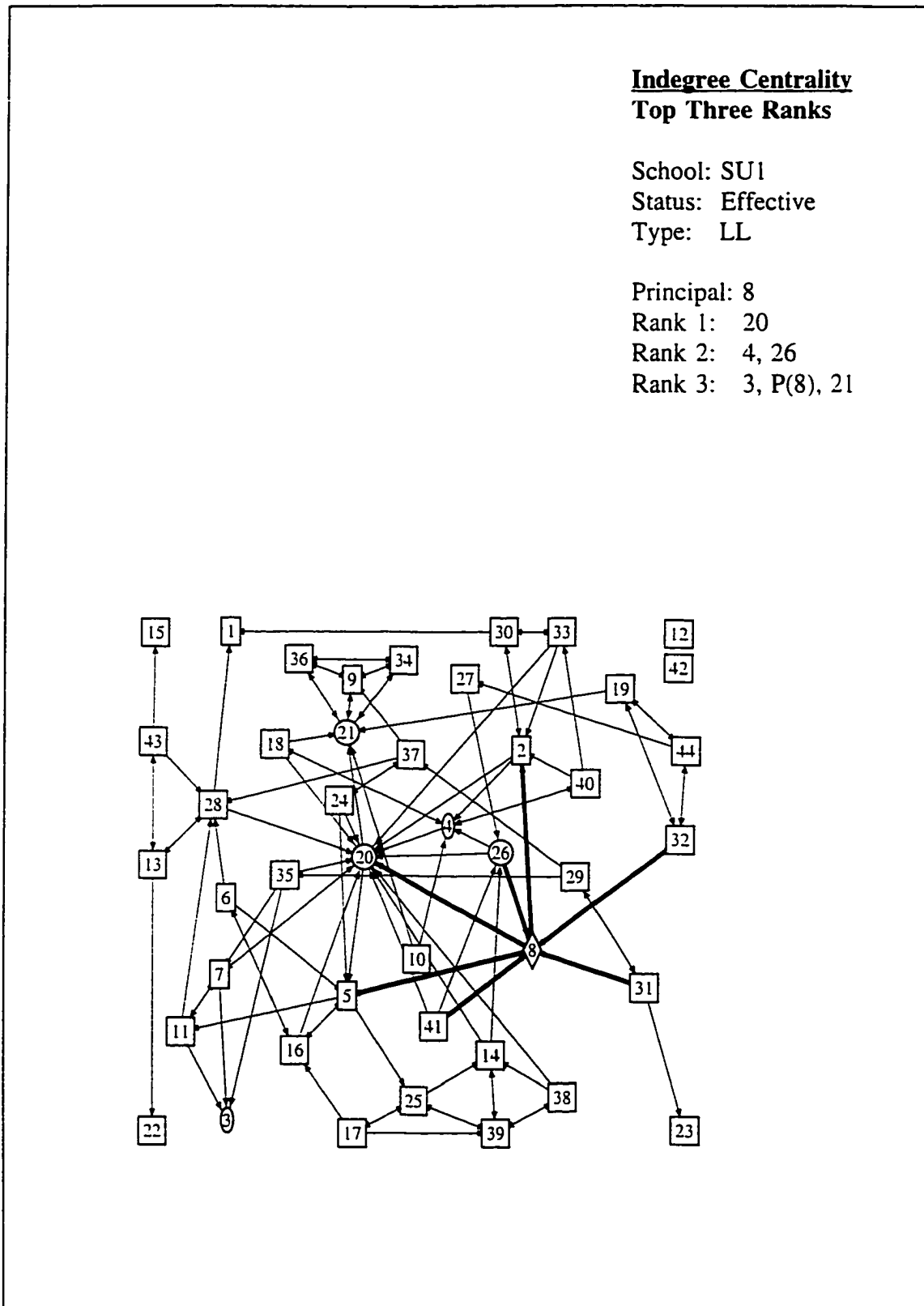


Figure 5.21. School SU1

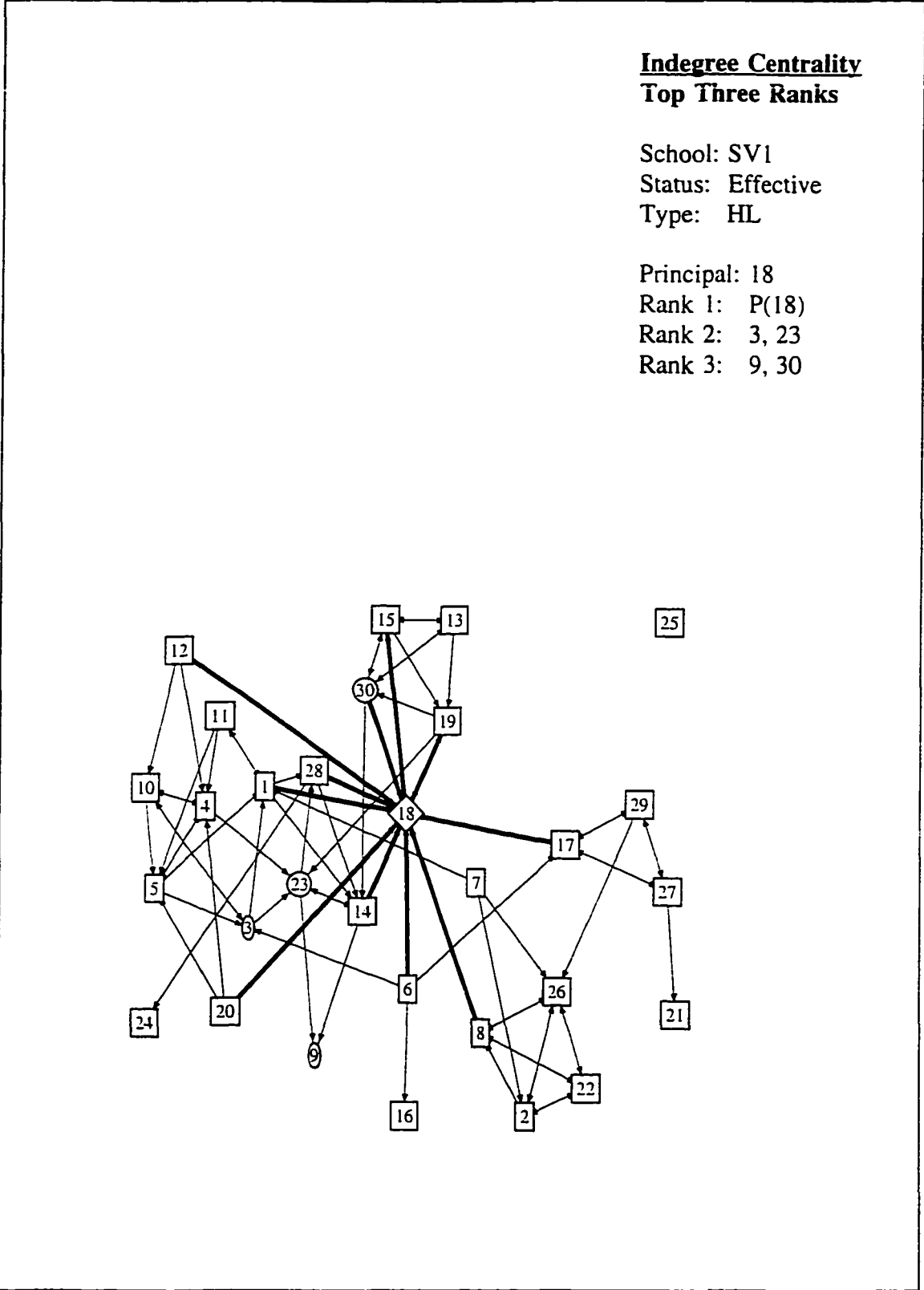


Figure 5.22. School SV1

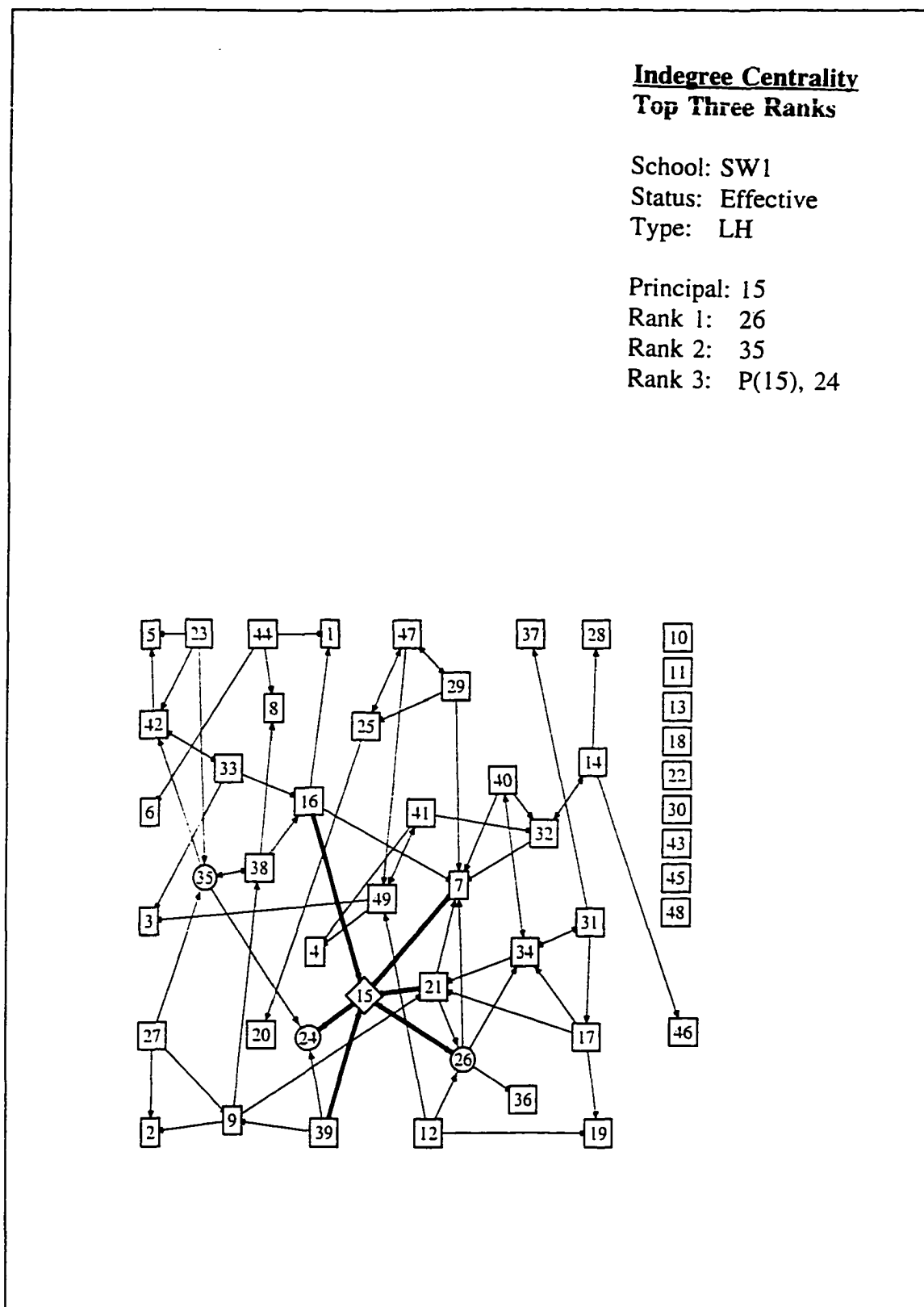


Figure 5.23. School SW1

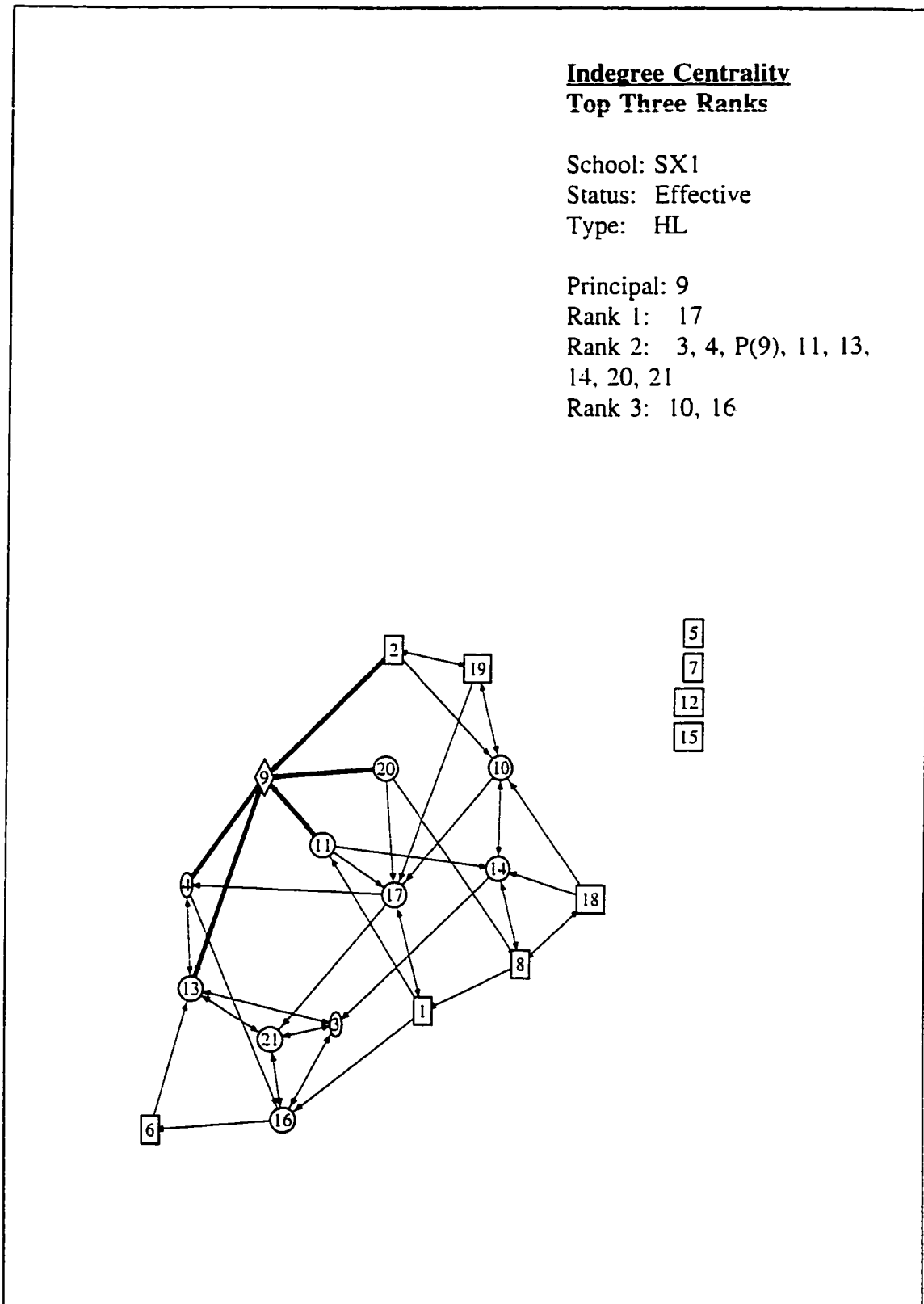


Figure 5.24. School SX1

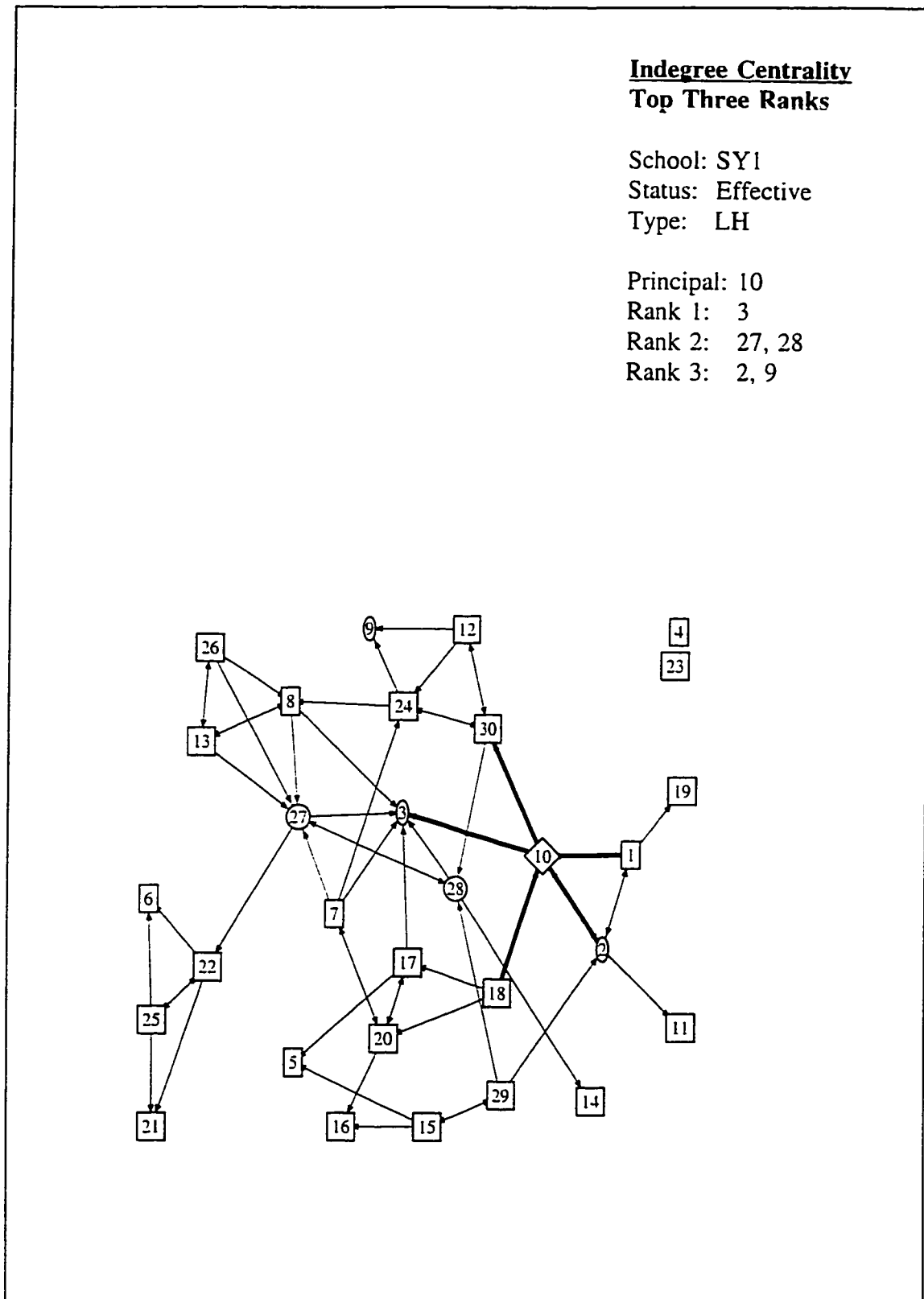


Figure 5.25. School SY1

Chapter Six: Quantitative Results from Parts I and II

Types of Analysis

Though the results of Part I, the Pilot Study, are reported separately in Chapter Four, the results for the centrality and the cohesiveness measures are also reported here along with the results from Part II, the Field Study. Results include the quantitative analysis of the centrality, centralization and density measures and the qualitative analysis of the sociograms.

In Part I, comparisons of the individual scores on the three measures of centrality were calculated. In both Parts I and II, comparisons were made between effectiveness levels on the principals indegree and betweenness scores. T-tests were used to determine if the centrality of the principal within the faculty structures showed statistically significant differences between effective and ineffective schools on these two centrality measures. Third, in both Parts I and II, comparisons were made between effectiveness levels on the network centralization (indegree and betweenness) and network density scores. In addition, a qualitative analysis was conducted on the network sociograms.

Results

The results for the comparisons and the analyses are reported below related to the hypothesis and questions for the study. A discussion of the results follows in Chapter Seven.

Results for Hypothesis One

Principals of effective schools will be more central to the leadership of the school than principals of ineffective schools as measured by their centrality scores.

Results from Part I on the normalized indegree centrality proved to be significant, while the betweenness comparisons were not significant. On the basis of the patterns of correlations from Part I, prior research (Bolland, 1988) and the t -tests from Part I, both measures of centrality were used in Part II, the normalized indegree and the normalized betweenness. In Part II, neither measure of principal centrality was significant, though there were differences in the means, in the expected direction.

In Part I, network centralization measures for differentially effective schools for both the network indegree centralization and the betweenness centralization were not significant. In Part II, comparisons of differentially effective groups on the network indegree centralization measure was significant; the mean of the effective group was 30.4 and the ineffective group was 20.0 ($t=2.63$, $df=22.62$, $p=.0150$) for unequal variances. Comparison of differentially effective groups on the network betweenness centralization measure was not nonsignificant; the mean of the effective group was 22.3 and the mean of the ineffective group was 22.1. The means and standard deviations for the principal and the network measures (for both indegree and betweenness) for the Pilot and the Field Study, are summarized in [Table 6.1](#).

Results for Question One

Are there more rivals for positions of leadership in ineffective schools than in effective schools as measured by centrality score ranks?

This question was partially addressed in this study. The verification of an individual as a rival could not be identified with the data collected for this study. However, assumptions were made about "rivals" for the purpose of analysis within the context of this study. A rival was defined as an individual who ranked first,

second, or third on the indegree centrality measure and was not directly connected to the principal. Rivals were assumed to be identifiable within the network as being distanced from the principal, both by scores and location, which was also verified by the sociogram for a school. This was verified again, when possible, by the network centralization measure, which would indicate if one individual was more central than any others. A visual inspection of the sociograms identified rivals in ineffective schools more than in effective schools.

Results for Question Two

Can effective schools be differentiated and characterized by a Type 1 or 2 configuration: ineffective schools by Types 3, 5, or 6 configurations; and changing schools by Types 4 or 5 configuration?

Results from both Part I and Part II support differential sociogram configurations corresponding to the predicted types. In the Pilot Study, 11 of the 16 schools clearly fell into the expected categories. Four of the other 5 schools fell into appropriate categories. Two schools in the HL category have well identified cliques which may contribute to the degree of density. Cliques as a dimension of connectedness were not explored within this study. Only one school, the LH stable effective school, was not classified as expected. This school also illustrates what may be a faculty split, even with a measure of high cohesiveness.

The sample schools also fell into expected categories, though less clearly than the schools from the Pilot Study. In the first category, HH (High leadership, High faculty cohesiveness) there were 3 effective schools and 1 ineffective school. One of the effective schools showed a clear hierarchial structure. In the second category, HL

(High leadership, Low faculty cohesiveness), there were 5 effective and 2 ineffective, in category three LH (Low leadership and High faculty cohesiveness) there were 5

Table 6.1

Mean Scores on Centrality and Centralization Measures

School Classification		<u>Principal Centrality Measures</u>			
		Indegree		Betweenness	
	<u>n</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
Part I - Total	16	38.54	17.83	14.99	16.70
Effective	9	47.15*	14.86	16.95	13.24
Ineffective	7	27.47*	15.71	12.46	21.23
Part II - Total	25	31.48	18.92	11.22	14.18
Effective	17	34.60	19.59	9.97	9.29
Ineffective	8	24.86	16.64	13.88	21.91
School Classification		<u>Network Centralization Measures</u>			
		Indegree		Betweenness	
	<u>n</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
Part I - Total	16	32.53	13.42	20.76	13.37
Effective	9	32.70	10.27	18.60	10.21
Ineffective	7	32.31	17.59	23.54	17.10
Part II - Total	25	27.08	12.21	22.26	13.30
Effective	17	30.39*	12.94	22.33	11.55
Ineffective	8	20.04*	6.72	22.10	17.35

* Difference between means is significant at $p < .05$

effective schools and 1 ineffective, and in the last category, LL (Low leadership and Low cohesiveness), there were 4 effective and 4 ineffective.

Results for Question Three

Do faculties of effective schools form a more cohesive group than faculties of ineffective schools as measured by density?

There was a significant difference on the density measure for Part I, the Pilot Study. For Part II, comparison of differentially effective groups on the density measure was not significant.

Table 6.2.

Mean Network Density

School Classification	<u>Network Density</u>		
	<u>n</u>	<u>M</u>	<u>SD</u>
Part I - Total	16	.24	.007
Effective	9	.28*	.072
Ineffective	7	.19*	.044
Part II - Total	25	.17	.072
Effective	17	.19	.062
Ineffective	8	.15	.088

* Difference between means is significant at $p < .05$

Chapter Seven: Results, Suggestions for Future Research and Conclusions

Results - Review

This study tested a framework of structural effectiveness within which principals, as leaders, were hypothesized to be influential through the communication network of a cohesive faculty. This was the first study to explore the sociometric characteristics of differentially effective schools within a network analysis methodology. This study was based on two propositions about effective schools, generated through prior school effectiveness and school improvement research:

1. Schooling is a complex interactive social process which is, conceptually, a structural model of interactions between and within components and not an additive model of specific components. This is the core even though schooling is comprised of individual components such as resources, teachers, students, activities, and outcomes and is influenced by contextual variables and situations.

2. Many of the characteristics of components associated with effective schools describe relationships or the results of relationships associated with communication structures. Identified in this study were those characteristics associated with the principal's leadership status within the faculty and faculty cohesiveness. These characteristics were defined as the structural indicators of a communication network.

The study took place in two parts: (a) a Pilot Study, using archived data and (b) a field study, using data from a stratified sample of differentially effective schools.

The Centrality-Cohesiveness Model of School Effectiveness, developed through the Pilot Study, defined a communication structure as having two network

parameters. The communication structure of a school was defined as a function of the leadership status of the principal (defined by the principal's centrality) and the cohesiveness of the faculty (defined as network density).

Principals in effective schools were theorized as having status within the network. Status, operationalized as centrality, was conceptualized as the individual's ability to obtain, transmit, or control communication throughout the network. Status described how central the position of the principal was within a communication network. Principals were hypothesized to hold central positions within a faculty network. Status was defined and measured for two models of this communication relationship:

1. The amount of network activity an individual engages in which is measured by degree.
2. The control one individual may exert over the overall network activity of all members within the network, which is measured as betweenness.

Cohesive faculties were theorized as being well connected. This was operationalized as density.

Chapter Seven contains a summary and discussion of the results from (a) the quantitative analysis of the individual centrality, network centralization and network density measures and (b) the qualitative analysis of the sociograms constructed for each schools and suggestions for further research

Principal Leadership

There were mean differences in the degree and betweenness centrality measures for the principals in differentially effective schools. In both the Pilot Study

and the Field Study, the normalized indegree was higher for principals in schools classified as effective. This difference was significant in the Pilot Study. In the Pilot Study, the mean betweenness score for principals was higher in effective schools. This mean measure was lower in effective schools in the Field Study. Neither were significant. The lower mean would indicate that principals might be seen as more "popular" than as "gatekeepers" in the Field Study, but in the Pilot (where the mean was higher) this distinction is not as clear. Degree centrality and betweenness centrality are probably measuring two different dimension of centrality within a network structure. Analysis of the sociograms does not clarify this finding. Additional analysis would be necessary.

The results from the network centralization measures for the Pilot Study indicate that there does not appear to be a difference between effectiveness classifications as to one individual being more prominent in the faculty structures, indicated by either of the measures used here (network centralization or betweenness centralization). However, this difference was significant in the Field Study on the indegree centralization measure. This would indicate that in the Field Study, there was a difference in how centralized faculties were around one individual, with the faculties of the effective schools being more centralized around an individual than faculties of ineffective schools. This means that in ineffective schools, faculty are not centered around one or more individuals, but rather have a more equally divided pattern of connections. It would be expected in a network that is more equally centralized, that there would be less indications of leadership, either measured or observed, within the faculty structure. Any individual considered a leader, such as a

principal, would be expected to exhibit the same kinds of linkages as the other members of the network (as indicated by an equally divided pattern of connections).

Differences in patterns of centralization were also observed through the sociograms in the classification of the schools on the Centrality-Cohesiveness Model in the LL (Low leadership, Low cohesiveness) cell. This cell contained 4 effective schools and 4 ineffective schools. The sociograms tend to be "stringy"; that is, there are indications of trees and semi-forests throughout the network, or around the edges. A tree is a description of a graph (sociogram) that is connected and that contains no cycles (as suggested by the configurations found in Schools SA1, SII, SN1, and SS1). A forest is a graph (sociogram) that is disconnected and contains no cycles (as is suggested by the configurations found in School SP1). By comparison, the sociograms for schools found in the HH category could be described as more webbed and woven (as is suggested by the configurations found in Schools PB1, PC1, SC1, SG1, and SH1). The connections of the principals is observable in the sociograms and they are connected to others as expected.

Faculty Cohesiveness

Quantitative results indicate that, first, school faculties tend to be somewhat sparsely connected and this connectivity is not much different across effective or ineffective schools, as indicated by mean density. Effective schools in both the pilot and the sample had higher density scores than ineffective schools, calculated from all links. This difference was significant in the Pilot Study, but not the Field Study. This may indicate several things about the connectedness of school faculties as measured by density. First, teachers, of necessity, are constrained in their communication

interactions and therefore are selective about the connections that they do make.

Second, the differential point on a density measure, may be located on a very narrow band. In other words, faculties may not have a large proportion of connections at any point, effective or not, and the parameters for density (as well as all of the measures used in this study) for this kind of a network have not been determined. The range for the Pilot Study was a low of .12 to a high of .43 and in the Field Study the low was .04 and the high was .33.

Each of the components included in the discussion above on network centralization are also applicable in describing the connectedness of a faculty and may be evaluated as separate variables of a network. When evaluated in the context of centralization the focus is on the pattern of connectedness and the identification of highly ranked individuals within that pattern. When evaluated from the perspective of cohesiveness, the focus is on the components of the patterns, such as the cutpoints, bridges, and trees.

One additional variable identified from the sociograms which indicates connectedness is the degree to which cliques can be identified and how complete the cliques appear to be. Cliques appear particularly in those schools in the HL category such as Schools PC1, SL1, SM1, and SO1. Cliques are especially noted in School PC2, (a LL category School) where each clique is almost exclusively formed from grade level connections.

The indications from the sociograms support the suggestion that density may need to be evaluated in combination with other measures. Two variables identified in the sociograms that would need to be explored further are the bridges and cutpoints

which connect various elements of the network together. Individual 59 in School PC2 is a cutpoint, as is individual 2. Structurally, the links between members combine to form the sociometric components such as cliques and clusters. The cohesiveness of a group is not just the connections within these subsets, but is also what Granovetter's (1973) has coined "weak ties", or the links between cliques and clusters. It is the "weak ties" that connect a network together and therefore also indicate a level of cohesiveness.

Another variable identified for future investigations in combination with density is school size. Friedkin (1981) has found that when the values are small, density can be a misleading summarization tool and should be used in conjunction with network size. There was a significant difference in faculty size between schools classified as effective and schools classified as ineffective in the pilot. There was no significant difference in the sample schools.

The results of this study support the hypothesis that quantitative network measures of the communication structures of school faculties can be used to differentiate schools on effectiveness levels. The potential to differentiate between the effectiveness levels of schools is enhanced when paired with the structural characteristics and dimensions identified from the sociograms.

Though there are differences in the pattern of results for the two parts of this study (the Pilot Study and the Field Study), when viewed together, the results begin to provide a picture of the structural characteristics of differentially effective schools, when measured with network analysis methods. The results of the Pilot Study and then the Field Study build a framework that supports both the application of this

methodology to the study of differentially effective schools and the further development of the methodological techniques as applied to the communication structures of faculties in differentially effective schools.

The results from the Pilot Study clearly support the purposes of the study, which was to define a model of school effectiveness and to select the operational definition and measures for centrality that were then utilized in Part II, the Field Study. The results and analysis of Part I indicate that differentially effective schools have different structural characteristics. The results indicate that the leadership of the principal and the cohesiveness of the faculty are two strong components of this structure and that combined within a communication structure, they can differentiate between effectiveness levels. The results from the Field Study also support the Centrality-Cohesiveness model but highlight the complexity and multiplicity of both the structural parameters of communication structures and the nature of effectiveness.

One example of this complexity is the variety of patterns found in the sociograms which identify the leadership of the principal within the faculty structure. In one pattern the principal is clearly and directly connected to the other members of the network. This is observed in Schools PB1, PC1 and PE1. In the second pattern principals are linked to other highly ranked faculty who in turn are connected to the rest of the network, as observed in Schools SC1 and SG1. This second pattern can also be less noticeable as observed in School SF1, where individual 37 is the assistant principal. This second pattern indicates a hierarchical nature to leadership and even to the identification of "surrogate" principals within the network. Surrogate principals can be defined as those individuals who are linked to the principal but appear to have the primary position of leadership within the structure.

Network Analysis as a Multi-level Methodological Tool

The Pilot Study illustrates the simplicity and the practicality of the model to categorize schools within the Centrality-Cohesiveness Model. The Pilot Study tested the model with a sample of unquestionably differentiated schools. The schools in the sample for the Pilot Study had clearly and carefully been reclassified on the basis of multiple dimensions of effectiveness (Teddlie & Stringfield, 1993). The classifications for the sample in the Pilot Study, from LSES-IV, were made on the basis of both quantitative and qualitative longitudinal data, such as: the stability of the faculty, norm and criterion-referenced test scores, changes in student attendance, teaching behavior, and student time-on-task. The network characteristics and parameters identified in this study exhibit another dimension of effectiveness, which correspond to the comparisons identified in previous research. The network characteristics help to reveal a richer picture of differentially effective schools.

The Field Study, on the other hand, was conducted with a sample of schools classified as effective on only one dimension, criterion-referenced test scores. The sample may, therefore, reflect less clearly differentiated classifications. Or the sample schools in the Field Study may simply present a more complex picture of differential structural effectiveness. Together, the Pilot Study and the Field Study illustrate that the model, with the defined structural indicators of principal leadership and faculty cohesiveness, is a multilevel methodological tool with which to understand the structural characteristics of school effectiveness. This means that on one level, some schools may clearly fall into a category on the basis of network measures. such as in the Pilot Study. On the second level, this means that there are

other structural characteristics that are necessary to completely understand the structural framework of some schools.

A multilevel methodological tool means that it is entirely appropriate to use sociograms to describe and clarify the structural characteristics of differentially effective schools. Schools wanting to engage in a school improvement program might investigate how information is processed throughout the entire faculty. Principals intent on change often describe how important it is to have key teachers on board. Sociograms document and identify why and where they may be located within a network.

A multilevel methodological tool also means that there are additional methodological resources available that have not been explored. Sociograms from both the Pilot Study and the Field Study illustrate some of the structural characteristics that may be necessary to explore more fully in order to understand leadership centrality and faculty cohesiveness. Sociograms of schools located in the LL category of the model especially illustrate specific characteristics that seem to differentiate these schools from the schools in the other categories.

First, there was the presence of cliques. Cliques appear to be close to maximal complete graphs. (Maximal complete graphs are a very strict definition of a subgraph, which is very restrictive, and includes at least three members of the group who choose each other, exclusively. This type of graph is not common.) Second was the presence of rivals. Third was cutpoints (individuals who are a link between other and whose removal breaks the network into multiple components). Fourth was isolates. Fifth was bridges, or lines that connect individuals as cutpoints do. Sixth

was multiple components. Each of these characteristics is a type of structural variable which has been identified in network methodology and for which measures have been developed.

Overall the results indicate that network analysis is an applicable methodology for merging what we already know about effective schools and the schooling process into a relational model of schooling by providing a new window through which to view the complex interactive nature of schooling. Sociograms tap into something that is hard to get from other measures. Sociograms tap into one aspect of the complex interactive nature of effectiveness. Sociograms illustrate visually (through a focus on the communication structure of a faculty) what has been called "a feeling" about the connectedness of a school. Sociograms and the corresponding measures and components provide details on what is now a somewhat hazy portrait. Sociograms, at both methodological levels, provide a very powerful tool within a SESI framework. First, sociograms and the corresponding measures and components fit well into the existing SESI framework and could easily be an additional component of both school effectiveness research and school improvement projects. The results of this study provide a beginning framework with which to identify the structural characteristics of differentially effective schools in future studies. This study clearly indicates the need for future studies on both the differential parameters of structural indicators and on the characteristics of specific structural measures. This also suggests longitudinal research on the structural dimensions of differentially effective schools. One such study suggested is further research on the comparisons between LSES-IV and -V, for which longitudinal

sociometric data are available. Such a study might explore what changes in the communication patterns are observed and if the stability or changes are associated with other variables such as student achievement changes or the stability of the principal. Other studies could investigate the differential characteristics of the structural measures such as the centrality measures. Such a study could explore several measures of the same construct, centrality, with a sample of clearly differentiate schools.

On the application side, sociograms provide evidence of specific communication patterns within a school and as such are a point from which to identify where changes and/or enhancements could be made in the process of school improvement programs. Sociograms could be used to identify the communication structure of a school as "well-webbed" or "stringy". This classification could then be used in order to plan how to convert a "stringy" structure to one that would be more aligned with the characteristics of a highly effective school. Principals who want to involve faculty would be able to identify or verify key players within the faculty network, isolates that would need to be drawn in, cutpoints and bridges that would need to be strengthened, and cliques that might need to be separated or that might be a strong starting point for developing a larger cohesive network.

Suggestions for Future Research

This study raises far more questions than provides it answers. This study is the first "testing of the network analysis waters" within the context of school effectiveness and school improvement, utilizing complete network data gathered on school faculties. Defined as such, this study begins to provide baseline characteristics

from which to construct a framework of structural parameters and from which to test hypotheses. Network analysis measures cannot be considered as "standardized" across all normal distributions, because it is within a particular structural context that each kind of relationship takes place. Data on schools may indicate different structural parameters than friendship relationships or other work organizations.

The results of this study support the propositions that (a) there may not be a differential nature to the quantitative measures of structural components as defined and measured now and (b) that there may be a set of structural parameters within which effectiveness can be identified. An analysis of the sociograms indicates that these parameters would include: (a) the principal is ranked first, second or third within the network, (b) the principal is connected to the first ranked individual within the network, (c) the network contains one component, (d) there are no or few isolates, (e) there are few or no complete cliques, (f) connections within the network are not skewed and (g) the others to whom the principal is connected are important.

One paradigm for exploring the complexity of faculty networks is within the context of a "social relational system" (Wasserman & Faust, 1994). Wasserman and Faust suggest that groups studied from a network analysis perspective should be studied within a system which conceptualizes: (a) the actors, (b) the pairs of actors, (c) the relations between pairs of actors, and (d) the attributes of the actors and the social network. This suggests at least four areas for refinement (a) the definition of the network, (b) the types of components explored that describe how faculty connect, (c) the context of the relationship explored, and (d) the details about those who are connected.

The first is the definition of the network, the actors. This study used complete networks for the data analysis, with either "all" choices or the "in" choices, and used first, second, third, choices for the sociograms. Other techniques may be necessary to both bound the network and to define the network. It is feasible to think of the current network data used to construct the measures as containing "noise" or irrelevant linkages, and that it does not truly define the relationship between the principal and teachers that the measure dictates. It is not a case of asking the wrong question, but rather one of not knowing what data answers the questions more specifically. For example, another perspective would be to define the data for the network as the set of ties surrounding one particular individual, in this case the principal, or what is defined as "egocentric" network data (Marsden, 1990).

Second, related to the construction of the data matrix which describes the network, another area for consideration is the definition of the link between the individuals within the network. This is defined through the measures used. The choice of a measure can be considered both alone and in terms how the network is defined. It is possible that instead of the principal's indegree based only on individuals choosing the principal, the normalized degree based on data gathered from mutual choices would be used. Marsden (1990) has addressed this application issue and has noted that "Network analysts commonly write about social structure conceived as patterns of specific or concrete social relations as if the issue of what constitutes a social relation were self-evident" (p. 436). From this introductory study on the faculty networks of differentially effective schools, it is quite obvious that we know less than might be visible.

The third area is related to the context of the relationship explored. An analysis of the content of communication interactions was not explored within this study and a next step would be to further define the specific characteristics of communication within the context of differentially effective schools. Slater (1991) found that there are differences in the content of communication in highly effective schools.

One factor related to communication context and appropriate to the study of differentially effective schools is the developmental level of the group. Bennis and Shepard (1974) state "...group development involves the overcoming of obstacles to valid communication among the members, or the development of methods for achieving and testing consensus." (p. 128). The development of the group and the characteristics of communication structures of faculties at various stages of development would be a useful tool for exploring the dynamics of changing schools.

Fourth, individual attributes and contextual parameters can influence and even impact the effectiveness level of a group.

"It is obvious that many physical, structural, and process problems pertaining to groups are involved in this issue. Variables such as size of group, nature of task, composition of membership, time and quality factors, motivational forces from within and from outside the group, imposed goals versus self-determined goals, intragroup communication, conformity pressures and morale, and processes of interpersonal influence have been studied in scattered researches and have a direct bearing on the question of productivity. But no comprehensive theory has been developed to link these variables in a way which would permit definitive answers." (Luft, 1984, p. 28).

Two areas stand out from this research, (a) the identification of the members of cliques and clusters and (b) the assigned roles and identification of high ranking individuals.

Conclusions

"An organization is a dynamic open system that creates and exchanges messages among its members and between its members and its environment." (Goldhaber, 1990, p. 16). Often the messages we send are not intentional and say a great deal about how open the system is. Even before schools participated in this study, there were indications that the willingness to communicate might be an indicator of differential effectiveness levels. On the one hand were principals who never answered the phone; principals who were constantly and consistently unavailable; principals who had faculty and secretaries as gatekeepers; assistant principals who were hesitant and relayed messages; and principals who used technology to block specific phone calls from ringing through to the school. This is contrasted with principals who answered their own phones; assistant principals who, though they indicated the principal was in charge of all final decisions, made the decision to participate in the study or not; and principals who returned phone calls. This study explored one small piece of a vast puzzle of understanding the relationship between communication and the schooling process.

How do we describe a process model of schooling? What do we mean by a process model of schooling. To use a metaphor: schooling as a process is much like a simple wave display in a sealed bottle. To create a "wave", oil, water and coloring are placed in a sealed jar. When you roll the bottle you create the motion of waves with the colored oil rolling on top of the water. Depending on the amount of each component added to the jar, or if a component is missing, the characteristics of the waves change. If you have too much water and not enough oil and color, then you

have a mess. Too much oil, too little water and not much color and again the mess. But occurring over and over, with many different formulas, in many different combinations. are beautiful waves, with just enough oil to show up in great color. Each display is unique, varying in proportions, size, color, but all are successful wave displays. Some displays are more permanent than others. The jar tilts and rolls on a permanent stand and imbedded in the display are other materials like coral, rocks, and bright glass. To look at these displays is to see a replication of the ocean or a coral reef.

This is the same concept behind a process model. This is not to say that the components comprising the schooling process - the faculty and the leadership of the principal - are as unlike as water and oil! Rather, it is to say that when the combination works, it is beautiful to see, and it is unique.

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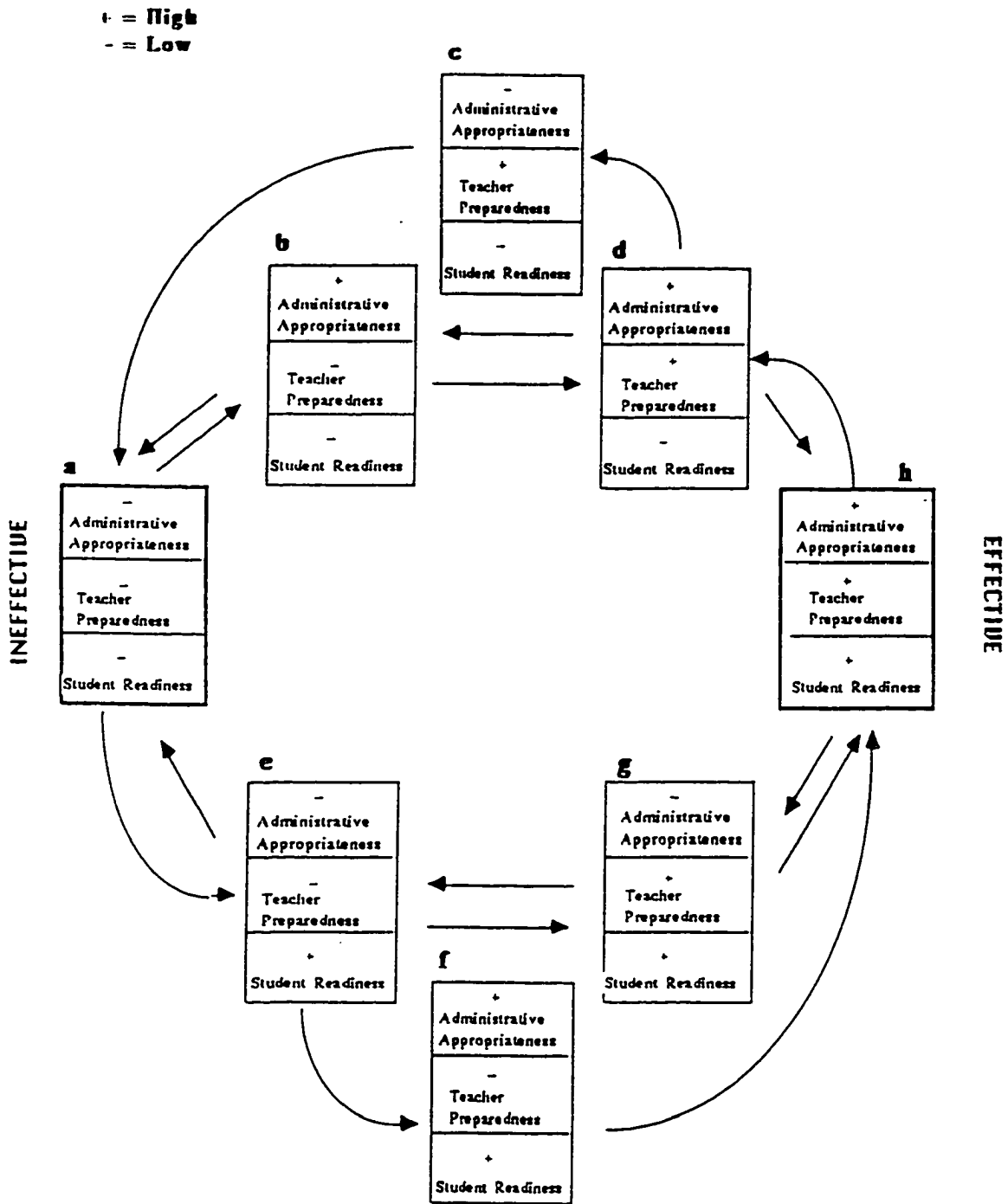
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Appendix A

A. Slater - Teddlie Typology of School Effectiveness and Leadership



Appendix B

B.1 Sociometric Survey Part I

Question Number One

Consider the following list of staff members at your school. Please put a check by the name of each person with whom you discussed school related academic matters last week. Then go back and indicate which three persons you communicated with the most about academic matters last week in your school. Do this by marking 1, 2, or 3 by their names.

SCHOOL NAME

_____faculty list

Question Number Two

Consider the following list of staff members at your school. Assume that you were on a committee that was organized to improve your school. Please put a check by the names of each person that you would like to be on the school improvement committee with you. Then go back and indicate the three persons that you would most like to be on the committee with you. Do this by marking 1, 2, or 3 by their names.

SCHOOL NAME

____ Faculty list

B. 2 Sociometric Survey Part II

1. Letter to Principal requesting participation in the study
2. Distribution and mail-back Instructions sent to each school with the surveys packets for each teacher
3. Sociometric Survey which includes the cover letter sent in each teacher's packet, the general instructions and the specific survey for a school

Maryann Durland
3220 Altaloma Drive
Birmingham, Al. 35216

Date sent

Principal
School
Address
Town. Alabama Zip

Dear Principal (Name),

Your school has been selected as a participant in a multi-state study on the communication patterns in elementary schools. The study is being conducted by Maryann Durland, a doctoral student at Louisiana State University in Baton Rouge, Louisiana.

Participation in the study is voluntary and would require completion of two activities. The first is to return to the researcher (in the enclosed, self-addressed stamped envelope) a faculty list which includes the first and last name of each faculty member of your staff. This would include all teachers, counselors, assistant principals, special teachers, P.E., music or art teachers and librarians. This faculty list will then be used in the survey developed for your school.

The second step in this study would require all faculty members to individually complete the communication survey developed for your school. The surveys will be provided to your school for each teacher to individually complete. The survey takes about 10-15 minutes to complete. The surveys will then be returned to a central location to be mailed back to the researcher in the envelope provided or will be collected by the researcher in person.

The study's purpose is to explore the methodology for measuring communication patterns in elementary schools. Though no individual teacher or school will be identified in the analysis and results of this study, the researcher would be available to share and discuss with you any findings that would relate to your school or that you might find interesting or informative.

I will be contacting you within the next few days by phone to answer any questions you may have about the study and your school's participation. Also, please feel free to contact me at any time at: 205 822-7883.

Thank you so much for your time. Your participation in this study is greatly appreciated.

Sincerely,

Maryann Durland

DISTRIBUTION AND MAIL-BACK INSTRUCTIONS

PLEASE DISTRIBUTE THE ENCLOSED SURVEYS TO THE TEACHERS IN YOUR SCHOOL FOLLOWING YOUR ESTABLISHED DISTRIBUTION PROCEDURES (TEACHER MAILBOXES, DURING REGULARLY SCHEDULED FACULTY MEETINGS, ETC).

EACH ENVELOPE IS LABELED FOR EACH TEACHER. ONE EXTRA SURVEY HAS BEEN INCLUDED IN THE EVENT THAT ANY TEACHER MAY HAVE BEEN INADVERTENTLY MISSED.

A LARGE ENVELOPE FOR MAILING BACK THE COMPLETED SURVEYS IS ENCLOSED. AS TEACHERS COMPLETE THE SURVEYS THEY CAN DEPOSIT THEM IN THIS LARGE ENVELOPE WHICH SHOULD BE LOCATED IN A CONVENIENT, CENTRAL LOCATION.

TEACHERS SHOULD COMPLETE THE SURVEY WITHIN 2-3 DAYS AFTER RECEIVING IT. TO ENSURE AS MANY RETURNS AS POSSIBLE, ON THE 4TH DAY PLEASE REMIND TEACHERS THAT THE SURVEYS ARE DUE BACK. PLEASE THANK THEM FOR ME FOR THEIR COOPERATION AND HELP.

ON THE 5TH DAY, IF ALL SURVEYS HAVE BEEN RETURNED, MAIL THE ENVELOPE BACK TO M. DURLAND. (SEE UNDER THE MAILING FLAP OF THE RETURN ENVELOPE FOR THE NUMBER OF SURVEYS INCLUDED IN THE PACKET FOR YOUR SCHOOL THAT SHOULD BE RETURNED, NOT COUNTING THE EXTRA ONE).

IF ALL SURVEYS HAVE NOT BEEN RETURNED ON THE 5TH DAY GIVE TEACHERS 1 OR 2 MORE DAYS TO COMPLETE THE SURVEYS. BEFORE RETURNING THE PACKET. IF YOU HAVE ANY QUESTIONS AT ALL, PLEASE CALL ME AT 205 822-7883.

THANK YOU SO MUCH FOR YOUR HELP WITH THIS RESEARCH PROJECT.

MARYANN DURLAND

SOCIOMETRIC SURVEY

Your school is participating in a state wide study on communication in schools. This information is part of a research project and will not be used by your school or your school system in any way. The research is intended to explore how teachers communicate with each other about academically related matters.

All information that you provide is strictly confidential. All data are coded for analysis and no individual teacher or school can be identified in any way.

There are three sections to this survey. The survey should take you about 10 to 15 minutes to complete. During the next two days, read over the instructions and then mark all of your answers on the computer answer sheet provided. When you are finished, place your answer sheet and survey in the large folder labeled M. DURLAND in the principal's office of your school. Please do not fold your answer sheets.

The folder will be collected within a few days after you receive this survey.

Thank you very much for your cooperation and help with this survey. If you have any questions you may contact the researcher at:

M. Durland

Phone: 205 348-3818 or 205 822-7883

GENERAL INSTRUCTIONS:

1. PLACE ALL ANSWERS ON THE COMPUTER ANSWER SHEET ENCLOSED WITH THIS SURVEY.
(SEE PAGE 4 FOR A SAMPLE OF A COMPLETED ANSWER SHEET.)
2. EACH QUESTION MATCHES A NUMBER ON THE ANSWER SHEET.
3. FOR EACH QUESTION, FILL IN THE CIRCLE ON THE ANSWER SHEET CORRESPONDING TO YOUR ANSWER.
4. FOLLOW THE SKIP INSTRUCTIONS AND ONLY ANSWER THOSE QUESTIONS THAT APPLY TO YOU. LEAVE THE ANSWER SHEET BLANK IF A QUESTION DOESN'T APPLY.

SECTION ONE

FILL IN YOUR RESPONSES TO THESE QUESTIONS ON THE LEFT SIDE, SIDE 1, OF THE COMPUTER ANSWER SHEET (SEE SAMPLE ON PAGE 4)

INSTRUCTIONS:

1. Do not fill in your name on the answer sheet.
2. Fill in your correct sex.
3. For the section "Grade" or "Education", fill in the grade that you teach.
IF YOU TEACH MORE THAN ONE GRADE EQUALLY, MARK "16"
4. Do not fill in birth date.
5. Identification number and special codes have been completed for you.

FILL IN YOUR RESPONSES TO THESE QUESTIONS ON THE RIGHT SIDE, SIDE 1, OF THE COMPUTER ANSWER SHEET (SEE SAMPLE ON PAGE 5)

Q1. What is the highest degree you currently hold. FILL IN THE CIRCLE NUMBER.

bachelors	1
masters	2
masters plus	3
EdD	4
PhD	5

Q2. How many years of teaching experience do you have? FILL IN THE CIRCLE NUMBER.

first year teacher	1
1-3 years experience	2
4-6 years experience	3
7-10 years experience	4
11+ years experience	5

Q3. How long have you been a teacher at this school? FILL IN THE CIRCLE NUMBER.

first year at this school	1
1-3 years at this school	2
4-6 years at this school	3
7-10 years at this school	4
11+ years at this school	5

FOR Q4 TO Q7. ANSWER ONLY THOSE QUESTIONS THAT APPLY TO YOU. FOLLOWING THE SKIP INSTRUCTIONS. LEAVE THE ANSWER SHEET BLANK IF A QUESTION DOESN'T APPLY.

IF YOU TEACH IN A ONE GRADE, SELF CONTAINED CLASSROOM SKIP TO THE SAMPLE QUESTION ON PAGE 3.

Q4. What is your primary position at this school? FILL IN THE CIRCLE NUMBER. IF YOUR POSITION IS NOT LISTED IN Q4. SKIP TO Q5.

Librarian	1
Chapter I teacher	2
Assistant principal	3
Principal	4
Counselor	5

Q5. Position at school continued: FILL IN THE CIRCLE NUMBER.

Special education teacher	1
Other	2

**IF YOU PRIMARILY TEACH IN A SUBJECT AREA COMPLETE Q6:
IF NOT SKIP TO THE SAMPLE QUESTION ON PAGE 3.**

Q6. What is the subject area you teach the most? FILL IN THE CIRCLE NUMBER. IF YOUR SUBJECT AREA IS NOT LISTED IN Q6, SKIP TO Q7.

English	1
Math	2
Social studies	3
Science	4
Reading	5

Q7. Subject areas continued. FILL IN THE CIRCLE NUMBER.

Foreign Language	1
Music or Art	2
Computer	3
Business	4
Other	5

SAMPLE QUESTION

FOLLOW THIS SAMPLE FOR BOTH SECTION TWO AND SECTION THREE.

INSTRUCTIONS: EACH INDIVIDUAL IN THE LIST BELOW IS NUMBERED. PLEASE BE SURE TO MARK YOUR ANSWERS BY THE MATCHING NUMBER ON THE ANSWER SHEET. IF YOU NEED TO ADD ANY INDIVIDUAL, LIST THEM ON THE SURVEY WITH THE NEXT SEQUENTIAL NUMBER.

Consider the following list of staff members at your school. Please, select the three persons with whom you discussed school related academic matters most last week.

Indicate the person you spoke with most by filling in the circle 1 on your answer sheet by the matching number. (See the sample on page 4. The person spoken with the most was "Sue Fish", #12.)

Indicate the person you spoke with second most by filling in the circle 2 on your answer sheet by the matching number. (On the sample, this person is #21, "Evan Dodd".)

Indicate the person you spoke with third most by filling in the circle 3 on your answer sheet by the corresponding number. (On the sample, this person is #14, "Brenda Quake".)

Now go back and indicate all other individuals with whom you discussed school related academic matters last week. Do this by filling in the "4" on the answer sheet by the number matching their name on the list below. (On the sample these are: #8 John Smith, #10 M. Table, #16 Lois Bean, #24 B. Moore and #27 Chris Jacobs.) Leave all others blank.

- | | | |
|------------------|-------------------|-------------------|
| 8. John Smith | 15. Tom Hill | 24. B. Moore |
| 9. Mike Scott | 16. Lois Bean | 25. Alice Butcher |
| 10. M. Table | 17. Cindy Wall | 26. Bill Cutter |
| 11. Q. Weaver | 18. John Bennett | 27. Chris Jacobs |
| 12. Sue Fish | 19. Mary Thorn | |
| 13. Scott Abbot | 20. Ellen Manwell | |
| 14. Brenda Quake | 21. Evan Dodd | |
| | 22. Beverly Grant | |
| | 23. Anthony James | |

DATE OF BIRTH

Month	Day	Year
Jan II	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Feb II	1 2 3 4 5 6 7 8	0 1 2 3 4 5 6 7 8 9
Mar II	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Apr II	1 2 3 4 5 6 7 8	0 1 2 3 4 5 6 7 8 9
May II	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Jun II	1 2 3 4 5 6 7 8	0 1 2 3 4 5 6 7 8 9
Jul II	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Aug II	1 2 3 4 5 6 7 8	0 1 2 3 4 5 6 7 8 9
Sep II	1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9
Oct II	1 2 3 4 5 6 7 8	0 1 2 3 4 5 6 7 8 9
Nov II	1 2 3 4 5 6 7 8	0 1 2 3 4 5 6 7 8 9
Dec II	1 2 3 4 5 6 7 8	0 1 2 3 4 5 6 7 8 9

ID NUMBER

1	2	3	4	5	6	7	8	9	0
1	2	3	4	5	6	7	8	9	0
1	2	3	4	5	6	7	8	9	0
1	2	3	4	5	6	7	8	9	0
1	2	3	4	5	6	7	8	9	0
1	2	3	4	5	6	7	8	9	0
1	2	3	4	5	6	7	8	9	0
1	2	3	4	5	6	7	8	9	0
1	2	3	4	5	6	7	8	9	0
1	2	3	4	5	6	7	8	9	0

LAST NAME

FIRST NAME

GRADE

IMPORTANT

USE NO. 2 PENCIL ONLY

EXAMPLE: 1 2 3 4 5

ERASE COMPLETELY TO CHANGE

SCANTRON GENERAL PURPOSE ANSWER SHEET

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-----

QUESTIONS 10 THROUGH 350 CONTINUE ON THE OTHER SIDE

SOCIOMETRIC SURVEY
SECTION TWO

INSTRUCTIONS: EACH INDIVIDUAL IN THE LIST BELOW IS NUMBERED. PLEASE BE SURE TO MARK YOUR ANSWERS BY THE MATCHING NUMBER ON THE ANSWER SHEET. IF YOU NEED TO ADD ANY INDIVIDUAL, LIST THEM AT THE END.

Consider the following list of staff members at your school. Please, select the three persons with whom you discussed school related academic matters most last week.

Indicate the person you spoke with most by filling in the circle 1 on your answer sheet by the corresponding number.

Indicate the person you spoke with second most by filling in the circle 2 on your answer sheet by the corresponding number.

Indicate the person you spoke with third most by filling in the circle 3 on your answer sheet by the corresponding number.

Now go back and indicate all other individuals with whom you discussed school related academic matters last week. Do this by filling in the "4" on the answer sheet by the number matching their name on the list below.

See faculty list on page 6

Faculty list for Section Two

8. L
9. S
10. A
11. C
12. L
13. V
14. C
15. S
16. D
17. C
18. T
19. P
20. P
21. S
22. G
23. I
24. S
25. D
26. D
27. S
28. K
29. M
30. I
31. B
32. C
33. J
34. L
35. D
36. J
37. J
38. J
39. B
40. S
41. R
42. D
43. P
44. J
45. M
46. M

SECTION THREE

INSTRUCTIONS: EACH INDIVIDUAL IN THE LIST BELOW IS NUMBERED. PLEASE BE SURE TO MARK YOUR ANSWERS BY THE MATCHING NUMBER ON THE ANSWER SHEET. IF YOU NEED TO ADD ANY INDIVIDUAL, LIST THEM ON THE LINES PROVIDED.

Consider the following list of staff members at your school. Assume that you were on a committee that was organized to improve your school. On the computer answer sheet, indicate the three persons that you would like to be on the school improvement committee with you.

Indicate your first choice by filling in the circle 1 on your answer sheet by the number matching the individual you chose.

Indicate your second choice by filling in the circle 2 on your answer sheet by the number matching the individual you chose.

Indicate your third choice by filling in the circle 3 on your answer sheet by the number matching the individual you chose.

Now go back and indicate all other individuals whom you would like on this school improvement committee. Do this by filling in the "4" on the answer sheet by the number matching their name on the list below.

See faculty list on page 8

Responses for Section Three begin with number "51"

Appendix C

C. Sociometric Data and Sociogram Construction

Appendix C contains the raw data used in the network analysis for this study. The data is for one school, sample school SA1. The individual data files are:

- C1. Unedited, raw data downloaded from scantrons into Word Perfect word processing file for questions one and two.
- C2. Word Perfect files coded for import into UCINETX, question one.
- C3. UCINETX matrix of data
- C4. UCINETX printout for Degree Centrality Measure calculations
- C5. Data, from UCINETX, coded for import into Krackplot 3.0 for constructing sociograms
- C6. Random graph of network connections
- C7. Graph from multidimensional scaling on random graph
- C8. Graph after annealing on multidimensional graph, with principal connections highlighted

C1. School SA - Unedited. raw data for questions one and two

01059070 01 100244 34 14 4 4 4 4 444 4444 4 24
 44 4 4 44 4 4 4 4 1 4 3 42
 01059070 02 105254 4 4 4 4 3 4 4 24 1 4
 3 2 1
 01059070 03 100355 2 441 4 3 4 4 4
 4 13 4 2 4
 01059070 04 1163552 2 3 1 2
 1 2 3
 01059070 05 103355 44 4 14 4 4 4 2 4 3
 4 4 1 4 2 3
 01059070 07 1162541 4 43 4 14444444444 44 44444 44444 4 4444444 2
 3 4 4 44 4 44 4 41 2
 01059070 08 101254 1 3 4 4 4 4 1 4 42 4
 4 44 443 2 4 1 4
 01059070 10 100233 2 5 1 2 3
 2 1 3
 01059070 11 116143 1 4 4 4 42 4 3 4 4 41
 4 1 4 4 4 4 3 4 2 44 4
 01059070 13 103133 4 4 1 3 4 42 4
 4 1 2 3
 01059070 14 101233 4 4 32 44 4 44 1444 4 4 4444444
 4 44 44 4 1 23
 01059070 15 002143 3 2 1
 24 3 1
 01059070 16 100355 4 41 42 44 4 4 43 4 4 4

 01059070 17 101354212 4 3 2 2 4 14 4 3121 3
 4 3 4 2 4 4 14
 01059070 18 104233 4 4424 4 1 3 4
 4 2 43 1 4 44 44 4 4
 01059070 22 116131 1 5 24 4 3 4 44 44444 44 4 41 444
 1 44444444344 4 44 4 44 4 4 44 4244444444
 01059070 23 116253 15 4 4 4 142 4 34 4 4 4 44444 44
 4 4 3 4 4 4 4 1 2 4 4
 01059070 26 1 333 55 4 2 14 3 4 4
 144 4444 4 4244 4 4 4 44 44444
 01059070 27 103253 1 3 4 21 4 4
 4 4 4 24 1 3 4
 01059070 28 101154 1 4 4 4 4 2 3
 4 4 3 1 4 2
 01059070 31 105255 2 3 1
 3 21
 01059070 32 101255 3 4 4 42 1
 4 4 4 4 4 3 2 1 4
 01059070 36 104255 22 1 2 3

01059070 37 016255 1 544 4 4 1 4 4 4 43 2
 3 1 2
 01059070 38 101122 2 1 23 44 4 4 4 4
 4 24 3 1
 01059070 40 103255 1 1 4 34 2 44
 2 1 3
 01059070 44 102452 4 3 2 1
 4 3 44 2 4 4 1
 01059070 45 101355 25 1 1 2
 4 4 3 4 42 414 4
 01059070 46

 01059070 47 11624352 4 4 4 1 442 3
 2 3 4 14 4
 01059070 48 101255 44 4 44 1 4 42414
 4 4 4 3 2 1
 01059070 33
 102133000000000400021000003000000000000000000040000040400000020
 0000004000000000000000040003000000000000000020100004
 01059070 06 m160000205

 01059070 09 m00

 01059070 12 m05

 01059070 19 m05

 01059070 20 m160000002

 01059070 21 m02

 01059070 24 m05

 01059070 25 m03

 01059070 29 m04

 01059070 30 m160000105

 01059070 34 m160000002

 01059070 35 m04

 01059070 39 m160005000

 01059070 41 m00

01059070 42 m01
01059070 43 m160003000
01059070 49 m000000100
01059070 50 m160000100
01059070 51 m05

C2. Word Perfect files coded for import into UCINETX, question one.

dl nr = 51 nc = 51
row labels embedded
data:

1 0 0 3 4 0 0 0 0 1 4 0 0 0 4 0 4 0 0 0 4 0 0 0 0 0 0 0 0 0 0 0
4 0 0 0 0 4 4 4 0 4 4 4 4 0 4 0 0 2 4 0

2 0 0 0 0 0 4 0 0 0 0 0 4 0 0 0 0 0 0 4 0 0 0 0 4 0 0 0 0 0 0 0
0 0 3 0 0 4 0 4 0 0 0 2 4 0 1 0 0 0 0 4

3 2 0 0 0 0 0 0 4 4 1 0 0 0 0 0 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
3 0 0 0 0 0 0 4 0 4 0 0 4 0 0 0 0 0 0 0

4 0 0 0 0 3 0 1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 0 0 0

5 0 0 4 4 0 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 4 0 4 0 4 0
0 4 0 2 0 0 0 0 0 4 0 0 0 0 3 0 0 0 0 0

6 0
0 0

7 0 4 0 4 3 0 0 4 0 0 1 + + + + + + + + + + 4 0 4 4 0 4 4 4 4 4 0
+ + + + + 0 4 0 0 + + + + + + 0 0 0 2

8 0 0 3 0 0 4 0 0 0 0 0 0 0 0 0 0 0 0 0 4 0 4 0 0 0 0 0 0 4 0
1 0 0 0 0 0 0 4 0 0 0 4 2 0 0 4 0 0 0 0

9 0
0 0

10 0 0 1 0
0 0 0 0 0 0 0 0 0 2 0 0 3 0 0 0 0 0 0 0

11 0 0 0 0 0 0 0 0 0 4 0 0 0 0 0 0 0 4 0 0 4 0 4 2 0 0 0 4 0 0 0
0 0 3 0 0 0 0 0 0 0 0 0 0 4 0 0 4 0 4 1 0

12 0
0 0

13 0 0 0 0 0 0 0 0 0 0 4 0 0 0 0 0 0 4 0 0 0 0 1 0 0 0 3 0 4 0 0
0 0 0 4 2 0 0 0 0 0 0 0 0 0 0 0 0 4 0 0

14 0 0 0 0 0 0 0 0 0 0 4 0 0 0 4 0 3 2 0 4 4 0 4 0 0 0 4 4 0 0 0
1 4 4 4 0 0 4 0 4 0 0 + + + + + 4 4 0 0

15 000000000000000000000000030000000000
0000000000020100000000

16 40410000420000004404040000000000
40000043040040000000

17 40030000000000202000400000000000
14000040003121003000

18 0000040000044240000400000100000
00030000000400000000

19 00000000000000000000000000000000
00000000000000000000

20 00000000000000000000000000000000
00000000000000000000

21 00000000000000000000000000000000
00000000000000000000

22 0240040300000000040000440004444
40044004000410000444

23 0004000400401420040034000400004
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00000000000000000000

25 00000000000000000000000000000000
00000000000000000000

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00000000000400400000

27 00003000000040000000000000000210
40040000000000000000

28 0000000000100400004000004000000
40000020003000000000

29 00000000000000000000000000000000
00000000000000000000

30 00000000000000000000000000000000
00000000000000000000

31 0002 00000000000000000000000003 00000000
 01 0000000000000000000000000000

32 0030 0400000004000000000000000000
 000000000000420001000

33 0000 0400021000003000000000000000
 00004000004040000002

34 0000000000000000000000000000000000
 0000000000000000000000000000

35 0000000000000000000000000000000000
 0000000000000000000000000000

36 0000 01000000000000000000000002 000000
 0300000000000000000000000000

37 4400 0400004000100040004000000000
 4000000000430200000000

38 000000000010023000000004400000000
 00000004004040040000

39 0000000000000000000000000000000000
 0000000000000000000000000000

40 0000 10000040340000000000000002 0000
 4400000000000000000000000000

41 0000000000000000000000000000000000
 0000000000000000000000000000

42 0000000000000000000000000000000000
 0000000000000000000000000000

43 0000000000000000000000000000000000
 0000000000000000000000000000

44 0000 0400000000300000000000000000
 2000000000000000001000

45 0000000000000000000100000000000000
 00000000000100000000

46 0000000000000000000000000000000000
 0000000000000000000000000000

47 000000040000004000004000000000
00000001004420300000

48 000440000000000040000440000000
10000040042414000000

49 0000000000000000000000000000
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50 0000000000000000000000000000
000000000000000000000000

51 0000000000000000000000000000
000000000000000000000000

C3. UCINETX Matrix of data

DISPLAY

Width of field: MIN
of decimals: MIN
Rows to display: ALL
Columns to display: ALL
Row partition:
Column partition:
Input dataset: CAUCINET\SAMPA1

Table with 55 columns and 55 rows of numerical data. Column headers are 1-55 and row headers are 1-55. The data consists of values ranging from 0 to 5, representing a matrix of relationships between 55 nodes.

C4. UCINETX printout for Degree Centrality Measure calculations

FREEMAN'S DEGREE CENTRALITY MEASURES - School Sample SA

Diagonal valid? NO
 Model: ASYMMETRIC
 Input dataset: C:\UCINET\DICH

		1	2	3	4
		OutDegree	InDegree	NrmOutDeg	NrmInDeg
1	1	18	4	36	8
2	2	11	3	22	6
3	3	9	7	18	14
4	4	3	9	6	18
5	5	11	5	22	10
6	6	0	10	0	20
7	7	36	0	72	0
8	8	10	5	20	10
9	9	0	3	0	6
10	10	3	6	6	12
11	11	11	8	22	16
12	12	0	4	0	8
13	13	8	6	16	12
14	14	22	8	44	16
15	15	3	8	6	16
16	16	14	3	28	6
17	17	12	6	24	12
18	18	9	8	18	16
19	19	0	5	0	10
20	20	0	5	0	10
21	21	0	8	0	16
22	22	20	4	40	8
23	23	19	11	38	22
24	24	0	5	0	10
25	25	0	3	0	6
26	26	7	3	14	6
27	27	6	5	12	10
28	28	7	4	14	8
29	29	0	5	0	10
30	30	0	4	0	8
31	31	3	3	6	6
32	32	6	14	12	28
33	33	8	7	16	14
34	34	0	4	0	8
35	35	0	7	0	14
36	36	3	4	6	8

37 37	11	2	22	4
38 38	9	7	18	14
39 39	0	9	0	18
40 40	7	1	14	2
41 41	0	7	0	14
42 42	0	11	0	22
43 43	0	15	0	30
44 44	4	18	8	36
45 45	2	6	4	12
46 46	0	8	0	16
47 47	8	5	16	10
48 48	12	5	24	10
49 49	0	6	0	12
50 50	0	4	0	8
51 51	0	4	0	8

DESCRIPTIVE STATISTICS

	1	2	3	4
	OutDegree	InDegree	NrmOutDeg	NrmInDeg
1 Mean	6.12	6.12	12.24	12.24
2 Std Dev	7.33	3.36	14.67	6.73
3 Sum	312.00	312.00	624.00	624.00
4 Variance	53.79	11.32	215.16	45.28
5 Euc Norm	68.21	49.86	136.41	99.72
6 Minimum	0.00	0.00	0.00	0.00
7 Maximum	36.00	18.00	72.00	36.00

Network Centralization (Outdegree) = 62.204%

Network Centralization (Indegree) = 24.735%

Actor-by-centrality matrix saved as dataset SAMP.A1.DG

Elapsed time: 1 second. 3/3/1996 8:36 PM.

UCINET IV 1.40/X Copyright 1991-1994 by Analytic Technologies.


```
00000000000000000000000000000000
00000000000000000000000000000000
00000000000000000000000000000000
0000000001010000000000000001
00000000000100000000001000
00000000000000110000010000
0000110000000000000000000001
0001100000000000000000000100
0000000000000000000000000000
```

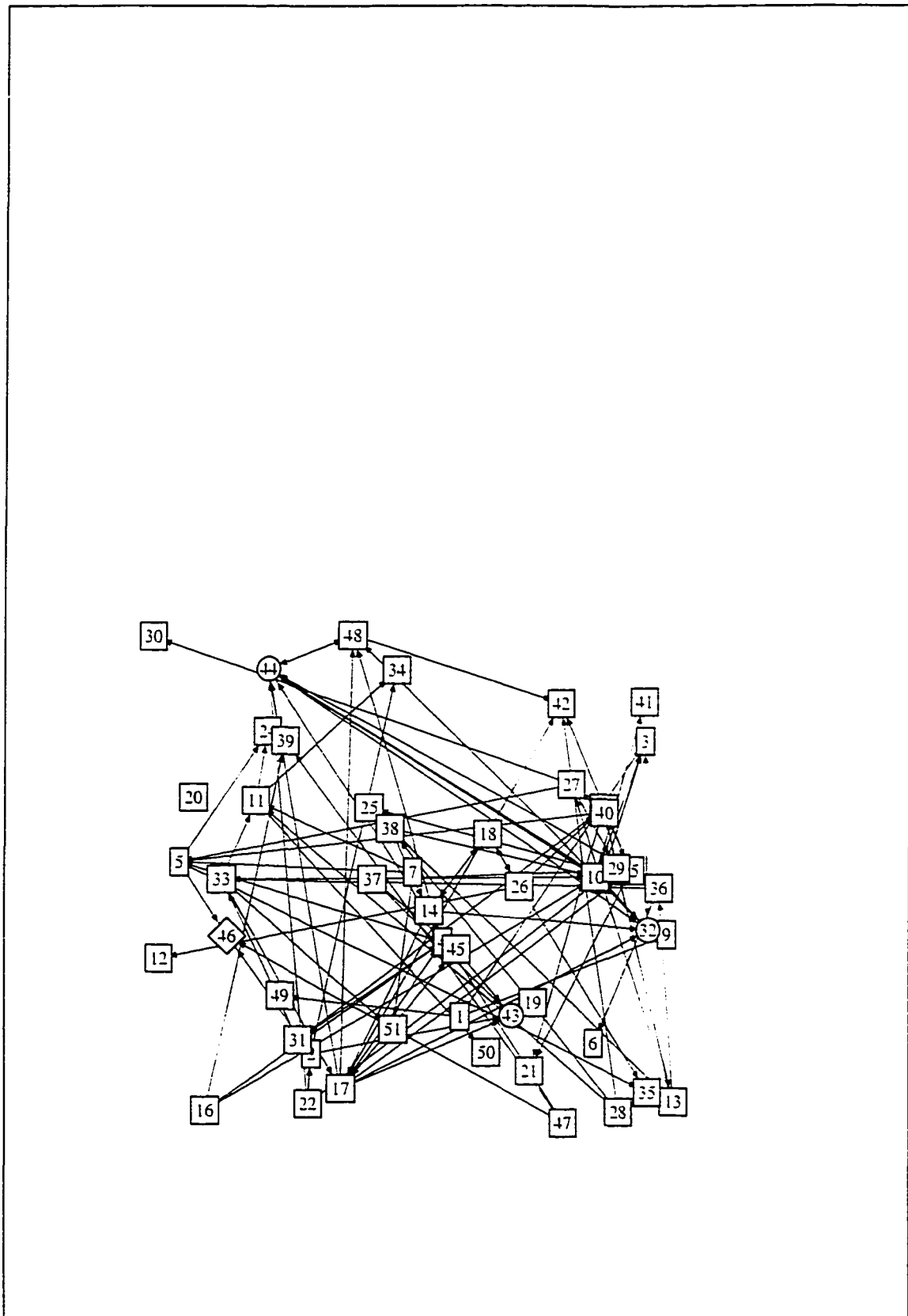


Figure C1. School SA1 - Random Graph

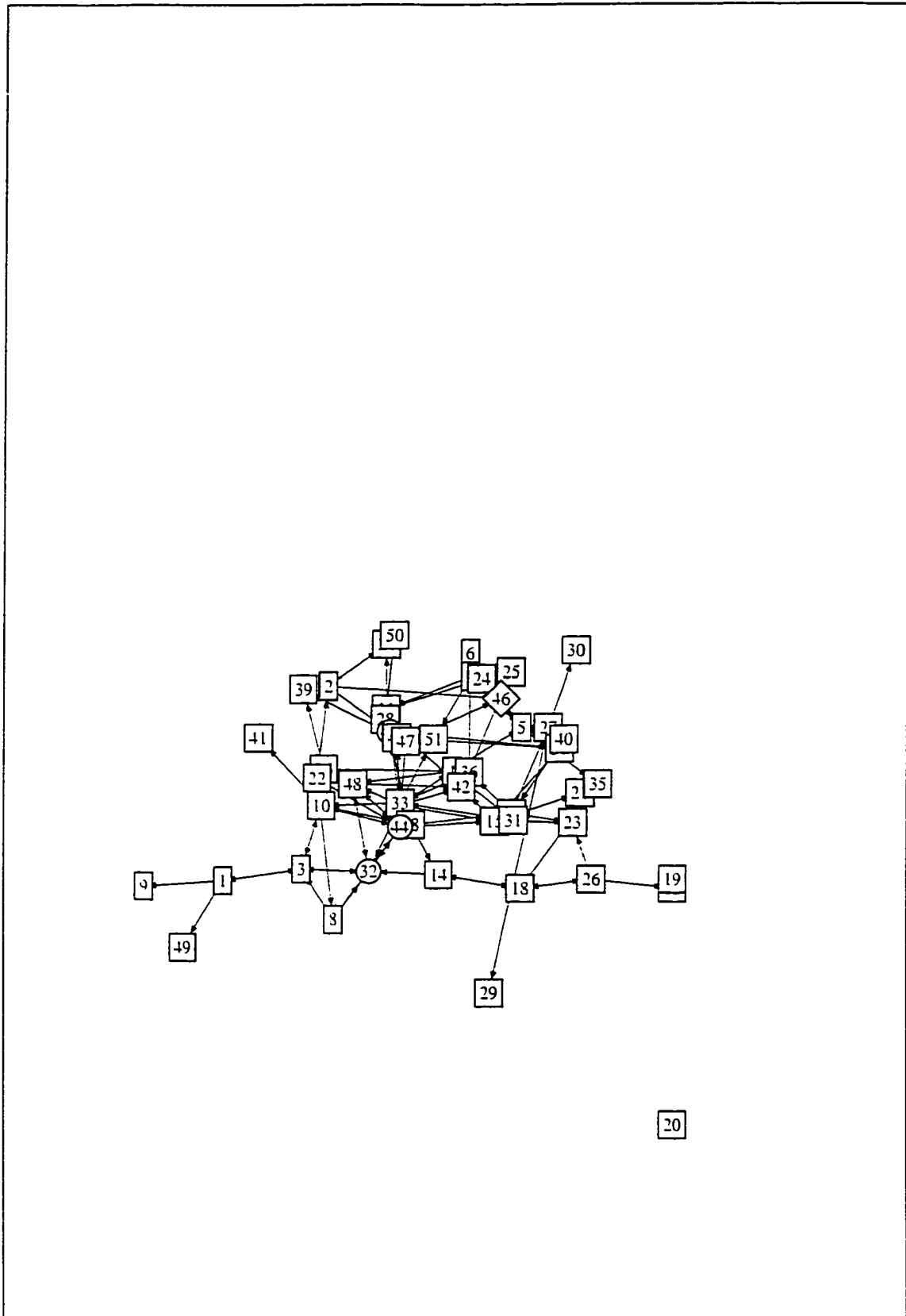


Figure C1. School SA1 - Quick Multidimensional Scaling Graph

Vita

Maryann Maxwell Durland currently resides in Birmingham, Alabama. She has been employed by the Institute for Social Science Research at the University of Alabama, in Tuscaloosa as a Research Associate; and at the University of Alabama at Birmingham, as both a supervisor of student teachers and an instructor in reading theory, development and methods courses. She also works as an independent contractor for program evaluations and conducts staff development workshops on both reading and learning behavior related topics, and research methodology.

Ms. Durland began her career as a classroom teacher, and has taught in West Virginia, Colorado, and Louisiana. She has held several positions in the Louisiana State Department of Education in both state and federally funded programs, including: Program Manager, Administrative Officer, Technical Assistant, and Reading Specialist.

She is a member of the: American Educational Research Association (AERA), Association of Louisiana Evaluators (ALE), International Reading Association (IRA), American Evaluation Association (AEA), International Network for Social Network Analysis, and the American Association of University Women. She has been a frequent presenter at AERA and ALE annual conventions and has presented at IRA and AEA conventions.

DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Maryann Maxwell Durland

Major Field: Educational Research

Title of Dissertation: The Application of Network Analysis To the Study of Differentially Effective Schools

Approved:

Charles Teddlie

Major Professor and Chairman

John W. Parkin

Dean of the Graduate School

EXAMINING COMMITTEE:

Albert T. ...

Eugene Kennedy

Richard ...

[Signature]

Date of Examination: 6/10/96
