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# The Impact of Leadership on School Organizations: Network Analysis Approach to Systematic Review of Literature on Teaching and Learning International Survey

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**Abstract:** The purpose of this study is to review the literature on the Teaching and Learning International Survey (TALIS) for the past 10 years to identify multiple paths through which school leadership exerted influences on school organizations and organizational outcomes. Our analysis of a network, consisting of 83 nodes (variables) and 242 variable ties from 29 reviewed studies identified four emergent themes. Reviewed studies (1) overwhelmingly framed the principal as the driver and teachers as the target of change; (2) suggested nine core variables (e.g., instructional leadership) to play central roles within the reviewed studies; (3) depicted student academic achievement as a function of the principal's instructional leadership and their job satisfaction influenced by school context, principal qualification, and organizational conditions (e.g., respect for others); and (4) suggested teacher self-efficacy as the potential bridging variable between multiple change processes. The discussion includes implications for school leadership and future research.

**Keywords:** *Literature review, network analysis, Teaching and Learning International Survey (TALIS).*

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## Introduction

The purpose of this study is to review the literature on the Teaching and Learning International Survey (TALIS) published in the last 10 years to identify multiple paths through which school leadership exerts influences on school organizations and organizational outcomes. We theorize school leadership as practices that exercise influences across the entire school organization and are enacted by both formal (e.g., the principal) and informal leaders (e.g., teachers; Ahn et al., 2021; Kelley & Halverson, 2012). With this conceptualization, an array of organizational outcomes (e.g., teacher job satisfaction, teacher collaboration, and student learning) must also be theorized as generated not only by principals but also by teachers and other leaders (e.g., department heads or instructional coaches). For example, as an instructional leader, a school principal may contribute to improving instructional quality and educators' professional development; however, teachers may also take on leadership roles, sometimes informal roles, in diverse capacities such as creating a safe and equitable learning environment.

Our study adopts a network analytical approach to a systematic review of the literature. To date, most quantitative literature on leadership impact on organizational outcomes has primarily focused on the relationships between "two factors"—one is a predictor, and the other is an outcome. Such bivariate approaches may run counter to consistent evidence that leadership impact, especially that of the principal, is bridged by multiple mediating conditions, such as teaching practice and school context (Day et al., 2016; Mulford & Silins, 2011). Additionally, although meta-analysis provides averaged, less biased meta-effects, it may fall short in terms of providing insights into a holistic view of the process in which leadership, teacher practices, and school context are interconnected with one another as a network. By contrast, network analysis allows for an examination of leadership in the intricate web of interrelated factors that influence organizational outcomes. It achieves this by analyzing multiple, simultaneous pathways through which leadership impacts organizational outcomes. Moreover, network analysis reveals the bridging roles that some factors (e.g., teacher autonomy and job satisfaction) may play in the mechanisms underlying leadership's impact on school

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organizations. As a result, we employed a network analytical approach to systematically review 29 studies on TALIS–an international educational survey created by the Organization for Economic Co-operation and Development (OECD). Teachers and principals in 24, 34, and 49 countries provided data in 2008, 2013, and 2018 data collection rounds, respectively. Such widespread participation in TALIS offered a valuable opportunity for researchers to examine the impact of school leadership on organizations across different countries, which warrants a systematic review of this body of literature. More specifically, this review aims to respond to two questions:

(1) Within the reviewed studies, what were the most prominent dependent variables, independent/controlling variables, and the variables serving potential mediating roles over the process of school leadership exerting influence on organizations?

(2) How were those variables interconnected to generate an array of organizational outcomes?

*Conceptual Framework*

We employed Leithwood et al.'s (2017) four-path framework to conceptualize how our systematic review, using network analysis, maps interconnected paths through which school leadership exerts influences on organizations. As shown in Figure 1, Leithwood et al.'s framework postulated that principal leadership influence on student learning was exercised via four sets of mediators: rational, emotional, organizational, and family.

A rational mediator consists of practices to enhance curriculum, instruction, and learning. For school leaders to exert a positive impact on the rational conditions, they should possess a strong knowledge base about the best instructional practices (Hattie, 2009) and mobilize human and material resources to promote these conditions. An emotional mediator speaks to staff affective states that shape the quality of their work (e.g., teacher self-efficacy).

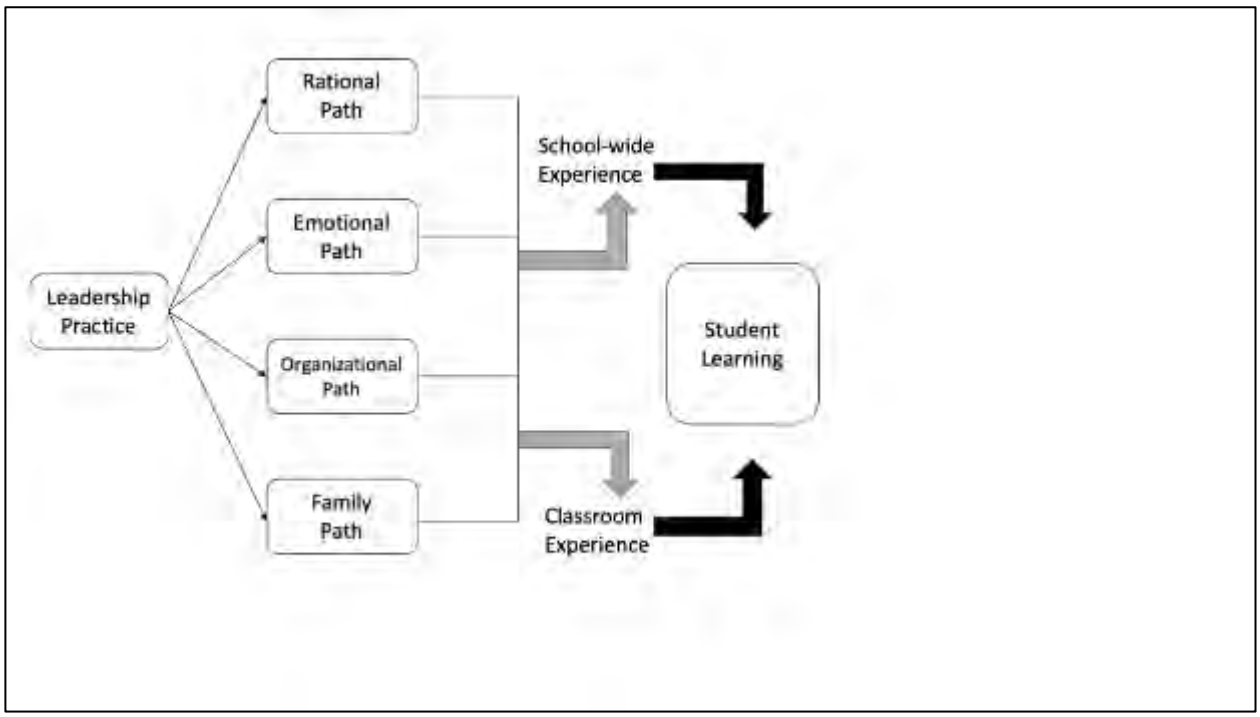


*Figure 1. Four Paths Framework of Leadership Influence on Student Learning (Note. Framework was obtained from Leithwood et al., 2017)*

Effective school leaders pay special attention to the importance of staff emotional states in enhancing student learning (Harris, 2003). For instance, Hallinger et al.'s (2018) quantitative analysis of over 400 educators suggested that the principal's self-efficacy positively influenced their instructional leadership behaviors, which, in turn, increased collective teacher efficacy, which then positively impacted teacher organizational commitment.

An organizational mediator denotes a set of cultural and structural conditions of school organizations. School policies, structures, and culture that directly impact teachers' working environment constitute this third set of conditions. These conditions must be organized and established so that teachers can reach full instructional capacity and students can maximize their engagement in authentic and meaningful learning. Therefore, not only do effective school leaders ensure these conditions should not prevent staff development and student learning, but they also strive to protect and maximize instructional time, maintain strong academic focus, and promote staff collaboration.

A family mediator refers to family aspects and community relationships. Research has consistently shown that family involvement in student learning resulted in higher test scores, increased student enrollment in advanced-level classes, and higher rates of graduation from high school (Gordon & Louis, 2013). Therefore, efficient school leaders must recognize parental engagement and community involvement as powerful leverage to enhance student learning.

The overarching takeaway from Leithwood et al.'s (2017) framework suggests that the principal's leadership impact on students' learning is mediated by the four sets of mediating conditions. For instance, the principal influences student learning outcomes via emotional conditions, such as teacher self-efficacy. However, additional research is needed to examine how the four mediating paths operate differently depending on the school context. Liu (2021) suggested that although school leadership helped enhance student learning through the four paths Leithwood et al. (2017) suggested, the leadership behaviors that utilized the paths were less prevalent in schools that served racially minoritized students and those from low socioeconomic backgrounds. Also, further research is necessary to explore whether there exist more salient factors that facilitate the relationship between the mediating paths and school leadership. Related, Tschannen-Moran and Gareis (2015) suggested that teacher trust in the principal might play a key role in strengthening the four paths by tapping into "academic press, collective teacher efficacy, and teacher professionalism" (p. 256).

Moreover, it is unclear whether other mediators are missing in the framework, whether the four mediators interact with one another, and whether there exist additional antecedents of the mediating conditions other than the principal's leadership. For example, is the emotional condition (e.g., teacher self-efficacy) influenced solely by the principal or facilitated by other variables as well? Therefore, we aim to expand Leithwood et al.'s (2017) framework by using a network approach to a systematic literature review to identify whether and how variables in one of Leithwood et al.'s mediating paths influence and are influenced by variables from across other paths and whether there exist additional antecedents of the mediating conditions.

## Methodology

We referred to Hallinger's (2013) guidelines for systematic reviews of research. Hallinger emphasized the need for researchers to clearly state an overarching purpose and framework that guided data collection and facilitated the interpretation of findings. Responding to Hallinger's call, our study aims to map the interconnections among school leadership, organizational climate, school context, and organizational outcomes, using Leithwood et al.'s (2017) four-path model and network analysis as our conceptual and analytic frameworks, respectively. Further responding to Hallinger's guidelines, we now detail the procedures to search and screen literature, extract data for network construction, and implement network analysis for our systematic review.

### *Literature Search, Screening, and Inclusion Criteria*

To ensure methodological rigor and enhance the transparency of our systematic review, we followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Liberati et al., 2009). Our literature screening process is delineated in Figure 2.

With the keywords "Teaching and Learning International Survey" and "TALIS," the initial literature search across 11 academic databases (EBSCO, EBSCO Professional Development Collection, Education Full-Text, Emerald, ERIC, JSTOR, ProQuest, SAGE, Science Direct, SpringerLink, and Taylor & Francis) yielded 618 articles. A supplementary search in Google Scholar (n.d.) contributed an additional 2,282 articles, aggregating to a total of 2,900 studies. Through an evaluation of article titles and abstracts, we eliminated irrelevant and duplicate studies, resulting in a focused pool of 79 articles—70 extracted from the databases and nine from Google Scholar. To make our literature research comprehensive, we also conducted a search on the top 20 journals in the field of Educational Administration, as identified by Google Scholar Metrics in 2020. This search added eight additional articles.

In the subsequent phase, the 87 articles underwent a screening process. We selected only English-language, quantitative TALIS studies published in peer-reviewed journals or book chapters from 2010-2019. This timeframe was chosen because the first TALIS dataset was made public in 2010, and scholarly articles analyzing this initial round of data also began appearing in the same year. It is worth noting that our literature search process did not include studies based on the 2018 TALIS dataset, because they were inaccessible at the time of our data acquisition.

The articles were then evaluated based on their abstracts and methods sections, resulting in the exclusion of 19 studies that either lacked statistical analysis or were solely concerned with methodological considerations about the TALIS. Further full-text review of the remaining 68 articles led to the elimination of an additional 39 studies that were deemed not directly relevant to leadership practices, such as Luschei et al. (2013). This rigorous selection process yielded a final set of 29 articles (see the supplementary material).

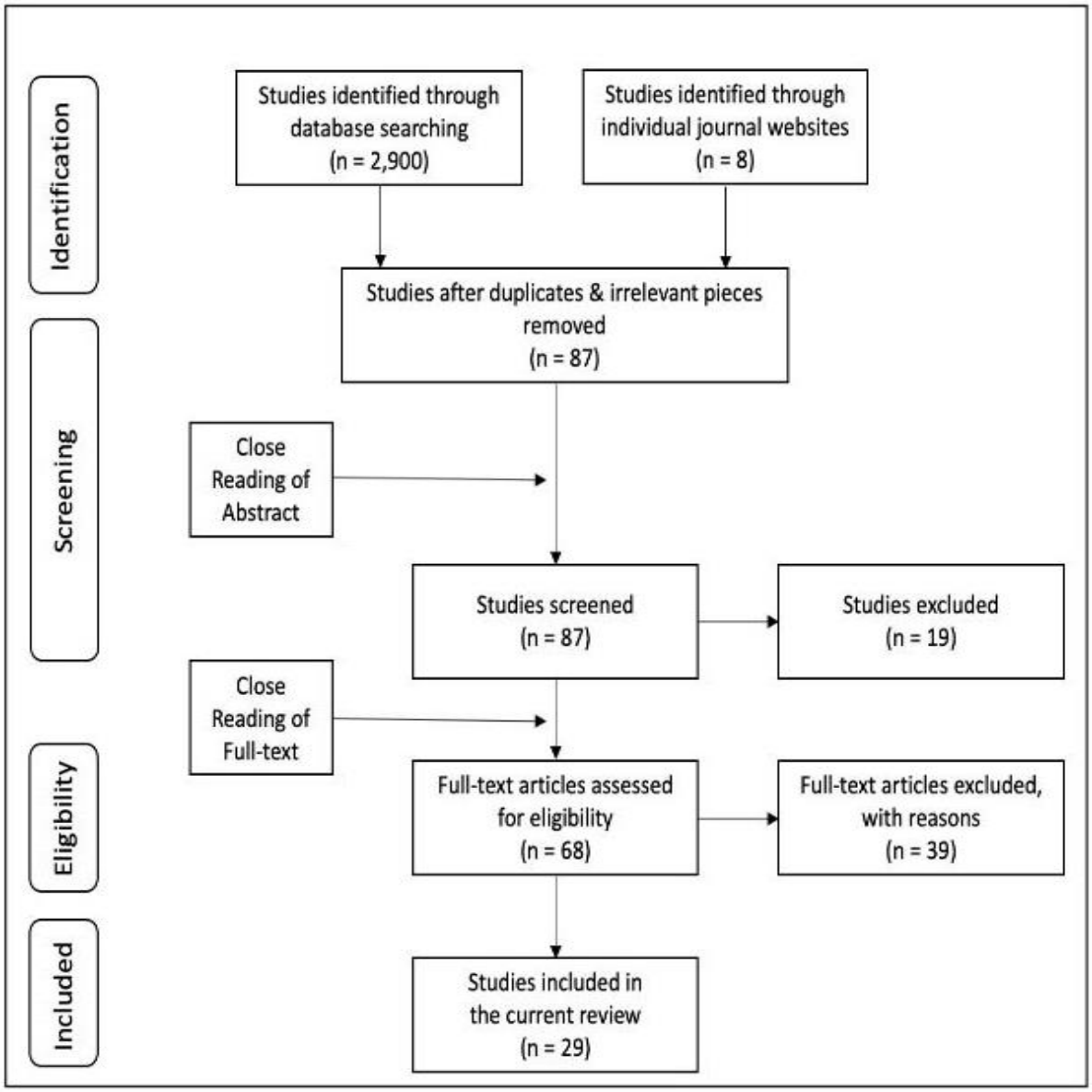


*Figure 2. Literature Screening Process*

*Extracting Data for Constructing Network*

The 29 articles were analyzed by conducting network analysis. In the network, nodes represent the variables investigated in the 29 articles, and ties represent statistically significant relationships between pairs of variables. As illustrated in Figure 3, negative and positive relationships are denoted by –1 and 1, respectively. For instance, Article 1 reported a positive relationship between Variables 1 and 2. In Figure 3, this relationship is illustrated as a tie connecting these two variables. Furthermore, arrows on ties clarify the directionality of relationships, pointing from independent to dependent variables. Next, Article 2 indicated a positive relationship between Variable 3 and Variable 4, mediated by Variable 2, which is represented by two ties in the network. In Article 3, multiple relationships were explored. Specifically, a positive relationship is observed between Variables 2 and 4, and additional relationships are examined between Variable 4 and Variables 5, 6, and 7. They are illustrated in the network as three distinct ties connecting Variable 4 to Variables 5, 6, and 7. It is of particular note that the relationship between Variables 4 and 6 is negative, represented by a tie with a negative (–) sign.

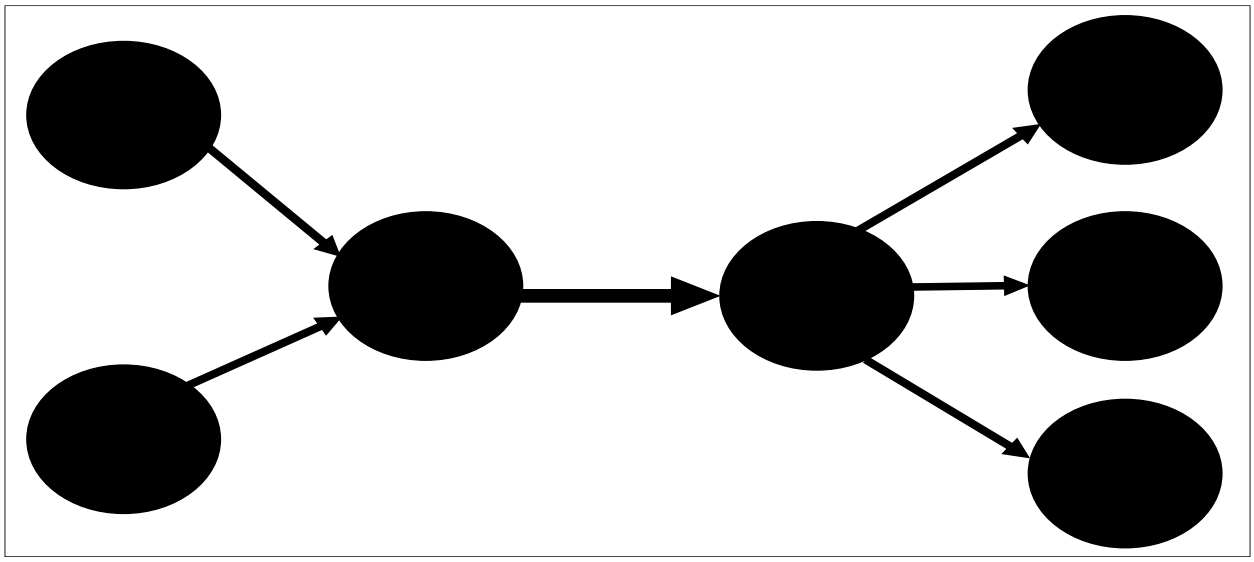

*Figure 3. A Hypothetical Network Created After Reviewing the Literature*

In the coding process, tie strength was quantified as the frequency of statistically significant relationships between pairs of variables across the 29 articles reviewed. In Figure 3, the tie strength between Variables 2 and 4 was 2, indicating two articles (Articles 2 and 3) reported significant relationships between the variables. Tie strength is visually represented through both the thickness and numbers next to the ties; therefore, the tie between Variables 2 and 4 appears thicker compared to others. If a pair of variables was tested six times and yielded five positive and one negative relationship, the aggregate tie strength was calculated as 4 (i.e., 5 + (−1) = 4). This approach was systematically applied to all relationships in the 29 reviewed articles.

All variables were initially coded independently by the authors, followed by regular discussions to identify discrepancies and resolve differences in coding. The intercoder reliability for the two authors, measured by Cohen's Kappa coefficient, was initially 0.477. This score represents a moderate level of agreement between the two raters. The primary point of divergence was whether to code overarching constructs (e.g., teacher self-efficacy) or their sub-dimensions (e.g., efficacy in instruction, student engagement, classroom management) as individual nodes. Upon deliberation, it was decided to treat the constructs themselves as nodes to streamline the interpretive process of the network analysis. Moreover, we encountered instances where identical survey items yielded differently labeled constructs across articles (e.g., teacher collaboration vs. teacher cooperation; school morale vs. teacher job satisfaction). To resolve these inconsistencies, multiple meetings were convened to ensure that latent constructs measured by the same variable sets were uniformly labeled in our network analysis. These discussions were instrumental in ensuring that our network analysis reflected a consistent representation of the constructs in the analytical process. For each case of divergent coding between the two raters, this iterative process of discussion and adjustment was critical to reaching a consensus on the constructs for data analysis.

*Network Analysis*

After achieving intercoder agreement, the data were imported into UCINET (Borgatti et al., 2002) for network analysis and visualization. We first focused on calculating three pivotal centrality measures—indegree, outdegree, and betweenness—to identify the prominent nodes (variables) in the reviewed literature. Next, core/periphery structures and structural equivalences were analyzed to highlight the interconnections among the variables. Below, we outline the methodological nuances of implementing these network analyses. Here we report detailed procedures for network analysis.

*Node Level: Centrality Measures*

To respond to the first research question about the prominent variables in the network of school leadership impact, we calculated three centrality measures for each node: indegree, outdegree, and betweenness centrality. In network analysis literature, "centrality" indicates the relative importance and influence of a node (variable) in the network (Freeman, 1979; Newman, 2018).

Each of the centrality measures indicates relative influence in different ways. Indegree centrality, one of the most intuitive centrality measures (Freeman, 1979), not only calculates the number of incoming ties (i.e., the ties with arrows pointing to a given variable) a variable has, but also takes into account tie strength—the frequency with which significant relationships were reported. In our study, since the ties start from independent variables and point to dependent variables, indegree centrality indicates the prominence of a variable as a dependent variable in the network of school leadership impact. In the hypothetical network in Figure 3, Variables 2 and 4 registered the highest indegree centrality.

Indegree centrality is a weighted measure, meaning its calculation took into consideration tie strength. This is why Variable 4's indegree centrality is 2, instead of 1, due to the reported frequency (2) of its positive relationship with Variable 2 in the reviewed articles, although only one tie arrow exists between the two. The indegree centrality of Variable 6 is –1, indicating one tie suggesting a negative relationship between Variables 4 and 6.

On the other hand, outdegree centrality focuses on outgoing ties—ties with arrows starting from variables. In Figure 3, Variable 4 has the highest outdegree centrality as it has three outgoing ties—the highest number than any other variables. Like indegree centrality, outdegree centrality is a weighted measure, explaining why Variable 2's outdegree centrality is 2 instead of 1.

Betweenness centrality indicates a node's brokerage role by quantifying its position on the shortest paths between all other pairs of nodes (Freeman, 1979). Mathematically, betweenness centrality $v$ is expressed as the following equation: $\sum_{u \neq v \neq w \in V} \left(\frac{\sigma_{uw}(v)}{\sigma_{uw}}\right)$, where $\sigma_{uw}$ represents the sum number of all shortest paths between variable $u$ and variable $w$, while $\sigma_{uw}(v)$ denotes the number of these paths that pass through variable $v$. In the current study, a variable with a high betweenness centrality can be interpreted as playing a potentially high bridging role in the network of school leadership impact, although its statistical mediation power needs to be empirically tested (Cowhitt et al., 2020). In Figure 3, Variables 2 and 4 have the highest betweenness centrality, as they bridge a group of variables (Variables 1 and 3) on the left and a group of variables (Variables 5, 6, and 7) on the right, thus implying the highest potential bridging role among the variables within the network.

*Group Level: Core/Periphery Structure & Structural Equivalence*

To answer the second research question on how variables were interconnected in the reviewed literature, we first identified the core/periphery structure of the network. Nodes belong either to the core, characterized by a high density of ties, or to the periphery, with fewer ties. The core/periphery function in UCINET was used to calculate the coreness score of each node and assess the degree to which the network fell into a core/periphery structure for different sizes of a core. The core/periphery structure of the network was then optimized based on coreness scores, centralization of the core and the periphery, weighted size of the core, and correlations between the given coreness scores of nodes in the core and those in the periphery (Borgatti & Everett, 1999).

To further examine the network structure beyond the core and the periphery, we zoomed in on the nodes that were structurally equivalent in the network. In network analysis, two nodes are considered structurally equivalent if they are connected to the same set of nodes (Boyd, 2002). Theoretically, structurally equivalent nodes are expected to have or develop similar characteristics. That underlying similarity, either known or unknown, explains why certain nodes are structurally equivalent (Borgatti & Grosser, 2015). In the current study, to identify the variables that shared an underlying similarity in the network of school leadership impact, we used the structural equivalence function in UCINET to identify structurally equivalent nodes in the network. Specifically, the network was partitioned by splitting blocks. The nodes in the same block are approximately structurally equivalent—having the same neighbors (i.e., variables in the current study).

## Results

As shown in Figure 4, our network analysis of 29 sampled studies visualized how 83 nodes (i.e., variables within articles we reviewed) were interconnected via 242 ties (i.e., associations among variables reported in the reviewed studies). Four themes emerged: Reviewed studies (1) overwhelmingly framed the principal as the driver and teachers as the target of change; (2) suggested teacher self-efficacy, teacher job satisfaction, and teacher collaboration as the variables that may potentially bridge the relationships between multiple change process; (3) suggested nine core variables (e.g., instructional leadership) to play central roles within the reviewed studies; and (4) depicted student academic achievement as a function of the principal's instructional leadership and their job satisfaction influenced by school context, principal qualification, and organizational conditions (e.g., respect for others).

*RQ1: Prominent Variables in the Sampled Literature*

The prominent variables were identified by centrality measures of the network analysis. Some variables attracted more attention from researchers than others. Table 1 shows the top 10 variables ranked by three different centrality measures. Table 1 shows that reviewed studies predominantly framed the principal as the driver and teachers as the target of change. Specifically, teachers' job satisfaction, teacher self-efficacy, and teacher collaboration emerged as those with the highest indegree centrality, indicating these three variables were reported and framed most frequently as dependent variables in the reviewed studies. Teachers' job satisfaction was a dependent variable in 52 statistically significant relationships, followed by teacher self-efficacy (39 variable associations) and teacher collaboration (35 associations). Those nodes as highly prominent dependent variables are represented as larger nodes in Figure 4.

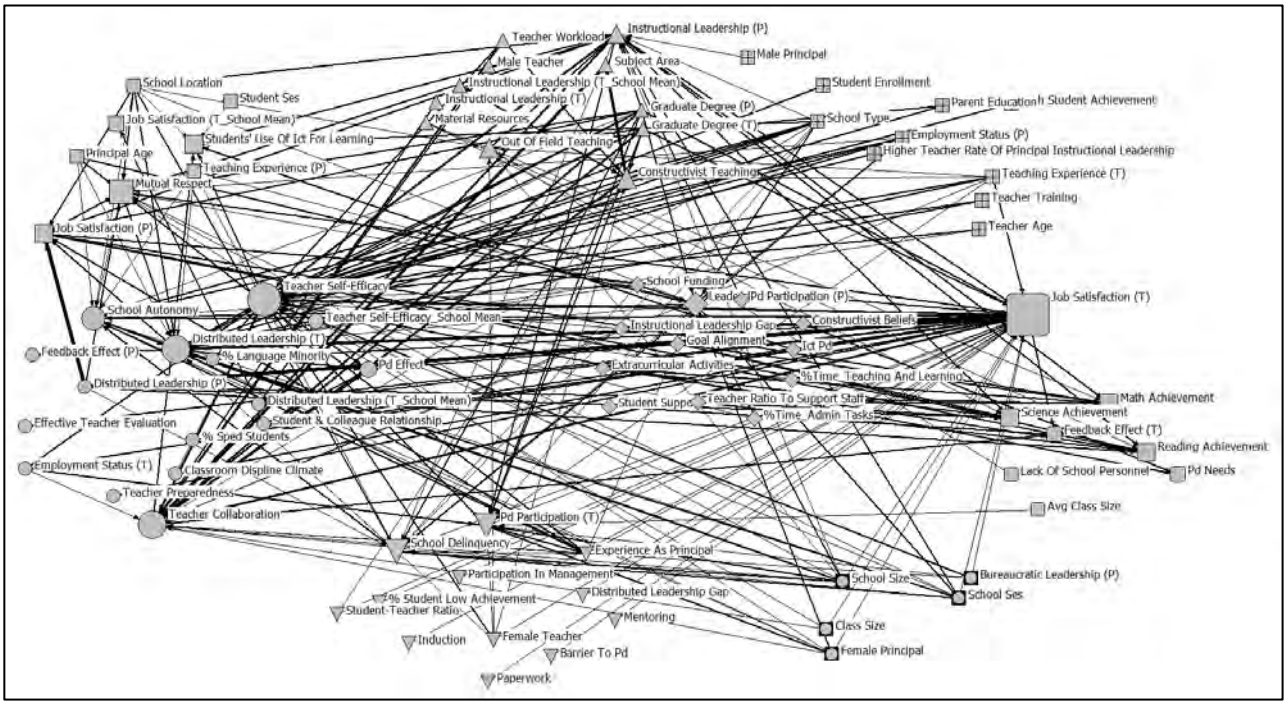


*Figure 4. The Network of the Statistically Significant Relationships Reported in the 29 Reviewed Articles*

*Note*. Node size and node label are proportional to the node's indegree centrality. Tie thickness represents tie strength. Different shapes of nodes represent the nodes that belonged to different blocks assigned by the structural equivalence.

*Table 1. Most Frequently Studied Variables in the Network of School Leadership Impact*

| Rank | Variables | Indegree Centrality | Variables | Outdegree Centrality | Variables | Betweenness Centrality |
|---|---|---|---|---|---|---|
| 1 | Job satisfaction (T) | 52 | Distributed leadership (P) | 43 | Teacher self-efficacy | 150.39 |
| 2 | Teacher self-efficacy | 39 | Instructional leadership (P) | 26 | Job satisfaction (T) | 134.95 |
| 3 | Teacher collaboration | 35 | Subject area | 22 | Teacher collaboration | 120.18 |
| 4 | Job satisfaction (P) | 23 | Teacher self-efficacy | 20 | Distributed leadership (T) | 58.63 |
| 5 | Constructivist teaching | 17 | Graduate degree (P) | 17 | Job satisfaction (P) | 37.15 |
| 6 | Math achievement | 7 | Graduate degree (T) | 17 | Instructional leadership (P) | 35.65 |
| 7 | Reading achievement | 7 | Teacher workload | 15 | School autonomy | 34.15 |
| 8 | Science achievement | 7 | Distributed leadership (T) | 14 | Mutual respect | 22.15 |
| 9 | PD effect | 5 | Teacher collaboration | 13 | Leadership training (P) | 19.00 |
| 10 | PD Participation | 4 | Constructivist teaching | 4 | Constructivist teaching | 10.20 |
| 10 | Students' use of ICT for learning | 4 | | | | |

*Note*. T = teachers; P = principals; PD = professional development; ICT = information and communication technology.

On the other hand, reviewed studies primarily conceptualized principal leadership as the driver (i.e., predictor) of changes. That is, distributed leadership and instructional leadership perceived by principals were the two variables that had the highest outdegree centrality. This meant they were the independent or controlling variables that had the highest number of variable relationships with statistical significance in the articles we reviewed.

Concerning our second emergent theme out of the network analysis, betweenness centrality informed us of a potential mediation role of the variables in the network of school leadership impact. By *potential mediation*, we make it clear that relevant statistical testing (i.e., mediation analysis) needs to be implemented to verify its empirical mediation power. Among the top 10 variables with the greatest betweenness, half of the variables referred to teachers, including (a) teacher self-efficacy, (b) teachers' job satisfaction, (c) teacher collaboration, (d) teachers' perception of their principals' distributed leadership, and (e) constructivist teaching. The other half of the variables concerned principals (e.g., principals' instructional leadership, principals' job satisfaction, and principals' training) and how teachers perceived the outcomes of their principals' work (e.g., school autonomy and mutual respect). Specifically, teachers' self-efficacy, teacher job satisfaction, and teacher collaboration indicated the highest betweenness centrality. It indicates that these teacher-related (or perceived) variables may potentially play the most powerful mediating role in connecting to other variables.

*Table 2. Predictors & Outcomes of High-Betweenness-Centrality Variables*

| **Predictors** | **High-Betweenness Centrality Variable** | **Outcomes** |
|---|---|---|
| Instructional Leadership Gap; Higher Teacher Rate of Principal Instructional Leadership; Instructional leadership (P); Graduate Degree (T); Teaching Experience (T); Female Teacher; School Type; Class Size; Teacher Collaboration; Employment Status (T); Bureaucratic Leadership (P); School Size; Female Principal; Principal Age; Graduate Degree (P); Experience as Principal; Employment Status (P); School Location; School Funding; School SES; Teacher Age; Teacher Training; Distributed Leadership (T); Teacher Workload; Constructivist Teaching; Classroom Displine Climate; High Student Achievement; %Time_Teaching and Learning; %Time_Admin tasks; % Language Minority; Parent Education; Student Enrollment | Teacher Self-Efficacy | students' use of ICT for learning; PD Effect PD Needs; Teacher Collaboration; Job Satisfaction (T); PD Participation (T) |
| Female Teacher; Teaching Experience (T); Teacher Training; Teacher Self-Efficacy; Distributed Leadership (T); School Size; School SES; Distributed Leadership (T_School Mean); Teacher Collaboration; School Delinquency; School Type; Effective Teacher Evaluation; Graduate Degree (T); Employment Status (T); % SPED Students; Induction; Mentoring; Participation in Management; Paperwork; Barrier to PD; Teacher Preparedness; Feedback Effect; Student & Colleague Relationship; Female Principal; Graduate Degree (P); Experience as Principal; School Location; Student-Teacher Ratio; % Language Minority; Feedback Effect (P); Job Satisfaction (P); Distributed Leadership (P); School Autonomy Scope for Progression (T); PD Effect; Teacher Workload; Instructional Leadership (P); Bureaucratic Leadership (P); Class Size; % Student Low Achievement; Classroom Displine Climate; Mutual Respect; Teacher Self-Efficacy_School Mean; Distributed Leadership Gap; PD Participation (T) | Job Satisfaction (T) | Feedback Effect (T); Teacher Collaboration |
| Instructional leadership (T); Female Principal; Graduate Degree (P); Experience as Principal; Teaching Experience (P); Job Satisfaction (T); School SES; Constructivist Teaching; Teacher Self-Efficacy; Female Teacher; Graduate Degree (T); Teaching Experience (T); Teacher Workload Subject Area; Male Teacher; Employment Status (T); School Type; School Size; Class Size; Instructional Leadership (P); Bureaucratic Leadership (P); Instructional Leadership Gap | Teacher Collaboration | Feedback Effect (T); Job Satisfaction (T); Teacher Self-Efficacy; PD Needs |

*Note*. T = teachers; P = principals; PD = professional development; ICT = information and communication technology; SES = socioeconomic status.

Table 2 presents the predictors and outcomes of the three highest-betweenness centrality variables. For example, in the 29 reviewed studies, teacher self-efficacy was predicted by 32 variables across blocks in the network. Teacher self-efficacy's predictors included teachers' graduate degree and teacher workload in Block 1, school discipline climate and teachers' perception of their principals' distributed leadership in Block 2, time spent in teaching and learning, and time

spent on administrative tasks (negative) in Block 3, school location and student socioeconomic status in Block 5, teaching experience and teacher age in Block 6, experience as a principal in Block 7, and class size in Block 8.

Among those 32 predictors, teacher collaboration in Block 2 was also predicted by teacher self-efficacy. This suggests a bi-directional relationship between teacher self-efficacy and teacher collaboration. Moreover, teacher self-efficacy, in turn, predicted outcomes in other blocks, including professional development effect and teacher collaboration in Block 2, teacher job satisfaction and teacher motivation for professional development (i.e., PD needs) in Block 4, the level of student educational technology use in Block 5, and teacher participation in professional development in Block 7. Taken together, the structural locations of the high-betweenness-centrality variables, including teacher self-efficacy, teacher job satisfaction, and teacher collaboration, enabled them to play a bridging role in the network of school leadership impact, bridging the variables across different blocks.

*RQ2: How Leadership, Teacher-Related Variables, and School Context are Interconnected and Contribute to Organizational Outcomes*

To further examine how our sampled studies portrayed the interconnections among leadership, teacher variables, and school context, we shifted our focus from individual variables to their interconnections. Concerning our third theme obtained from the network analysis, the results of the core/periphery analysis suggested nine variables were assigned to the network core, and the remaining variables belonged to the periphery of the network. Specifically, the density of those nine variables in the core (concentration = 0.872) was much higher than that of the variables in the periphery. The nine core variables included: (1) subject area (coreness = 0.496), (2) instructional leadership perceived by principals (coreness = 0.368), (3) teachers' graduate degree (coreness = 0.349), (4) teacher workload (coreness = 0.329), (5) principals' graduate degree (coreness = 0.259), (6) distributed leadership perceived by principals (coreness = 0.247), (7) constructivist teaching (coreness = 0.197), (8) teacher self-efficacy (coreness = 0.196), and (9) instructional leadership perception gap between principal and teachers (coreness = 0.175). These high coreness scores suggest that the nine variables are situated at the center of the network, exerting greater influence on the variables in the network than the variables with lower coreness scores in the network periphery.

To further examine the network structure beyond the core and the periphery, we zoomed in on the nodes that were structurally equivalent in the network. The results of structural equivalence analysis suggested eight blocks, as presented in Table 3. Figure 5 further presents the four blocks that includes the variables in the core of the network. The structurally equivalent variables, illustrated by the same shape (e.g., circle) in Figure 5, meant they were predicted by the same sets of variables. Concerning our fourth emergent theme from the network analysis, we identified the variables regarding student achievement (e.g., reading, math, and science achievement) located on the right-hand side of Figure 5 were associated with the same set of seven independent/controlling variables from across the remaining core blocks: (a) distributed leadership perceived by principals, (b) instructional leadership perceived by principals, (c) principals' job satisfaction, (d) goal alignment, (e) extracurricular activities, (f) material resources, and (g) teacher ratio to support staff (see Figure 6).

We further traced what variables predicted those seven predictor variables of student achievement. In doing so, we identified that two of those variables—principals' job satisfaction and instructional leadership perceived by principals—were predicted by ten additional independent/controlling variables, including (a) school location, (b) school type, (c) school size,

*Table 3. Structurally Equivalent Variables*

| Blocks | Shapes in the network | Variables |
|---|---|---|
| 1 | Up triangle | Constructivist teaching, graduate degree (P), graduate degree (T), instructional leadership (P), instructional leadership (T), instructional leadership (T_school mean), male teacher, material resources, out of field teaching, subject area, teacher workload |
| 2 | Circle | % language minority, SPED students, classroom discipline climate, distributed leadership (P), distributed leadership (T), distributed leadership (T_school mean), effective teacher evaluation, employment status (T), feedback effect (P), PD effect, school autonomy, student & colleague relationship, teacher collaboration, teacher preparedness, teacher self-efficacy, teacher self-efficacy_school mean |
| 3 | Diamond | %time_admin tasks, %time_teaching and learning, constructivist beliefs, extracurricular activities, goal alignment, ICT PD, instructional leadership gap, leadership training (P), PD participation (P), school funding, scope for progression (T), student support, teacher ratio to support staff |

*Table 3. Continued*

| Blocks | Shapes in the network | Variables |
|---|---|---|
| 4 | Rounded square | Average class size, feedback effect (T), job satisfaction (T), lack of school personnel, math achievement, PD needs, reading achievement, science achievement |
| 5 | Square | Job satisfaction (P), job satisfaction (T_School Mean), mutual respect, principal age, school location, student SES, students' use of ICT for learning, teaching experience (P) |
| 6 | Box | Employment status (P), high student achievement, higher teacher rate of principal instructional leadership, male principal, parent education, school type, student enrollment, teacher age, teacher training, teaching experience (T) |
| 7 | Down triangle | % Student low achievement, barrier to PD, distributed leadership gap, experience as principal, female teacher, induction, mentoring, paperwork, participation in management, PD participation (T), school delinquency, student-teacher ratio |
| 8 | Circle in box | Bureaucratic leadership (P), class size, female principal, school SES, school size |

*Note.* T = Teachers, P = Principals, P = Professional Development, SPED = Special Education, ICT = Information and Communication Technology

(d) school socioeconomic status, (e) experience as a principal, (f) male principal (negative), (g) principals' graduate degree, (h) distributed leadership perceived by teachers, (i) mutual respect, and (j) professional development participation. That is, sampled studies suggested student achievement as a function of networked contribution from leadership practice (i.e., instructional and distributed leadership, goal alignment), material resources, organizational context (i.e., school location, type, size, socioeconomic status), and school climate (i.e., mutual respect). The interconnected process that influences student achievement is presented in Figure 6. It illustrates a holistic view of interconnected variables that contribute to student achievement.

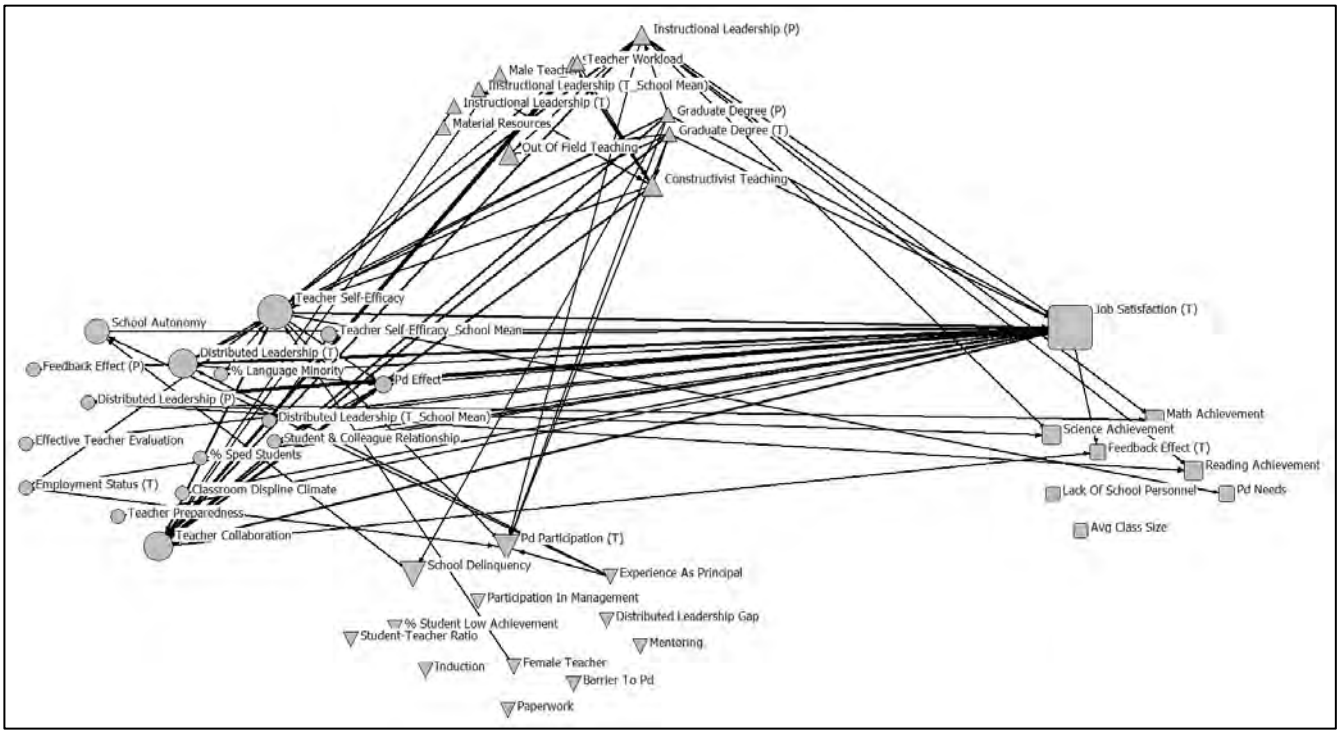


*Figure 5. Core Variables and the Blocks They Belonged To*

*Note.* Structurally equivalent variables are represented by the same shape (e.g., circle, rectangle etc.)

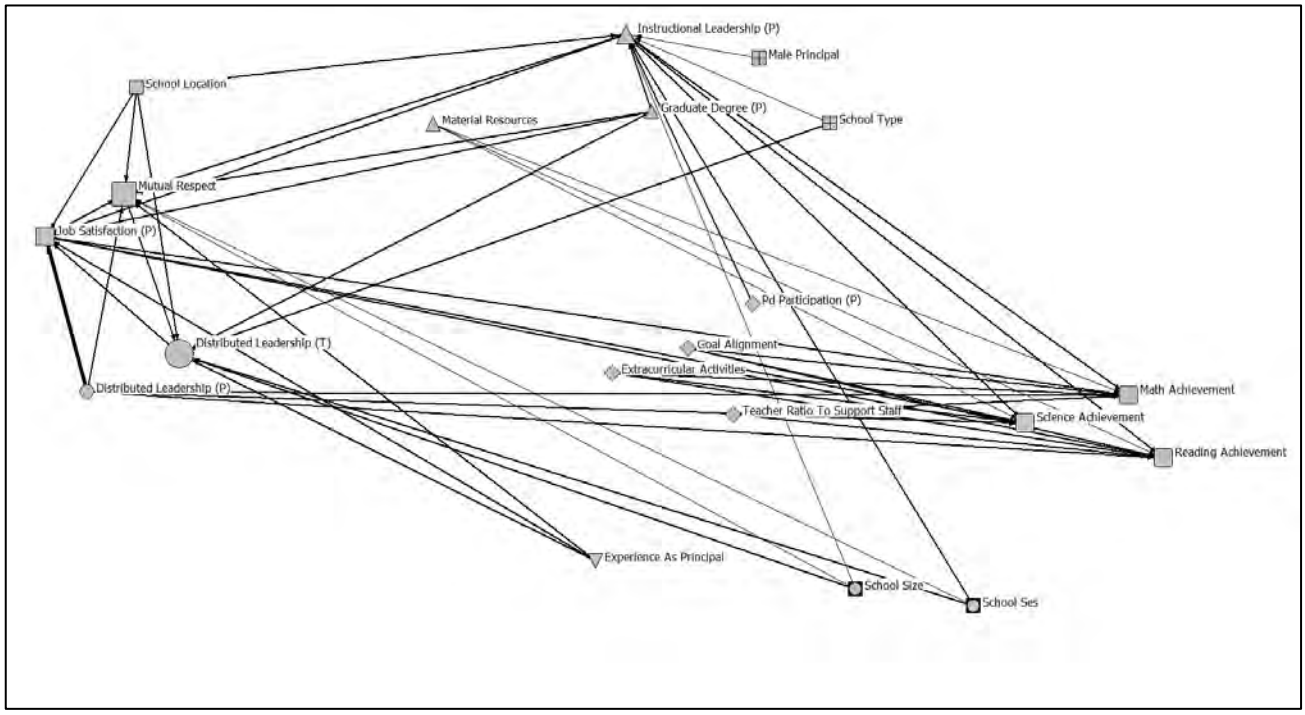


*Figure 6. Interconnected Process That Influenced Student Achievement*

## Discussion

Our review of 29 sampled studies, using network analysis, suggested that the impacts of school leadership extend beyond Leithwood et al.'s (2017) four-path (rational, emotional, organizational, and family) framework. Contrary to the independent paths implied in Leithwood et al.'s framework, our findings underscore a profound interconnectedness among these paths, suggesting that the influence of school leadership is far more integrated than previously understood. For example, our findings indicate an interplay between the rational and emotional paths, where leadership practices aimed at improving curriculum and instruction (rational) are deeply intertwined with efforts to improve teacher self-efficacy and staff morale (emotional). Similarly, the organizational and family paths demonstrate a synergistic relationship, wherein the structural and cultural conditions in schools (organizational) both influence and are influenced by family engagement and community relationships (family). By embracing the interconnected nature of these paths, researchers and practitioners in school leadership can explore innovative research and leadership practices that reflect the interconnected realities of school environments.

Our findings also suggested four themes: Reviewed studies (a) framed the principal as the driver and teachers as the target of change; (b) indicated self-efficacy, job satisfaction, and collaboration of teachers as the factors that may possibly bridge the relationships between multiple change process; (c) suggested nine core variables to play central roles in the network of school leadership impact; and (d) depicted student academic achievement as a function of the principal leadership, qualification as well as school context and organizational conditions. In this section, we first discuss how to interpret the four major themes, followed by implications for school leaders and researchers.

### *Interpretation of Four Themes and Implications for Leadership Practice*

Concerning our first emergent theme, the analysis of degree centrality (Table 1) indicated that the top three outcome variables concerned teachers, while the principal leadership practices were mostly conceptualized as predictors. That is, our reviewed studies theorized principal factors mostly as *drivers* of change, whereas they conceptualized teachers as targets. However, our further examination of the network identified that other organizational conditions (i.e., teacher participation in professional development, staff mutual respect) also impacted the principal's practice and affective status (i.e., instructional leadership behaviors, job satisfaction). A recent line of inquiry concurs that the principal leadership, teacher autonomy and influence, and school climate exchange reciprocal influences, highlighting the principals' leadership must *adapt* to the changed school conditions, beyond the initial leadership behaviors (Boyce & Bowers, 2018; MacBeath & Townsend, 2011). Therefore, we suggest that the principal should acknowledge this dynamic nature of mutual influence among their leadership, staff capacity, and organizational conditions and must adapt their leadership practices, responding to evolving school culture and staff development.

Concerning our second emergent theme, it is important to note that the top three variables, possessing the highest betweenness centrality, all referred to teachers (i.e., teacher self-efficacy, teacher job satisfaction, and teacher collaboration). Critically, teacher self-efficacy, implying its potential mediating power connecting multiple variables, was

influenced by 32 conditions (e.g., teacher workload), and in turn, influenced teaching and learning outcomes (e.g., perceived effect of professional development and student use of educational technology), organizational climate (professional collaboration), and teacher affective states (job satisfaction). In terms of implications for leadership practice, school principals may need to acknowledge the strong bridging power of teacher confidence in their ability (teacher self-efficacy), job satisfaction, and their collaboration with colleagues, and appropriately address their antecedents to be able to maximize the effectiveness of their leadership enactment.

Regarding our third emergent theme, our core/periphery analysis identified nine core variables in the network of school leadership impact and how these core conditions were interconnected with one another. Given the highly interconnected nature of the nine core variables, it is important for school leaders to understand that any change in one of those nine core variables would likely lead to changes in the rest of the variables. For example, adjusting teachers' workload could impact teacher self-efficacy, as well as their perceptions of school principals' instructional leadership and distributed leadership practices. Collectively, the changes in those nine core variables exert a stronger influence on organizations.

Concerning the fourth theme from our network review of the TALIs literature, our network depicted the paths through which student academic achievement is facilitated. Using Leithwood et al.'s (2017) four-path framework, we found that student achievement was first subject to mostly two sets of predictors: rational (e.g., goal alignment extracurricular activities, and teacher to staff ratio) and organizational (e.g., material resources). Two of those predictors of student achievement (i.e., the principal's job satisfaction and instructional leadership) were influenced by ten additional conditions, some of which were from the organizational path (e.g., mutual respect and professional development participation). This result attests that it is not the principal's single *style* of leadership (e.g., instructional leadership) that influences student learning. It is rather "the dynamic combination and accumulation of different leadership values, strategies, and actions" (Day et al., 2016, p. 239) that are affected by the school's organizational context and culture (e.g., school location, type, mutual respect). Thus, we argue that the principal should diagnose the school's social, economic, and cultural aspects and identify more timely, relevant, applicable, and sustainable leadership actions, instead of adhering to a single model of leadership (Day et al., 2016). We further suggest that leadership preparation programs should forgo oversimplistic promotion of a single-style approach to leadership (e.g., instructional, transformational, and distributed leadership) and redesign leadership training curriculum so that it could accommodate evolving conceptualizations of leadership into more integrated perspectives, such as leadership for learning (Ahn et al., 2021). Leadership for learning offers an integrated conceptualization of leadership that goes beyond stylistic approaches (e.g., instructional leadership). It is also more appropriate for developing aspiring leaders as it highlights *tasks*, instead of leadership styles, so that school leaders can focus on actionable practices to influence future organizational changes (Ahn et al., 2021). Only when school leaders possess relevant knowledge of and receive feedback on actionable tasks (not styles), can they strategize measurable next steps to enhance leadership practice (Halverson & Kelley, 2017).

*Implications for Research*

Educational leadership scholarship has persistently aimed to elucidate the complex relationships between leadership and student academic outcomes (Bridges, 1982; Leithwood et al., 2020). Our review, undergirded by network analysis, contributes a more granular lens. Specifically, we underscore the importance of examining interrelations among an array of variables that are instrumental in the multifaceted mechanisms through which school leadership influences outcomes. This nuanced approach transcends the limitations of studies that exclusively focus on binary relationships, given the extant evidence indicating that the impact of principal leadership is often mediated by a multitude of internal school factors (Leithwood et al., 2020; Robinson et al., 2008). Our empirical findings call for a more nuanced investigation into these mediating conditions, challenging the oversimplified narrative that positions student achievement as a direct outcome of principal leadership. Thus, we suggest that those variables with high potential bridging power are worth closer attention from researchers, warranting further efforts to test their empirically significant mediating roles between organization-wide leadership practice and student achievement (Grissom et al., 2015). Methodologically, additional *mediation effect* research is needed, focusing more on *multiple paths* of school leadership impact beyond exploring the relationships between predictors and outcomes (Hayes, 2015). It is important to note that network analysis does not necessarily test the mediation effect but suggests potential mediation relationships. Therefore, based on the network analysis results, researchers should statistically test these relationships using the mediation frameworks (e.g., Baron & Kenny, 1986; Hayes & Preacher, 2014). Also, as our findings indicate, variables influence and *are influenced* by others. Therefore, researchers should further leverage network analysis to identify potential reciprocal relationships between variables (Hallinger & Heck, 2011).

Indeed, our network analysis identified that some relationships between variables might be bi-directional (e.g., teacher collaboration, self-efficacy). This finding calls for the scholarly pursuit of investigating the reciprocal interplay among school leaders' individual leadership practices, group-level outcomes such as staff capacity, school-level outcomes such as school culture, and school conditions (Hallinger & Heck, 2011). While the need for reciprocal-effects models has been a topic of frequent discourse in the wider academic landscape, the educational leadership literature has yet to robustly engage in empirical inquiries examining the intricate web of mutual influence among leadership, school conditions,

teacher self-efficacy, and student outcomes (MacBeath & Townsend, 2011). This gap in empirical exploration calls for renewed scholarly attention to reciprocally influential factors that collectively shape educational leadership.

## Conclusion

The purpose of this study was to review the literature on TALIS for the past 10 years to identify multiple paths through which school leadership exerts influences on school organizations and organizational outcomes. Our findings highlight that the reviewed studies overwhelmingly framed the principal as the driver and teachers as the target of change. However, our network analysis further identifies that organizational conditions also impact the principal's practice and affective status. Additionally, although the principal's instructional leadership was a predictor of student achievement, it was also affected by organizational context and culture (e.g., mutual respect). These findings suggest a further need to examine the interconnected and reciprocal relationships between principals, teachers, and organizational conditions. Findings also indicated that self-efficacy, job satisfaction, and teacher collaboration as the potential mediating factors that possibly bridge the relationships between multiple change processes. It is important to note that the top three potential mediating variables all refer to *teachers* (i.e., teacher self-efficacy, teacher job satisfaction, and teacher collaboration). Considering these findings, school leaders should acknowledge the strong bridging power of teacher factors as well as organizational culture (e.g., mutual respect) to maximize the effectiveness of their leadership enactment and ultimately enhance student learning.

## Recommendations

Our findings suggest that the impact of school leadership on organizational outcomes may not be fully explained by one pair of factors. Rather, organizational outcomes could be explained by multiple interconnected relationships, such as instructional leadership, distributed leadership, teachers' job satisfaction, teacher self-efficacy, teacher collaboration, and mutual respect. In light of the findings of highly prominent variables, as evidenced by high-betweenness centrality measures, we recommend that future researchers pay closer attention to the interplay between multiple variables beyond the investigation of bivariate associations ( Ahn et al.,, 2023).

Second, the results of structurally equivalent variables, as seen in Table 2, suggest underlying similarities among those variables. Theoretically, structurally equivalent nodes are expected to have or develop similar characteristics. That underlying similarity, either known or unknown, may inform why certain nodes are structurally equivalent in a network (Borgatti & Grosser, 2015). For example, there may be some underlying similarities among the structurally equivalent variables, such as teacher self-efficacy, teacher preparedness, effective teacher evaluation, professional development effect, school autonomy, distributed leadership, and teacher collaboration (Block 2 in Table 2 and illustrated by circles in Figure 4). The results of structurally equivalent variables, therefore, draw concerns over construct proliferation. "Construct proliferation occurs when research streams are built around *ostensibly new* [emphasis added] constructs that are theoretically or empirically indistinguishable from existing constructs" (Shaffer et al., 2016, p. 81). To establish a new construct or variable or to validate an existing one, researchers must demonstrate that the new construct or variable has a distinct theoretical definition, and is empirically distinct from related constructs (i.e., constructs or variables "should not be perfectly (or near perfectly) correlated" (p. 81). Our findings indicate that the structurally equivalent variables may not meet empirical distinctions among the constructs. Hence, we recommend future researchers scrutinize potentially redundant constructs by evaluating construct discriminant validity—the distinctiveness of constructs (Ahn et al., 2021; Wang & Ahn, 2023).

## Limitations

The findings of this study need to be interpreted with caution due to the following limitations. First, all of the 29 reviewed articles were cross-sectional studies, capturing only a snapshot of the school leadership impact. As a result, the empirical evidence is insufficient to draw a conclusion about causation. Second, the frequent appearance of certain variables in the literature should not be construed as an endorsement of their empirical significance. The selection of these variables is often constrained by the availability of corresponding items in TALIS. The absence of particular measures within TALIS may limit their inclusion in quantitative analyses, thereby influencing the focus of academic research. Lastly, questionable research practices may lead to outcome-reporting bias—researchers' tendency to report incomplete outcomes by omitting the outcomes that were actually collected (Pigott et al., 2013). This censorship of reporting outcomes can lead to incomplete evidence in a body of literature.

### Authorship Contribution Statement

Ahn: Concept and design, data acquisition, drafting manuscript, critical revision of manuscript, final approval. Wang: Data analysis / interpretation, drafting manuscript, critical revision of manuscript, final approval

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## Appendix

*Table A1. Supplementary Materials: List of Articles Reviewed in the Current Study*

| Author. Year | Title | Journal | TALIS Year |
|---|---|---|---|
| Han et al. 2018 | A Comparative Study of Factors Associated with Technology Enabled Learning Between the United States and South Korea | Educational Technology Research and Development | 2013 |
| Badri et al. 2017 | A Structural Equation Model of Determinants of the Perceived Impact of Teachers' Professional Development–The Abu Dhabi Application | SAGE OPEN | 2013 |
| Ham et al. 2015 | Agreement of Self-Other Perceptions Matters: Analyzing the Effectiveness of Principal Leadership Through Multi-Source Assessment | Australian Journal of Education | 2008 |
| Urick and Bowers. 2019 | Assessing International Teacher and Principal Perceptions of Instructional Leadership: A Multilevel Factor Analysis of TALIS 2008 | Leadership and Policy in Schools | 2008 |
| Cha and Ham. 2012 | Constructivist Teaching and Intra-School Collaboration Among Teachers in South Korea: An Uncertainty Management Perspective | Asia Pacific Educational Review | 2008 |
| Torres. 2018 | Distributed Leadership and Teacher Job Satisfaction in Singapore | Journal of Educational Administration | 2013 |
| Torres. 2019 | Distributed Leadership, Professional Collaboration, and Teachers' Job Satisfaction in U.S. Schools | Teaching and Teacher Education | 2013 |
| Cooc. 2019 | Do Teachers Spend Less Time Teaching in Classrooms with Students With Special Needs? Trends From International Data | Educational Researcher | 2013 |
| Ford et al. 2018 | Exploring the Effect of Supportive Teacher Evaluation Experiences on U.S. Teachers' Job Satisfaction | Education Policy Analysis Archives | 2013 |
| Liu et al. 2018 | How School Context and Educator Characteristics Predict Distributed Leadership: A Hierarchical Structural Equation Model With 2013 TALIS Data | Educational Management Administration & Leadership | 2013 |
| Garcia-Carmona et al. 2016 | Leadership in Brazilian, Singaporean, and Spanish Secondary Schools: An In-Depth Analysis Based on TALIS 2013 | Book Chapter | 2013 |
| Sims. 2019 | Modeling the Relationships Between Teacher Working Conditions, Job Satisfaction, and Workplace Mobility | British Educational Research Journal | 2013 |
| Duyar et al. 2013 | Multilevel Analysis of Teacher Work Attitudes (Teacher Self-Efficacy and Job Satisfaction): The Influence of Principal Leadership and Teacher Collaboration | International Journal of Educational Management | 2008 |
| Bellibas and Liu. 2017 | Multilevel Analysis of the Relationship Between Principal's Perceived Practices of Instructional Leadership and Teachers' Self-Efficacy Perceptions | Journal of Educational Administration | 2013 |
| Wang et al. 2019 | Selected Factors Contributing to Teacher Job Satisfaction: A Quantitative Investigation Using 2013 TALIS Data | Leadership and Policy in Schools | 2013 |
| Huang et al. 2019 | Singapore's School Excellence Model and Student Learning: Evidence from PISA 2012 and TALIS 2013 | Asia Pacific Journal of Education | 2013 |
| Sun and Xia. 2018 | Teacher-Perceived Distributed Leadership, Teacher Self-Efficacy and Job Satisfaction: A Multilevel SEM Approach Using the 2013 TALIS Data | International Journal of Educational Research | 2013 |
| Fackler and Malmberg. 2016 | Teachers Self-Efficacy in 14 OECD Countries: Teacher, Student Group, School and Leadership Effect | Teaching and Teacher Education | 2008 |
| Cooc. 2019 | Teaching Students With Special Needs: International Trends in School Capacity and the Need for Teacher Professional Development | Teaching and Teacher Education | 2013 |
| Bellibas and Liu. 2018 | The Effects of Principals' Perceived Instructional and Distributed Leadership Practices on Their Perceptions of School Climate | International Journal of Leadership in Education | 2013 |
| Gumus and Bellibas. 2016 | The Effects of Professional Development Activities on Principals' Perceived Instructional Leadership Practices: Multi-Country Data Analysis Using TALIS 2013 | Educational Studies | 2013 |

*Table A1. Continued*

| Author. Year | Title | Journal | TALIS Year |
|---|---|---|---|
| Gumus. 2013 | The Effects of Teacher- And School-Level Factors on Teachers' Participation In Professional Development Activities: The Role of Principal Leadership | Journal of International Education Research | 2008 |
| Liu and Werblow. 2019 | The Operation of Distributed Leadership and the Relationship With Organizational Commitment and Job Satisfaction of Principals and Teachers: A Multi-Level Model and Meta-Analysis Using the 2013 TALIS Data | International Journal of Educational Research | 2013 |
| Brezicha et al. 2019 | The Ownership Perception Gap: Exploring Teacher Job Satisfaction and Its Relationship to Teachers' and Principals' Perception of Decision-Making Opportunities | International Journal of Leadership in Education | 2013 |
| Gumus et al. 2013 | The Relationship Between Principal Leadership and Teacher Collaboration in Turkish Primary Schools: A Multilevel Analysis | Education Research and Perspectives | 2008 |
| Berkovich and Bogler. 2019 | The Relationship Between School Leadership Standards and School Administration Imperatives: An International Perspective | School Leadership & Management | 2013 |
| Zhou. 2014 | The Relationship Between School Organizational Characteristics and Reliance on Out-of-Field Teachers in Mathematics and Science: Cross-National Evidence from TALIS 2008 | The Asia-Pacific Education Researcher | 2008 |
| Park and Ham. 2016 | Whose Perception of Principal Instructional Leadership? Principal-Teacher Perceptual (Dis)agreement and Its Influence on Teacher Collaboration | Asia Pacific Journal of Education | 2008 |
| Ham and Kim. 2015 | The Influence of Principals' Instructional Leadership on Teachers' Use of Autonomy-Supportive Instruction: An Analysis of Three Asia-Pacific Countries | The Asia-Pacific Education Researcher | 2008 |