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Journal of Educational Administration
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Kenneth Leithwood, Jingping Sun, Catherine McCullough,

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How school districts influence student achievement

Kenneth Leithwood
*Department of Leadership, Higher and Adult Education in Education,
University of Toronto, Toronto, Canada*
Jingping Sun
*Department of Educational Leadership, Policy and Technology Studies,
University of Alabama, Tuscaloosa, Alabama, USA, and*
Catherine McCullough
CMC Leadership, Toronto, Canada

Abstract

Purpose – The purpose of this paper is to test the effects of nine district characteristics on student achievement, explored the conditions that mediated the effects of such characteristics and contributed to understandings about the role school-level leaders play in district efforts to improve achievement.

Design/methodology/approach – Data for the study were provided by the responses of 2,324 school and district leaders in 45 school districts to two surveys. Student achievement evidence was provided by multi-grade provincial measures of math and language achievement. The analysis of these data included calculation of descriptive statistics, confirmatory factor analysis and regression mediation analysis.

Findings – Seven of nine district characteristics contributed significantly to student achievement and three conditions served as especially powerful mediators of such district effects. The same three conditions, as well as others, acted as significant mediators of school-level leader effects on achievement, as well.

Practical implications – District characteristics tested in the study provide a powerful framework for guiding the district improvement work of senior educational leaders. The organizational improvement efforts of both district and school leaders would be substantially enhanced by a better understanding of how to diagnose and improve the status of those conditions acting as significant mediators of the effects of both district and school leadership on student achievement.

Originality/value – This is one of a very few large-scale quantitative studies examining the extent to which characteristics frequently identified by district effectiveness research explain variation in student learning. It is also one of the very few studies identifying classroom, school and family variables that mediate district effects on such learning. The study also adds to a growing body of evidence about variables which mediate school leaders' effects on such learning.

Keywords Student achievement, Mediation analysis, District effect, Indirect effect, School leadership effect

Paper type Research paper

After a long period of neglect by school reformers, a small but compelling body of research now demonstrates the significant variation in student learning explained by district-level organizations (Thompson *et al.*, 2008). Much research of this sort, however, has limited its explanations for such variation to readily measured factors over which districts have little or no control, for example, district-wide SES (Fahle and Reardon, 2018) and district size (Chingos *et al.*, 2013).

A much larger body of research on districts has aimed to identify how districts performing beyond expectations improve student learning. Often referred to as "district effectiveness" studies, the size of this body of research is evident from the samples of the studies incorporated into three relatively recent reviews: Leithwood's (2010) review examined 30 studies, the oldest published in 1999; Trujillo's (2013) review examined 50 primary documents on districts dating back to 1988 (although 40 were carried out after 2000); and Anderson and Young's (2018a, b) review included 98 studies reported over the

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past three decades. There is substantial overlap in the studies included in these reviews primarily accounted for by the differences in study selection criteria.

As all three of these reviews indicate the largest proportion of this evidence is exclusively qualitative and mostly case study in nature, typically using "outlier" research designs with small samples of districts, that is, designs that locate one or multiple districts performing beyond expectations and examine those districts to find out why, and in some cases, using low-performing districts for comparison. This was the case for all of the studies in Leithwood's (2010) review. Anderson and Young's (2018a) review included 50 studies of this type (and only nine quantitative studies), while 56 percent of the studies in Trujillo's (2013) review were of this type. While Bowers (2010, 2015) has recently proposed more rigorous methods for improving site selection, the fundamental limitations of outlier designs remain. Studies using outlier designs produce contextually bound results which may or may not account for exceptional performance and may or may not generalize beyond the settings in which they were conducted. Because these results are rarely tested using more robust – or at least different – research designs, the knowledge base now available to help guide district leaders' improvement efforts is generally considered to be both shaky and potentially misleading (Anderson and Young, 2018a, b; Rorrer *et al.*, 2008; Trujillo, 2013). These features of the district effectiveness knowledge base seriously constrain the efforts, investigated by Honig *et al.* (2018), for example, to encourage the use of research by district leaders to improve their own contributions to teaching and learning in their schools.

This paper reports the quantitative portion of the data collected as part of a larger mixed-methods study (Leithwood and McCullough, 2017) and is limited to one of three dependent measures (student achievement) included in the larger study, the others being student well-being and student engagement. The study is the latest in a nine-year combined research and professional development (PD) project aimed at improving the contribution that school districts in the Canadian province of Ontario make to their students' learning (Leithwood, 2013; Leithwood and McCullough, 2015). After Rorrer *et al.* (2008), the study defined a district as an "organized collective constituted by the superintendent, the board, the central office-level administration, and principals, who collectively serve as a network and critical link to uniting the district and the schools in ways to both develop and implement solutions to identified problems" (p. 311).
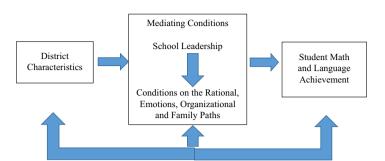
Results of this study help answer three broad questions: What characteristics of districts, under the control of districts themselves, explain significant amounts of variation in student learning? How do such characteristics interact with the conditions found in schools, classrooms and families to achieve their effects on student learning? What role do school-level leaders play in district efforts to improve student learning? Results replicate and extend important features of an earlier study of high-performing district characteristics (Leithwood and Azah, 2016), as well as a previous study identifying significant mediators of school leaders' effects on student achievement (Leithwood, Sun and Schumacker, 2017).

Framework
As Figure 1 indicates, the framework for the study consists of nine characteristics of high-performing districts with both direct and indirect effects on students' combined math and language achievement. Indirect district effects are mediated by school leadership and four categories of mediating conditions.

District characteristics
The nine district characteristics serving as independent variables for this study are briefly summarized in this section. Further information about each of them can be found in Leithwood's review of original empirical evidence about what districts do to close achievement gaps among their students (Leithwood, 2010), as well as in Leithwood (2013)

Figure 1.
Framework for study

and Leithwood and McCullough (2015, 2016). With some differences in the wording of labels, the nine district characteristics also are among the 13 included in Anderson and Young's (2018b) "Framework for District Effectiveness Practices" and their recent extensive review (Anderson and Young, 2018a). These nine characteristics encompass all of the characteristics justified by either strong or moderate evidence, as judged by Anderson and Young (2018a, b); they also reflect 13 of the 14 most commonly identified correlates of effective districts identified by Trujillo (2013) and four of the five district practices mentioned by Bowers (2015) in his synopsis of the literature. In addition to the results of these reviews, the description of each of the district characteristics below cites examples of specific, original evidence supporting the value of each district characteristic.

Creating a broadly shared mission, vision and goals for students entails a district engaging all key stakeholders in building a shared sense of direction for the district, a process that includes many elements of strategic planning (e.g. Berson *et al.*, 2015) aimed at identifying ambitious outcomes for all students (e.g. Spillane *et al.*, 2018). When a district focuses its curriculum standards and frameworks, instructional practices (Joyce *et al.*, 2009), PD emphases and assessment tools on that vison, it is providing coherent instructional guidance. Deliberate and consistent use of multiple sources of evidence to inform decisions includes districts' uses of systematic evidence from multiple sources to monitor progress, revise strategies and encourage data-based decision throughout the organization (Datnow *et al.*, 2007; Honig and Venkateswaran, 2012).

Two of the district characteristics are explicitly about the individual and collective learning of staff. Learning-oriented organizational improvement processes create structures and norms to encourage regular, reciprocal evidence-based deliberations about improvement progress within and across schools, as well as across the system as a whole. PD for all members is extensive, aligned with district visions, guided by individual learning plans and often job-embedded. Such learning often takes place in collaborative peer structures such as networks (Leithwood *et al.*, 2010), the effectiveness of which depend critically on trusting relationships (Daly and Finnigan, 2012). More formal approaches are sustained over time, anchored to practice, use active learning strategies and are coherent with other learning activities (Garet *et al.*, 2001; Sun *et al.*, 2013). This vision-oriented learning is extended and reinforced by the alignment of budgets, personnel policies/ procedures, and uses of time with district mission, vision and goals. As Honig and Hatch (2004) argue, to be effective such alignment or coherence is dynamic; it requires "school and school district central office leaders to work in partnership to continually 'craft' or negotiate the fit between external demands and schools' own goals and strategies" (p. 17). Anderson and Young (2018a, b) report this characteristic to be the most strongly represented among the district characteristics in their data base.

Professional leadership development across high-performing districts (those at least moderate to large in size) is guided by comprehensive policies and programs for recruiting,

pre-appointment PD, selection, appointment, post-appointment learning opportunities, evaluation (Davis *et al.*, 2005) and succession planning (Schmidt and Bottoms, 2011). Notwithstanding important shorter-term strategies (see, e.g. Honig, 2012), the enactment of these policies is among the strongest levers available to districts for improving the quality of school-level leadership over time. The best available evidence about successful leadership shapes these policies and programs. Especially recruitment, selection and appointment policies include strong provisions against gender and racial biases. District governance is provided by a policy-oriented board of trustees (Land, 2002) which, as Saatcioglu *et al.* (2011) found, makes increasingly significant contributions to students' performance when it forges strong internal bonds, as a first priority (bonding), without neglecting "bridging" or "boundary spanning," the development of relationships with relevant external agencies and individuals. Honig (2006) has unpacked the challenges faced by district administrators who assume boundary-spanning roles, only some of which will be faced by elected trustees. Productive working relationships are developed within the senior district leadership team, between school and district staffs (Daly and Finnigan, 2011), as well as with external stakeholders, including the local community. Anderson and Young (2018a, b) reported strong evidence for the contribution of this characteristic to district effectiveness.

The nine district characteristics in this framework were derived from a content analysis of studies included in our literature reviews, not as inferences from theory. As in the school effectiveness literature, theory development in the district effectiveness literature has been quite limited and largely *post hoc* (but see Honig *et al.*, 2010, use of sociocultural and cognitive learning theories to guide their study of district office work). However, some work has attempted to cast a theoretical net over most of the practices explaining district effectiveness. Examples include Togneri and Anderson's (2003) and Rorrer *et al.* (2008) use of "institutional actor" theory, Thompson *et al.* (2008) application of a concept of "coherence," and Bowers (2012) exploration of a theory used to explain effective corporate practice to account for the success of one outlier school district. The challenge faced by such "grand" theory development is to adequately acknowledge the complex and wide range of variables accounting for district performance.

Our preferred approach to district effectiveness theory development, at this point, is more fine-grained; it is an approach that takes each of the nine district characteristics as a focus for independent theorizing. The detailed features of most of the nine characteristics framing this study are consistent with an eclectic array of relevant and well-established theory. Broadly shared mission, vision and goals, for example, reflects the key role of personal goals in most theories of human motivation (e.g. Bandura, 1981). Coherent instructional guidance includes the reciprocal interactions between district and school personnel considered central to learning by sense-making theory (Weick, 1995). Deliberate and consistent uses of evidence incorporates the feedback loops considered essential for progress by organizational learning theory (Huber, 1991).

Key aspects of both learning-oriented improvement processes, as well as productive working relationships with staff and stakeholders can be understood through a handful of theoretical lenses such as collaboration (Wood and Gray, 1991) and social network theory (Daly and Finnigan, 2012). Argyris and Schon's (1978) conception of "Model 2" forms of social interaction is especially relevant. The governing variables in Model 2 forms of interaction are information seeking, respect for self and others and the promotion of internal commitments. Model 2 behaviors entail being clear about one's own agenda but inquiring deeply into others' views and checking for accuracy of understanding. The intended consequences of Model 2 learning are greater understanding of decisions, mutual agreement and double-loop learning. Also helping to understand the underlying premises of these two district characteristics is the concept of "collective mind" (Weick and Roberts, 1993) and how individual members in groups engage in mutual adaptation (Hutchins, 1991; Schoenfeld, 1987).

PD (especially job-embedded approaches) is consistent with theories about effective transfer of learning, specifically "high and low road" transfer (Perkins and Solomon, 1992). Alignment of policies and practices to support the organizations' vision and goals, as well as coherent instructional guidance, reflects claims by Thompson *et al.* (2008) that creating coherence across the political, administrative and professional elements of a district supports the classroom and school-level coherence essential for improvement of instruction and student learning.

These examples illustrate the potential value of using multiple theoretical lenses to explain and predict the unique contributions to district success of individual district characteristic as an alternative to relying on any single theory of effective district characteristics; this approach (the use of multiple lenses) similar to Durland *et al.*'s (2016) conclusion from the study of race-to-the-top initiatives:

> The implementation of multiple race-to-the-top (RTTT) innovations recommends a theoretical hybrid consisting of policy implementation theory, leadership theory, organizational change theory, and organizational learning theory, especially learning-focused leadership strategies such as bridging, brokering, and buffering strategies for crafting coherence across organizational boundaries. (p. 45)

We do not suggest, however, that efforts toward developing a single theoretical lens for explaining district effectiveness should not continue.

Mediating conditions: school leadership

The conception of school leadership used for this study was based on the leadership practices described on the Ontario Leadership Framework (OLF) (Leithwood, 2012) and was recently judged to be among the most comprehensive, evidence-based account of effective school leaders' practices available (Hitt and Tucker, 2016). The OLF includes a description of both effective leadership practices and leadership "dispositions" (not included in the conception of leadership for this study). The OLF is an "integrated" model of leadership (see, e.g. Printy *et al.*, 2010) although a more fully developed one than appears in most literature to date. This leadership model, combining both transformational and instructional leadership practices, includes five domains of practice (21 specific practices): setting directions, building relationships and developing people, developing the organization to support desired practices, improving the instructional program and securing accountability. These 21 specific practices in the OLF include all ten of the primary equity leadership practices identified in Ishimaru and Galloway's (2014) review and many of leadership responsibilities tested in Jacob *et al.*'s (2015) study[1]. The contribution of practices included in these five categories depends on leaders enacting those practices in ways that are sensitive to the specific features of the settings in which they work, the people with whom they are working and changes over time (Hallinger, 2016).

Four categories of additional mediating conditions

As well as school leadership, four categories of conditions served as mediators in this study. Briefly summarized here, these four categories represent one set of variables mediating leaders' influence on student learning among a small number of other proposed sets (e.g. Bryk *et al.*, 2010; Hallinger and Heck, 2010; Sebastion *et al.*, 2017). The four categories of mediating conditions have been labeled rational, emotions, organizational and family conditions, and conceptualized as "Paths" along which the influence of leadership "flows" to exercise influence on student learning. Detailed descriptions of the four paths and justification for their use as leadership mediators – including their individual and combined effects on student achievement – can be found in Leithwood, Sun and Schumacker (2017) and Leithwood, Sun and Pollock (2017). A very brief account of these mediating conditions

is provided in this section of the paper, including examples of evidence supporting the significant effects on students of the individual path conditions.

Conditions on the rational path reflect the knowledge and skills of school staff members about curriculum, teaching and learning – the technical core of schooling – along with features of the school culture which directly support the technical core. Four individual conditions populate this path including classroom instruction (Hattie, 2009; Marzano *et al.*, 2001), teachers' use of instructional time (Tornroos, 2005; Wang, 1998), academic press (Cooper, 2018; Hoy *et al.,* 1998, 2014) and disciplinary climate (Ma and Crocker, 2007; Willms and Ma, 2004). The emotions path encompasses those feelings, dispositions, or affective states of staff members (both individual and collective) shaping the nature of their work including Collective Teacher Efficacy (Bandura, 1993; Tschannen-Moran and Barr, 2004) and Teacher Trust in Others (Forsyth *et al.*, 2006; Goddard *et al.*, 2001).

Conditions on the organizational path include features of schools that structure the relationships and interactions among organizational members. Among the most significant of these conditions are safe and orderly environments (Bucher and Manning, 2010), collaborative cultures and structures (Camburn and Won Han, 2017: Lomos *et al.*, 2011), as well as the organization of planning and instructional time (DuFour and Fullan, 2013; Sun *et al.*, 2016). The family path is populated by three conditions which, taken together, represent educational cultures in the home that contribute most to students' success at school. Fostering development of the knowledge and dispositions families need to productively work with schools in the interests of their children's success, these conditions include parent expectations for children's success at school (Jeynes, 2005), forms of communication among parents and children in the home (Epstein *et al.*, 2002; Jeynes, 2005) and parents social and intellectual capital about schooling (Davies and Rizk, 2018; Ferlazzo, 2011).

Methods
Based on her relatively recent review of district effectiveness research, Trujillo (2013) concluded that such research shared many of the same methodological weaknesses found in much of the school effectiveness research. Such research has included almost exclusively cross-sectional research designs applied to small samples of typically high-performing districts, narrow definitions of the meaning of effectiveness (test scores in reading Ad math) often in only a single grade, and very limited attention to school or classroom processes. Although not longitudinal in design, methods used in this study addressed Trujillo's (2013) remaining limitations. This cross-sectional field study used large samples, and multiple dependent variables (although this paper is limited to student achievement) measured in multiple grades and collected considerable evidence about not just school and classroom processes but relevant family processes, as well. Descriptive statistics, confirmatory factor analysis (CFA) and regression mediation analysis were applied to test the direct and indirect effects of the nine district characteristics on student achievement, through the mediating effects of school, classroom and family conditions, as well as school leadership.

Measures and data collection procedures[2]
Two surveys, administered simultaneously, measured all of the study's independent and mediating variables. Survey administration typically occurred during a regularly scheduled meeting of district and school administrators. Attendees were divided into two groups. One group, including only principals and vice-principals, responded on-line to the leading and teaching in schools survey. The second group, including both district and school-level administrators, responded on-line to the "Ontario District Survey." Both surveys required about 15 min to complete.

The "Ontario District Survey" was adapted from an instrument used in the earlier study on which this study built (Leithwood and Azah, 2016). This 67-item survey measured the status of each of the nine district characteristics in the study framework. The 87-item leading and teaching in schools survey, adapted in only minor ways from its use in the studies recently carried out in both Ontario and Texas, measured the status of each of the four categories of mediating conditions, as well as school leadership practices, included in the study framework. Results from earlier uses of both surveys reported scale reliabilities exceeding the commonly acceptable norm of about 0.70 (Nunnery and Bernstein, 1994) by a wide margin.

Student achievement data were based on results of the province's testing program including math, writing and reading in grades 3 and 6, literacy in grade 10 and math in grades 3, 6 and 9. Collected annually, results of these tests are reported as the percentage of students achieving at each of four levels (1 = lowest, 4 = highest). Level 3 is typically considered an acceptable level. Achievement evidence in this study was reported as average results for 2016 in the proportion of students in each district achieving level 3 or above. All math and language scores were combined to provide district combined achievement scores in math and language.

Sample
Ontario's publicly funded school system includes 76 districts, 12 of which are francophone and did not participate in the study. While 54 of the 64 English speaking districts accepted the invitation to participate, only 45 provided sufficient numbers of responses to be included, an 83 percent response rate. For a district to be included in the study, the number of responses to each of the two surveys from a district had to closely approximate the number required to be statistically representative of the district at the 0.05 level of probability. This number varied from one district to another, reflecting differences in the population of potential respondents in each district. Close approximations to the ideal size were accepted to retain as much data as possible. Quantitative studies, such as this one, make use of natural variation in district effects to determine the relative contribution of individual district characteristics to student success. While non-random, the sample of districts for this study had wide variation in measures of the dependent variable.

Across the 45 participating districts, 1,252 school administrators responded to the "Leading and Teaching in Schools Survey" (an average of 29 respondents for each district) while 1,072 district and school administrators responded to the "Ontario District Survey" (an average of 24 respondents for each district). Lack of a teacher sample is an obvious limitation of the study, but school and district leaders are likely to have significant experience with the variables measured, and more than many teachers.

Analysis
The analysis of these data included calculation of descriptive statistics, CFA and regression mediation analysis. Means, standard deviations and scale reliabilities (Cronbach's α) were computed for all variables. A CFA using LISREL 9.3 was conducted to assess whether the conceptual allocation of each of the four path conditions could be empirically justified and the four paths treated, in subsequent analyses, as latent variables. Bivariate correlations were computed between all variables measured by the two surveys. Intra-class correlations (ICC) were calculated using SPSS 24 ANOVA random effects for all district and school variables to examine whether individual respondent measures of these variables clustered significantly at the district level. ICC (1) (representing the variance attributed to group membership), and ICC (2) (representing the within-group agreement between respondents) were used to assess whether aggregation to the group level was appropriate (e.g. Van Mierlo *et al.*, 2008).

Mediation analyses were used to assess the direct and indirect effects of both district characteristics and school leadership on student achievement. Mediation refers the relationship between a predictor variable and an outcome variable which can be explained by their relationship to a third variable, the mediator (MacKinnon *et al.*, 2007). Mediation occurs if the strength of the relationship between the predictor and outcome variables is reduced by including the mediator.

In this study, the term "direct effect" means the direct effect in a mediated relationship (i.e. the relationship between a district characteristic and student learning mediated by a path condition, not the direct effect in a simple relationship without mediation (a "total effect"). An "indirect effect" is the effect of a district characteristic (or aggregate), or school leadership, on achievement through a mediator.

Regression mediation analyses were conducted (about 170), using SPSS 24 PROCESS, to test the two levels of district and school leadership influence on student learning:

(1) the direct and indirect effects of each of the nine district characteristics (and district aggregate) on student achievement through each of the four paths, as well as through each of the individual path conditions; and

(2) the direct and indirect effects of school leadership on student achievement through each of the four paths, through each of the individual path conditions, and through the 13 individual conditions included in the four paths treated as one mediator.

While many effect size measures for indirect effect have been proposed (e.g. Preacher and Kelley, 2011), the simplest is the regression coefficient for the indirect effect and its confidence interval (Field, 2017). This study employed SPSS PROCESS (Hayes, 2017) to calculate the indirect effect (R_m^2) by the proportion of variances in the outcome variables explained by the predictor ($R_{Y,X}^2$), the mediator ($R_{Y,M}^2$), and both ($R_{Y,MX}^2$); this is calculated by the following formula:

$$R_M^2 = R_{Y,M}^2 - \left(R_{Y,MX}^2 - R_{Y,X}^2\right).$$

The indirect effect can be interpreted as the variance in the outcome that is shared by the mediator and the predictor but cannot be attributed to either in isolation (Field, 2017). Standardized rather than unstandardized regression coefficients were used since they could be compared across different mediated relationships.

Instead of the commonly used Sobel test (Sobel, 1982) to assess the significance of indirect effects, the significance of mediation effects was assessed using confidence intervals in order to avoid the "black-and-white" thinking of significance tests, and the possible inaccurate interpretation of results (Field, 2017). Estimates of indirect effects and confidence intervals indicated the degree of mediation observed in the data. When point estimates do not include zero, mediation is interpreted to be significant, or the indirect effect is significant via the mediator.

Results
Descriptive statistics
Tables I and II summarize the means, standard deviations and reliabilities (Cronbach's α) for all scales used to measure the status of district characteristics (Table I) and all mediating conditions (Table II). These tables also report the number of items included in each scale.

As Table I indicates, all scales in the district survey exceeded an acceptable standard for reliability of 0.70 (Nunnery and Bernstein, 1994) by a significant margin, and each of the nine district characteristics received mean ratings above the mid-point on the four-point response scale. Highest ratings were awarded to mission, vision and goals ($m = 3.28$) and extent of district

	Mean	SD	Rel.	n
District characteristics (aggregate)	2.98	0.22	0.94	
Mission, vision, goals for students	3.28	0.22	0.92	7
Coherent instructional program	3.07	0.29	0.97	5
Uses of evidence	2.92	0.28	0.94	6
Professional development	2.89	0.25	0.90	7
Professional leadership	2.87	0.28	0.94	8
Extent of district/district's alignment	3.24	0.26	0.90	4
Elected leadership	2.86	0.36	0.95	7
Organizational improvement processes	2.72	0.27	0.94	8
Relationships	2.93	0.23	0.86	17

Note: Mean, standard deviation, scale reliability and number of items in scales

Table I.
Status of nine district characteristics (four-point scale)

	Mean	SD	SR	n
School leadership	3.95	0.19	0.96	22
Mediating conditions (aggregate)	3.77	0.17	0.94	
Rational path				
Classroom instruction	3.52	0.21	0.93	11
Uses of instructional time	3.62	0.18	0.87	6
Academic emphasis	3.76	0.19	0.84	5
Disciplinary climate	3.62	0.23	0.75	4
Emotions path				
Teacher commitment	4.00	0.23	0.94	6
Teacher trust in others	3.97	0.18	0.82	4
Teacher collective efficacy	3.84	0.21	0.88	5
Organizational path				
Organization of planning and instructional time	3.59	0.31	0.80	4
Safe and orderly environment	4.09	0.19	0.77	6
Collaborative cultures and structures	3.69	0.21	0.92	9
Family path	3.61	0.26	0.89	5
Parent expectations	3.43	0.85		1
Social/intellectual capital	3.74	0.69	0.81	3
Parent/child communication	3.40	0.92		1

Note: Mean, standard deviation, scale reliability (SR) and number of items (n) in scale

Table II.
The status of school leadership and the four paths conditions (five-point scale)

alignment ($m = 3.24$). Lowest rated was learning-oriented improvement processes ($m = 2.72$). Standard deviations for all characteristics were relatively small indicating considerable uniformity in ratings among respondents. An Exploratory Factor Analysis (details not reported) conducted on this instrument found that all items loaded on nine factors, and almost all items conceptually associated with each district characteristic loaded as expected.

Table II reports results for the survey which measured all mediating conditions. All but two scales on this survey (disciplinary climate and safe and orderly environment) exceed the acceptable standard for reliability (0.70) by a significant margin. Only one item was used to measure two of the parent conditions. The 13 conditions, as well as school leadership, measured by this survey all received mean ratings above the mid-point on the five-point response scale. Highest ratings were awarded to safe and orderly environment ($m = 4.09$) and teacher commitment ($m = 4.00$); lowest rated were classroom instruction ($m = 3.52$) and organization of planning and instructional time ($m = 3.59$). As with the results of the district survey, all standard deviations were relatively small indicating considerable uniformity in ratings among respondents.

Results of an exploratory factor analysis (details not reported) conducted on items in this survey closely reflected the conception of variables on which the instrument was developed for half of the variables measured, while the distribution of items measuring the remaining six conditions were not readily interpretable. Given the relatively high reliabilities of all 13 scales, subsequent analyses were based on the original distribution of items to scales.

ICC and CFA analyses were carried out. Suffice to say that results of the ICC analysis indicated reliable within-group agreement supporting the aggregation of data to the group level and the appropriateness of aggregating the data to district level for data analysis. Results of four CFAs justified treatment of each of the four paths as well-defined latent variables.

Effects of district characteristics on student achievement
Table III reports the direct and indirect effects of each of the nine district characteristics (and aggregate – far right column) on student achievement through each of the four paths, as well as through each of the individual path conditions and school leadership. The top figure in each of the path cells indicates the direct effect of a district characteristic through a path, while the figure at the bottom indicates the indirect effect. These results indicate that none of the district characteristics influence student achievement through school leadership, a result explored later in the paper. Each path was treated as a latent variable. The direct and indirect effects of each district characteristic through each of the four paths were calculated when the effects of all the conditions included in the path were entered into the regression equation as mediators.

For each path, the indirect effects of a district characteristic (or aggregate) through a single school condition is reported in the cell at the intersection of the district characteristic column and the mediating conditions row. The figures in these cells indicates the indirect effect of the district characteristics on student learning through that mediating condition when the effects of all other mediating conditions included as part of that path were controlled. The significant indirect effects of several district characteristics on student learning through several mediating conditions became non-significant when the effects of other conditions on the same path were considered. This result was due to high collinearity between the mediating conditions on each of the four paths.

District characteristics, as a whole, had significant, indirect effects on student learning through the emotions ($b = 0.31$), organizational ($b = 0.27$) and rational ($b = 0.21$) paths but not the family path. When the 13 individual conditions included in the four paths were treated as one mediator in separate analyses, seven district characteristics had significant indirect effects on student learning: uses of evidence ($b = 0.30$), coherent instructional program ($b = 0.28$), mission vision and goals ($b = 0.25$), district alignment ($b = 0.24$), relationship ($b = 0.23$), professional leadership ($b = 0.22$) and learning-oriented improvement processes ($b = 0.20$). District characteristics (aggregate) had significant indirect effects on achievement through the four path conditions taken as a whole ($b = 0.26$).

Rational path
Of the nine district characteristics, uses of evidence ($b = 0.25$), mission, vision and goals ($b = 0.25$), relationships aggregate ($b = 0.23$) and coherent instructional program ($b = 0.22$) had significant, indirect effects on students' combined math and language achievement measures. Uses of evidence ($b = 0.16$) and relationships ($b = 0.16$) had significant indirect effects on student learning through academic emphasis. District characteristics, in aggregate, had significant indirect effects on student learning through this path ($b = 0.21$), though their indirect effects through each of the individual mediating conditions on this path were non-significant.

Mediating conditions	Mission/ vision	Coherent. instruct	Uses of evidence	Pro devlp.	Alignment	Elected lead	Prof lead	LOIP	Relation	District aggregate
Rational path	0.17	0.19	0.09	-0.01	0.08	0.00	0.09	0.16	0.12	0.12
	0.25*	0.22*	0.25*	0.08	0.16	0.07	0.18	0.18	0.23*	0.21*
Academic emphasis	0.16	0.16	0.16*	0.07	0.12	0.07	0.12	0.14	0.16*	0.15
Disciplinary climate	0.05	0.05	0.06	0.04	0.05	0.01	0.03	0.03	0.04	0.05
Teachers' use of instr. time	-0.04	-0.09	-0.06	-0.07	-0.09	-0.08	-0.05	-0.08	-0.07	-0.09
Classroom instruction	0.08	0.09	0.10	0.05	0.08	0.07	0.07	0.09	0.09	0.10
Emotions path	0.10	0.10	-0.06	-0.08	-0.03	-0.02	-0.07	0.10	0.08	0.02
	0.31*	0.31*	0.40*	0.16	0.26*	0.09	0.33*	0.25*	0.27*	0.31*
Teacher commitment	-0.08	-0.41	-0.10	-0.05	-0.08	-0.05	-0.08	-0.11	-0.10	-0.10
Teacher trust	0.18*	0.15*	0.20*	0.13	0.18*	0.09	0.19*	0.18*	0.19*	0.20*
Collective efficacy	0.22*	0.82*	0.29*	0.08	0.17*	0.05	0.21*	0.18*	0.18*	0.21*
Organizational path	0.15	0.12	-0.04	-0.02	0.00	-0.08	0.04	0.18	0.14	0.06
	0.26*	0.29*	0.38*	0.09	0.23*	0.15	0.23*	0.16	0.21*	0.27*
Org. and plan	0.01	0.01	0.01	0.00	0.01	0.01	0.01	-0.01	0.01	0.01
Safe environ.	0.21*	0.23*	0.29*	0.06	0.18*	0.12	0.17*	0.14*	0.17*	0.21*
Collab culture	0.04	0.05	0.07	0.03	0.05	0.03	0.05	0.03	0.03	0.05
Family path	0.31*	0.28*	0.21	0.09	0.17	0.14	0.16	0.30*	0.26	0.26
	0.10	0.13	0.13*	-0.01	0.07	-0.06	0.10	0.05	-0.09	0.07
Parent expectations	-0.04	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
Family communic.	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parents' social CAPITAL	0.13	0.13	0.13	-0.02	0.07	-0.06	0.11	0.05	0.09	0.08
School leadership	0.30*	0.32*	0.22	0.09	0.18	0.03	0.19	0.24	0.26*	0.24
	0.11	0.08	0.12	-0.01	0.06	0.05	0.07	0.11	0.09	0.09
Sch. Cndtns aggregate	0.16	0.12	0.04	-0.04	0.00	-0.05	0.05	0.15	0.12	0.07
	0.25*	0.28*	0.30*	0.12	0.24*	0.12	0.22*	0.20*	0.23*	0.26*

Note: *CI does not include zero

Emotions path
When all the three conditions on the emotions path were entered into the regression model as mediators, there were significant indirect effects on student learning of uses of evidence ($b = 0.40$), professional leadership ($b = 0.33$), coherent instructional program ($b = 0.31$), beliefs and vision for students ($b = 0.31$), relationships aggregate ($b = 0.27$), district/board's alignment ($b = 0.26$) and organizational improvement processes ($b = 0.25$). These seven district characteristics also had significant indirect effects on student learning through teacher collective efficacy (bs ranging from 0.17 to 0.29) and teacher trust (bs ranging from 0.15–0.20). The aggregate measure of district characteristics also had significant indirect effects on student learning through the emotions path ($b = 0.31$), especially through collective teacher efficacy ($b = 0.21$) and teacher trust ($b = 0.20$).

Organizational path
Among the nine district characteristics, uses of evidence ($b = 0.38$), coherent instructional program ($b = 0.29$), mission, vision and goals ($b = 0.26$), professional leadership ($b = 0.23$), district alignment ($b = 0.23$) and relationships aggregate ($b = 0.21$) had significant influences on student learning through the organizational path, as a whole. Safe and orderly environment mediated the effects of these district characteristics (bs ranging from 0.14 to 0.29) while district characteristics, in aggregate, had a significant indirect effect on student learning through this path ($b = 0.27$), a result mainly due to the mediation of safe and orderly environment ($b = 0.21$).

Family path
When all three individual conditions on this path were entered into the regression model, only uses of evidence had significant, indirect effects on student learning ($b = 0.13$). In contrast, mission, vision and goals ($b = 0.31$), organizational improvement processes ($b = 0.30$) and coherent instructional program ($b = 0.28$) had significant, direct effects on student learning. District characteristics, in aggregate, had no significant effect on student learning either directly or indirectly when all the conditions on this path were entered into the regression model as mediators.

Total effects of district characteristics compared
The design of our earlier district study (Leithwood and Azah, 2016), partially replicated by the current study, did not allow for the calculation of direct and indirect effects of district characteristics on student achievement. That study, however, did calculate total effects (Pearson r effect size) as did this study. Both studies found similar, practically meaningful, total effects of four district characteristics on combined measures of math and language achievement: mission, vision and goals ($r = 0.40$ and 0.39), coherent instructional program ($r = 0.40$ both studies), uses of evidence (0.31 and 0.34), district alignment ($r = 0.21$ and 0.35). Weak effects on achievement were reported by both studies for policy-oriented board of trustees ($r = 0.01$ and 0.11). As compared with the 2010 study, the present study reported stronger or much stronger total effects on achievement of professional leadership ($r = 0.28$ vs -0.01), learning-oriented improvement processes ($r = 0.38$ vs 0.05) and relationships ($r = 0.28$ vs 0.16), while the opposite was true for PD ($r = 0.09$ vs 0.29).

School leadership
As noted above, Table III indicates that school leadership did not significantly mediate district effects on student learning. But because considerable evidence now points to school leadership as an important explanation for variation in student achievement across schools, the same type of analysis used to examine district effects was extended to an examination of

the indirect effects of school leadership on achievement mediated by the four paths and their individual conditions (Table IV). School leadership had significant, indirect effects on student learning through the rational ($b = 0.38$) and emotions ($b = 0.40$) paths only.

These indirect effects were largely due to academic emphasis ($b = 0.32$) on the rational path and both collective teacher efficacy ($b = 0.33$) and teacher trust ($b = 0.24$) on the emotions path. Safe and orderly environment ($b = 0.36$) was a significant mediator of School leaders' effects on student achievement, in spite of lack of significance of the organizational path, as a whole.

This study also replicated and extended the result of a recent study about the mediated effects of school-level leadership on student achievement (Leithwood, Sun and Pollock, 2017) using evidence from teachers rather than administrators and in a different policy context (Texas). School-level leadership in that study was significantly mediated by the same conditions identified in the present study as well as disciplinary climate and uses of instructional time, conditions on the rational path.

Discussion and conclusion
Limitations
While this study had methodological strengths common only to a small proportion of the district effectiveness literature, four limitations deserve explicit mention here. First, the context for the study was a Canadian province with unique province-wide policies, district-government relations and forms of district accountability. Such unique features place important limitations on the generalizability of results. Second, the study used a cross-sectional design that did not allow for an analysis of the extent to which the district characteristics included in the study were associated with change in district effectiveness over time. Third, the nine district characteristics framing this study did not encompass the full set of characteristics accounting for district effectiveness identified in the literature. For example, Anderson and Young's (2018a, b) review identified "Foster district-wide sense of efficacy" and Trujillo's (2013) review identified "Acknowledgement of social, historical context," neither of which were among the characteristics examined in this study. Finally, evidence about student achievement, the dependent variable, was available to us in the form

	Direct effect	Indirect effect
Rational path	0.25	0.38*
Academic emphasis		0.32*
Disciplinary climate		0.08
Teachers' use of instructional time		−0.17
Classroom instruction		0.16
Emotions path	0.23	0.40*
Teacher commitment		−0.17
Teacher trust		0.24*
Teacher collective efficacy		0.33*
Organizational path	0.38	0.26
Organization of planning		0.07
Safe and orderly environment		0.36*
Collaborative cultures		0.03
Family path	0.39*	0.24
Parent expectation		−0.01
Form of communication		0.00
Parent social capital		0.13
Note: *CI does not include zero		

Table IV.
Direct and indirect effects of school leadership on student achievement

of proficiency cut scores even though scale scores have been recommended for reporting annual achievement performance (Ho, 2008).

Three questions guided this study: What characteristics of districts, under the control of districts themselves, explain significant amounts of variation in student learning? How do such characteristics interact with conditions found in schools, classrooms and families to achieve their effects on student learning? and What role do school-level leaders play in district efforts to improve student learning? The remainder of the paper summarizes and discusses the main results of the study about each of these questions, in turn, and identifies a small number of promising implications for practice (3), theory (1) and research (3).

Effects of district characteristics on student achievement

Results of the study largely replicated the total effects on student achievement of the 2010 study for five of the nine district characteristics and provided justification, not found in the 2010 study, for "Professional leadership and Learning-oriented improvement processes." Along with evidence from the present study about direct and indirect effects, these results support the efficacy of at least seven of nine district characteristics. None of the characteristics dominates these results, supporting claims that comprehensive and coordinated efforts by districts are likely needed to improve student achievement at scale (Spillane *et al.*, 2018).

One practical implication of this set of results recommends that central office leaders use the district characteristics as a framework for their district improvement efforts. Many districts participating in this study are now doing this, some with our direct assistance, reflecting the requirements for research use by central office staff identified by Honig *et al.* (2018). For many districts, this use of the district characteristics as an improvement planning framework would count as the sort of central office transformation, also identified by Honig *et al.* (2010), requiring considerable capacity development among central office leaders.

A second practical implication flows from evidence in this study that district-provided PD had a little or no effect on student achievement. PD consumes considerable district resources and often counts as a district's main reform strategy. District leaders should ensure that their districts' efforts reflect what is known about effective PD, for example, that it is sustained over time, anchored to practice, uses active learning strategies and is coherent with other learning activities (Sun *et al.*, 2013; Garet *et al.*, 2001).

Results also suggest a promising direction for future theory development. The nine characteristics framing this study were identified through a synthesis of largely a theoretical studies and this paper has not added any conceptual "glue" to them. Most individual characteristics are at least loosely linked to well-developed theories (Durland *et al.*, 2016), but we have not yet proposed an overall explanatory and/or predictive theory, nor have we adopted any of the small number that have been proposed (e.g. "institutional actors" theory proposed by Rorrer *et al.*, 2008). Future theoretical work exploring the links between the district characteristics and existing or new theory has the potential to enrich current understandings about effective district practice.

Conditions mediating district effects on student achievement

A key improvement in the design of the present study, as compared with our 2010 study, was the inclusion of school leadership and four other categories of specific conditions, 13 in total, mediating the effects on achievement of the nine district characteristics. Results indicated that district effects on student achievement were mediated by three of the four categories of mediators (not the family path) but especially by the same three specific mediators – teacher trust, collective teacher efficacy and safe and orderly environments. Teacher trust, in particular, fosters the development of teachers' social capital which fosters

the development of teacher networks (Coburn and Russell, 2008), a significant mechanism for improving student learning (Lee *et al.*, 2012).

Based on these results, we speculate that teachers' responses to district initiatives depend in no small measure on teachers' perceptions of central office staffs' trustworthiness (e.g. Are they competent? Will they follow through with the support they promise?), the extent to which teachers believe they have the collective capacity to implement initiatives proposed by central office staff and how disruptive will those initiatives be to the orderliness of their classrooms when implemented. Put differently, the extent to which teachers are willing to authentically further their districts' goals and vision may depend as much on the perceived trustworthiness and support of central office leaders as on the forms of control and coordination enacted by those leaders. Such trustworthiness and support may be an as-yet underappreciated condition for the "tighter coupling" some evidence has associated with effective districts (e.g. Peterson *et al.*, 1987).

Mediators included in the present study, however, are just one of several different sets that have been proposed (see, e.g. Bryk *et al.*, 2010; Hallinger and Heck, 2010; Sebastion *et al.*, 2017). Future research exploring the relative value of all or most mediators proposed so far would be useful.

School leadership
While School-level Leadership featured strongly as a contributor to student achievement, such leadership was not a significant mediator of any of the nine district characteristics. The modal leadership development efforts of districts in this study did not seem to be making much difference to achieving district goals for student achievement. District effects and school leadership effects seemed independent of one another, even though both sources of influence were mediated by approximately the same set of classroom and school conditions. These results point to a remarkable degree of consistency in what influences teachers' responses to change initiatives, whether the source of the initiative is the district or the school leader.

This study replicated and extended the result of a recent study about the mediated effects of school leadership on student achievement (Leithwood and Azah, 2016). School leadership was significantly mediated by the same conditions as mediated district effects in this study, as well as academic emphasis, disciplinary climate and uses of instructional time. Another practical implication arising from these results is that district leaders should include specific PD for school leaders about how to diagnose and improve the status of those conditions in their schools.

The generalizability of our results about the nine district characteristics is relatively high. Results of a parallel study recently completed in the Canadian province of British Columbia (Handford and Leithwood, 2019) largely mirror the results of the current study, as well as the previous Ontario study (Leithwood, Sun and Schumacker, 2017). In addition, research in Alberta has resulted in a "Framework for School System Success" (Bedard and Mombourquette, 2015; Brandon *et al.*, 2013) reflecting many of the nine characteristics, although not fully organized and labeled in the same way. As a whole, then, the case for generalizability to districts in other Canadian provinces is fairly strong. The generalizability of these results to US districts also seems promising since the nine district characteristics were initially identified through a review of research (Leithwood, 2010) most of which was carried out in US districts, as well as the results of more recent reviews (Trujillo, 2013; Anderson and Young, 2018a). School districts in both the USA and Canada share many of the same responsibilities including, for example, hiring the CEO (superintendent, directors), establishing district policy, ensuring that local community values are respected in the process of policy development, holding the CEO accountable for policy implementation and setting district budgets.

JEA

Notes

1. Using a randomized control design, Jacob *et al.* (2015) conducted an evaluation of one leadership development program, the contents of which (e.g. 21 leadership "responsibilities") overlap some of the school-level leadership practices but very few of the district practices included in this study. The evaluation reported no effects on student achievement.

2. More information about the origin, validity and reliability of the instruments used in the study can be obtained on request from the first author (kenneth.leithwood@utoronto.ca).

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About the authors
Kenneth Leithwood is emeritus Professor of Educational Leadership and Policy at Ontario Institute for
Studies in Education, University of Toronto. His research is about leadership expertise, educational
change and the assessment of educational policy effects.

Jingping Sun is Associate Professor in the Department of Educational Leadership, Policy and
Technology Studies at the College of Education, University of Alabama. Her research is about
educational leadership, policy evaluation and improvement and research synthesis. Her policy
experience through her work at the Ontario Ministry of Education in Canada before joining the faculty
at the University of Alabama was mainly about large-scale development of school and district leaders.
Jingping Sun is the corresponding author and can be contacted at: jsun22@ua.edu

Catherine McCullough is Experienced Senior Leader, Workshop Facilitator, Keynote Speaker and
Executive Coach who works with learning organizations on research based strategies that develop and
integrate the qualities of successful organizations. She is expert in the use of emotional intelligence
strategies that develop group and personal leadership resources for increased success in working
relationships. Throughout her career, she has served as Teacher, Consultant, Elementary and
Secondary Principal, a Supervisory Officer and a Director of Education for three different school
systems. In addition to facilitating a range of leadership engagements for organizations, Catherine
through her company CMC leadership currently coordinates with Dr Kenneth Leithwood a project for
system Leaders, leveraging the research entitled "Strong Districts and their Leadership" (www.
strongdistrictleaders.com). For further details, please go to Catherine's website www.cmcleadership.ca