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Successful School Leadership for Improved Student Outcomes: Capacity Building and Synergy

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Abstract

The research reported in this article builds on work commenced eight years ago with reviewing the literature and models of successful school leadership for improved student outcomes. When the findings of this review were combined with the results from case studies of successful schools it resulted in a preliminary model of successful school principalship. We examined a range of areas using further analysis of the case study data, detailed analysis of the subsequent quantitative surveys (developed in part from the preliminary model) and actual school literacy and numeracy results. We also included a measure of teacher perceptions of student social development. This inclusion is consistent with evidence that social skills have become many times more important in determining students' relative life chances in the 21st Century than cognitive outcomes alone. The final part of our research used model building and powerful multi-level statistical analyses of the survey data. In this way, we examined all the factors that may influence a school's success with student outcomes. Model building allowed us to construct inherently logical and theoretically defensible representations of the "world" in which successful schools exist, and the models can be statistically tested to see how well these representations explain the reality portrayed by the data collected.

Keywords: School leadership, student outcomes, successful schools

Liderazgo Escolar de Éxito para Mejores Resultados del Alumnado: Desarrollo de Capacidades y Sinergias

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Resumen

Esta investigación se basa en un trabajo iniciado hace ocho años revisando la literatura y modelos de liderazgo escolar que han mejorado los resultados del alumnado. Al combinar los resultados del análisis con los de los estudios de caso en escuelas con éxito se pudo plantear un modelo preliminar de liderazgo escolar exitoso. Se examinan diversas áreas mediante un exhaustivo análisis de: datos del estudio de caso, ulteriores estudios cuantitativos (desarrollados en buena parte a partir del modelo preliminar) y resultados actuales de competencias matemáticas y de lecto-escritura. Se incluye la medición de las percepciones del profesorado sobre el desarrollo social del alumnado. Esto refuerza la evidencia de que las habilidades sociales son a menudo más importantes que los resultados cognitivos, para determinar las oportunidades de los alumnos en el siglo XXI. La última parte del estudio utiliza la construcción de modelos y potentes análisis estadísticos multi-nivel de los datos del estudio. De esta forma, se examinan todos los factores que pueden llevar al éxito de una escuela en resultados del alumnado. La construcción del modelo permite elaborar representaciones lógicas y teóricamente defendibles del "mundo" donde se produce éxito escolar; los modelos pueden ser comprobados estadísticamente para ver hasta qué punto estas representaciones explican la realidad representada por los datos obtenidos.

Palabras Clave: liderazgo escolar, resultados alumnado, escuelas de éxito.

The research reported in this article builds on work commenced eight years ago with reviewing the literature and models of successful school leadership for improved student outcomes. When the findings of this review were combined with the results from five Australian¹ case studies of successful schools it resulted in a preliminary model of successful school principalship (Mulford & Johns, 2004). This model (see Figure 1) hypothesised that successful school principalship was an interactive, reciprocal and evolving process involving many players, which is influenced by and, in turn, influences, the context in which it occurs. This context included community and system/employer understandings, requirements and levels of support.

Further, the findings suggested that successful principalship was underpinned by the core values and beliefs of the principal. These values and beliefs informed the principal's decisions and actions regarding the provision of individual support and capacity building, at both the individual and school level, including school culture and structure. The principal's core values and beliefs, together with the values and capacities of other members of the school community, fed directly into the development of a shared school vision, which shaped the teaching and learning, student and social capital outcomes of schooling. To complete the proposed model, we posited a process of evidence based monitoring and critical reflection which could lead to change and transformation.

We argued for more clarity regarding these descriptions and relationships as well as further testing of the model. Taking our own advice, we examined a range of areas using further analysis of the qualitative case study data, detailed analysis of the subsequent quantitative surveys (developed in part from the preliminary model) of principals and teachers and actual school literacy and numeracy results. These areas, reported in a number of published works and summarised in Mulford & Edmunds (2009), included² :

- the 'what' and 'who' of successful school principalship (Mulford et al, 2007);
- leadership tensions and dilemmas (Edmunds et al, 2008);
- instructional leadership (Gurr et al, 2007);

- evaluation and accountability (Mulford et al, 2008a);
- decision making (Mulford et al, 2008c);
- schools in high poverty communities (Mulford et al, 2008b);
- small schools (Ewington et al, 2008); and,
- principals in late career (Mulford et al, 2009).

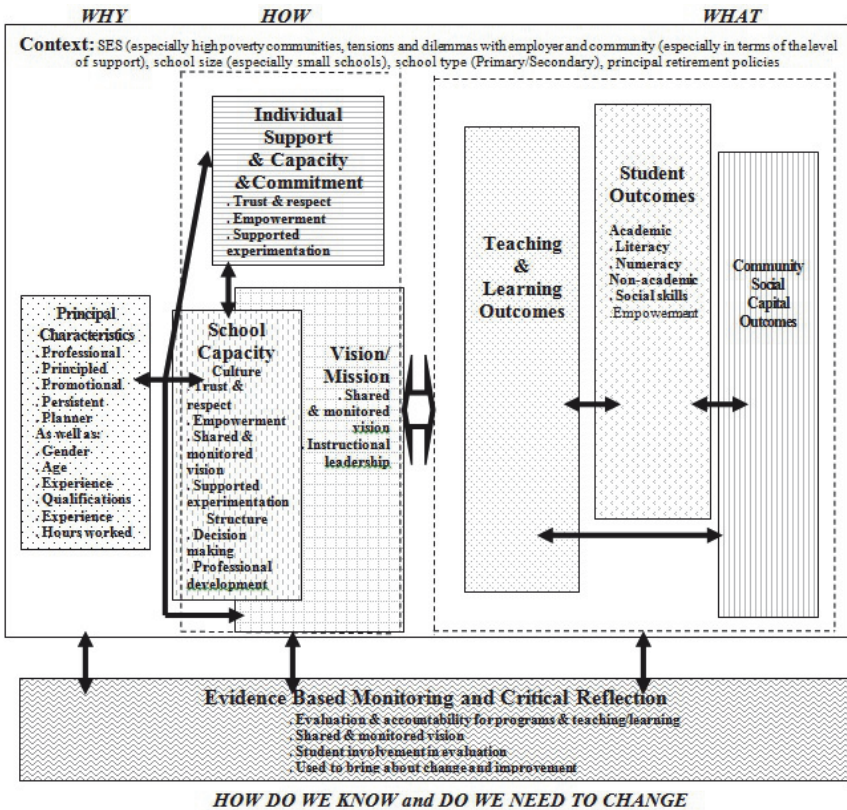


Figure 1. The preliminary model of successful school principalship listing the variables examined in subsequent research.

Adaptivity as a transformative disposition of schools for learning in the 21st century

The research in the areas listed above employed case study and survey data to answer specific questions about successful principalship and schools. Surveys were distributed to the population of government schools in the Australian state of Tasmania (excluding Special Schools and Year 11 and 12 Colleges). The useable response rate from principals in schools that had not had changes to their principal during the survey period was 79 per cent (N = 131). Surveys were randomly assigned to 20 per cent of teachers in each school. The useable response rate from teachers was 12 per cent (N = 494). It was found that there was a similar distribution on a range of available demographic variables between this teacher sample and the teacher population, except for an over representation in the sample of Primary school teachers³.

For the dependent variables in our research, actual Tasmanian student test results were made available by the Tasmanian Department of Education. School median scores were calculated for each year level (3 and 5 for primary and 7 and 9 for secondary) for each of literacy and numeracy. Finally, an average of these medians was determined.

We also included a measure of teacher and principal perceptions of student social development. This inclusion is consistent with evidence that social skills have become many times more important in determining students' relative life chances in the 21st Century than cognitive outcomes alone. In fact, it has been demonstrated in powerful longitudinal studies that continuing to ignore social development will actually result in declining life chances for children. This decline has been found to be particularly acute for those from lower socio-economic communities (Carneiro et al, 2006; Cunha et al, 2005; Feinstein, 2000; Hogan & Donovan, 2005; Margo et al, 2006; OECD, 2010; Schweinhart & Weikart, 1993; UNICEF, 2007).

Factor analysis of our measure of student social success (Social Success Index - SSI) found that items such as the following grouped as one factor accounting for 50 per cent of variance:

- are able to solve conflicts through negotiation

- are able and want to have an influence
- can work by themselves and as a group
- are able to listen to others
- do not accept discrimination
- have adapted to democratic values
- use many different ways of expressing themselves
- are responsible and democratic
- are effective communicators
- understand that bullying is totally unacceptable

The results from this stage of our research demonstrated that some variables had stronger relationships with student outcomes than others. One variable strongly related to student outcomes was school capacity building. As will be seen in the next section, our definition of school capacity building included a measure of adaptivity as a transformative disposition, or what we called “supported experimentation”.

Our positive findings on the relationship between school capacity building, including school adaptivity as a transformative disposition (as measured by the factor titled supported experimentation), and student learning outcomes for the 21st Century (in particular, social development) have led us to further examine of our data base. It is this further analysis that forms the basis of the remainder of this article. In what follows we explore:

- the definition of school capacity building and, in particular, supported experimentation;
- how socio-economic status was taken into account in analysing student outcomes;
- the developmental nature of school capacity building;
- relationship between school supported experimentation and social development in the context of a range of other possible variables.

The definition of school capacity building

School capacity building was found to contain the following four factors

accounting for 61 per cent of the variance:

- Trust and respect
- Empowerment
- Shared and monitored mission
- Supported experimentation

Supported experimentation contained eight items as follows⁴ :

- School structures support teacher initiative, experimentation and change for the benefit of pupils;
- School values support teacher initiative, experimentation and change for the benefit of pupils;
- High expectations are expressed to staff in relation to teaching, learning and behaviour;
- Staff values and knowledge in relation to teaching, learning and behaviour are challenged;
- There is critical reflection on and analysis of school practice, ideas, problems and policies;
- There is ongoing professional dialogue among teachers;
- The professional development programme is relevant to the needs of all staff; and,
- There is an ongoing professional development program for all staff.

Taking socio-economic status into account in analysing student outcomes

As expected, a strong relationship was found between the socio-economic status of the school and the various student success measures. The Pearson Correlation Coefficient between the Literacy/Numeracy test scores and our measure of socio-economic status the Economic Needs Index (ENI)⁵ was -0.56 and between SSI and ENI -0.37, both statistically significant at the 0.01 level (two-tailed).

In order to avoid over-interpreting small differences in scores, and given the negative correlation of student outcome scores with ENI, 'adjusted' scores were calculated. These adjusted scores were based on

the number of points a school lay above or below a regression 'band'. Schools were given an adjusted score of 3 if they were in the top 17 per cent, a score of 2 in the middle 66 per cent or a score of 1 if in the bottom 17 per cent. This is illustrated in the following charts. Figure 2 shows each Primary school by ENI and mean medium literacy/numeracy scores and Figure 3 shows each school by ENI and mean SSI scores. The solid arrows indicate schools with scores of 3 (High), between the black lines schools with scores of 2 (Medium) and hatched arrows schools with scores of 1 (Low).

It is worth noting that in comparing the SSI (Figure 3) with Literacy/Numeracy (Figure 2) the range of responses was more widespread and the slope of the regression 'band' less steep. This may be indicative of the complexities involved but may also provide an insight to an area (social development) in which, with appropriate attention, schools could make a great deal of difference in student outcomes irrespective of socio-economic status.

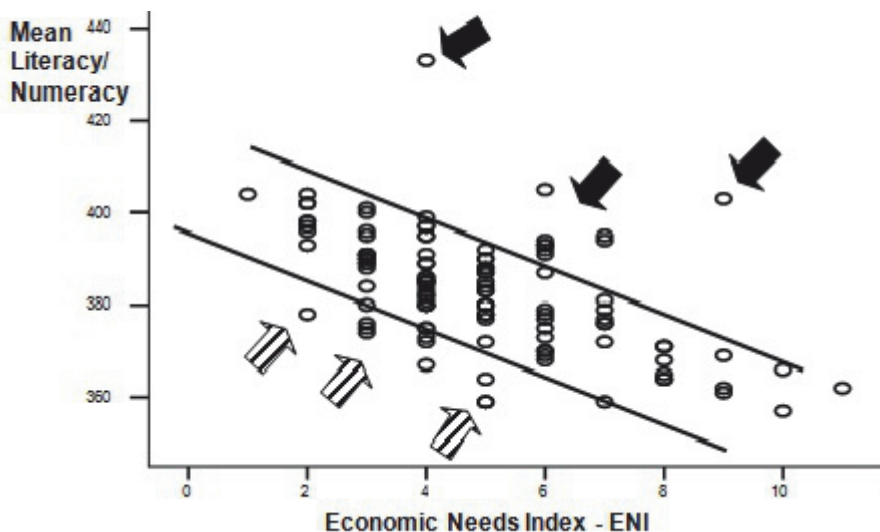


Figure 2. Primary literacy/numeracy and ENI (each circle represents a school)

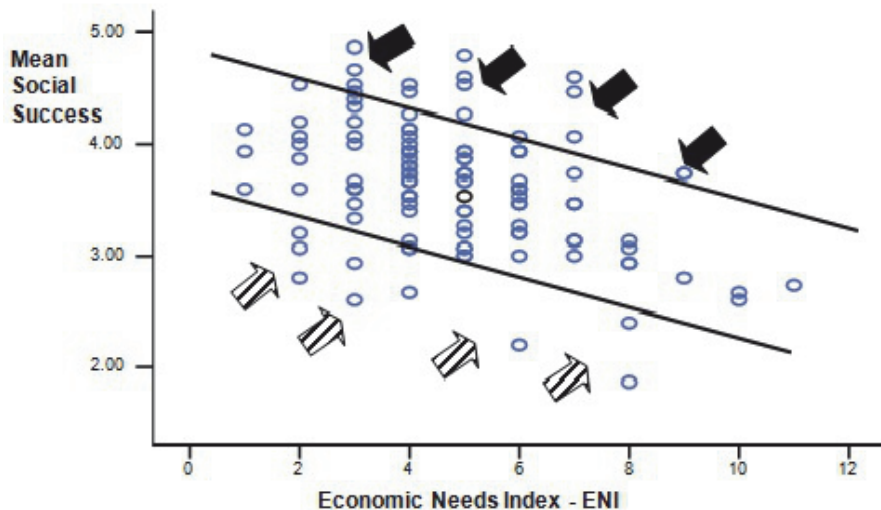


Figure 3. Primary social success and ENI (each circle represents a school)

The developmental nature of school capacity building

The following charts map the relationships between both the ENI adjusted social success (SSI) for Primary schools (Figure 4) and ENI adjusted literacy/numeracy for Secondary schools (Figure 5) and the school capacity building factors. Statistically significant differences were found between the high and low adjusted SSI on all four of the school capacity factors. Except for the trust and respect factor, school capacity building was also found to discriminate on the ENI adjusted literacy/numeracy success measure in Secondary schools.

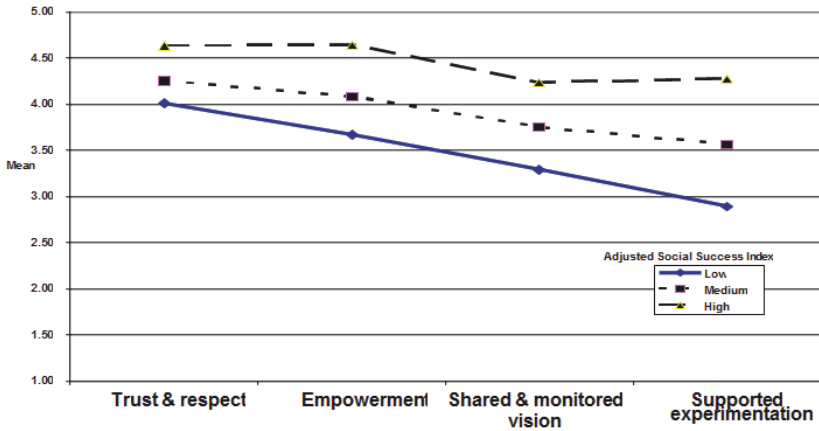


Figure 4. Primary and secondary school capacities and student social success



Figure 5. Secondary school capacity and literacy/numeracy success

There is evidence in Figures 4 and 5 that the four school capacity building factors are additive, or developmental, in nature, starting with trust and respect, moving through empowerment and shared and monitored mission, and ending with supported experimentation. Trust and respect scores are similar and high (between 4.0 and 4.5 on a five-point scale with 5.0 representing the highest/most positive score) across all three school success classifications (low, medium, high) whereas in the other school capacity building factors the gaps among the three success classifications gets wider, especially between the low and high schools and on the supported experimentation factor. The scores for the most successful schools, taking account of socio-economic status, remain high (between 4.6 and 3.9) across the remaining school capacity building factors, whereas the least successful schools, taking account of socio-economic status, drop from 4.00+ on trust and respect to around the mid-point (3.0) on the scale.

Relationship between school supported experimentation and student social development in the context of a range of other variables

Learning from result such as those presented above, we move to the final part of our research using model building and powerful multi-level statistical analyses of the principal and teacher survey data⁶. In this way, we examined all the factors that may influence a school's success with student outcomes. Model building allowed us to construct inherently logical and theoretically defensible representations of the "world" in which successful schools exist, and the models can be statistically tested to see how well these representations explain the reality portrayed by the data collected.

Preliminary analyses were carried out using SPSS Factor Analysis to reduce the raw data to meaningful variables explaining the highest variance possible at both the school and teacher levels. SPSS Reliability tests were performed to obtain the best solutions. SPSS SAV files were formed using Principle Component and regression weights to form new variables.

These data reduction techniques were employed to prepare variables for use in developing models employing the student outcome variables, as perceived by the teachers.⁷ Two-level hierarchical linear models were specified on the basis of these preliminary results to take account of the hierarchical structure of the data in which teachers were nested within their schools.

Analysis was undertaken using the Hierarchical Linear Modeling (HLM 6.01) software developed by Raudenbush et al (2005). HLM procedures allowed the simultaneous analysis of the teacher-level and school-level data.⁸ This avoided the various limitations of single level analytical techniques, used so far in our research, which required either the aggregation of data or disaggregation of data.

All the independent variables in this final part of our research are listed in Table 1 with an asterisk indicating the variables found to be significant.

Table 1 <i>List of predictor variables derived from principal and teacher surveys for exploratory investigations using hierarchical linear modeling.</i>	
TEACHER-LEVEL (Level-1)	SCHOOL/PRINCIPAL-LEVEL (Level-2)
Teacher characteristics: Age, Gender, Qualifications, Teaching Years, Years in School Leadership characteristics: Facilitator, Trustworthy, Courageous, Promoter, Professional *Capacity Building evident in school by teachers *Accountability and evaluation Values and beliefs of principal *Values and beliefs of teachers *Students' social development	School characteristics: * School Size, *School Type, *Economic Needs Index (ENI) Principal characteristics: Age, Gender, Qualifications, Years as Principal, *Years in School, *Hours Worked Leadership characteristics: Planner, Persistent, Professional, Principled, Promotional Capacity Building evident in school by principals Accountability and evaluation Values and beliefs of principal Degree of autonomy in school decision-making Leadership tensions and dilemmas Students' social development Implementing learning and development *Extent of Supportive educational home environment *Socio-economic disadvantage of students rated by principal Student attendance rated by principal Student academic results rated by principal *School reputation rated by principal

*Indicates the variables found to be significant

The dependent variables for model building, constructed from the teacher data, differ slightly from our previous research in that they add a third variable, student empowerment. Student empowerment involved meaningful student participation in decisions about school directions, self-direction, and in the evaluation of teaching and learning.

There were also changes in some of our predictor variables. School capacity building was redefined with three (not four) sequential dimensions with slightly different emphases (underlined): trust and empowerment, shared and monitored mission and practice and supported, collaborative experimentation.

The predictor variables (see Table 1) used to investigate factors operating at the teacher and school/principal levels in the models were the same. The predictor variables were initially employed in an exploratory investigation searching for significant relationships with the slope of each outcome variable modeled in turn.

Analyses were carried out by first running the fully unconditional model, known as the 'null model' which was equivalent to a one-way analysis of variance with random effects. A second step identified the Level-1 (Teacher) variables that contributed to explaining differences in the outcome measure for the models. A 'step-up' strategy was employed by entering teacher-level variables, one at a time, to examine whether or not they had a significant impact on the outcome variable. Variables with a significant effect (at $p \leq 0.05$ or $p \leq 0.10$) remained in the model and those found not to influence the outcome measure significantly were removed. In this way, the possible contribution of each teacher-level variable was examined and only those found to have a significant effect on the outcome were retained.

The third step used the step-up strategy to test each Level-2 (principal/school) variable for the significance of its direct impact on the outcome variable. In addition, interaction effects of Level-2 variables on the effects of Level-1 variables on each of the outcome measures were examined. This procedure tested whether the effect of teacher-level variables on, for example, Student Social Development, differed depending on certain school characteristics or principal's behaviours. These cross-level interaction effects were estimated in the HLM analysis by using a school-level variable as a predictor of the slopes and

intercepts of the effects of the teacher-level variables on the outcome variable.

At the end of this process, all teacher and principal/school level variables with significant effects on the outcome variables were identified (see Table 1). Moreover, any school-level variables that influenced the effect of teacher-level variables on the outcome were also identified by way of the moderating or cross-level interaction effects. This resulted in the final models in which the significant effect of any variable on the outcome variable was controlled for the effects of all other variables employed.⁹

The revised, combined conceptualisation in Figure 6¹⁰ illustrates in a network of effects how the significant variables from the models in the analyses influenced the student outcomes being studied. The four teacher-level direct predictors are:

- Capacity Building;
- Accountability and Evaluation;
- Teachers' Values and Beliefs; and,
- Students' Social Development.

Capacity Building and Accountability and Evaluation¹¹ are predictors of all three outcomes studied. Teachers' Values and Beliefs¹² are significant in predicting Empowerment and Student Social Development. Students' Social Development is the strongest predictor of Student Academic Achievement.

Three school and principal-level cross-level interaction effects were identified:

- Hours Worked by the Principal moderating Capacity Building's influence on Empowerment only, by strengthening its effect above a critical level of school functioning in Capacity Building;
- School Type and School Size both moderating Accountability and Evaluation's influence on Student Academic Achievement only, by strengthening its effect above a critical level of school functioning in these systems in primary and larger schools, and below this critical level, in secondary and smaller schools.

Six school/principal-level direct effects of the three outcomes were found:

- Years in School influencing Empowerment; Supportive Home Educational Environment influencing;
- Empowerment and Student Social Development;
- Two measures of socio-economic status;
- Social Disadvantage, determined by principals' perceptions of students' social disadvantage influencing Student Social Development;
- ENI, the Department of Education determined school Economic Needs Index, influencing Student Academic Achievement; and,
- Reputation influencing Student Academic Achievement.¹³

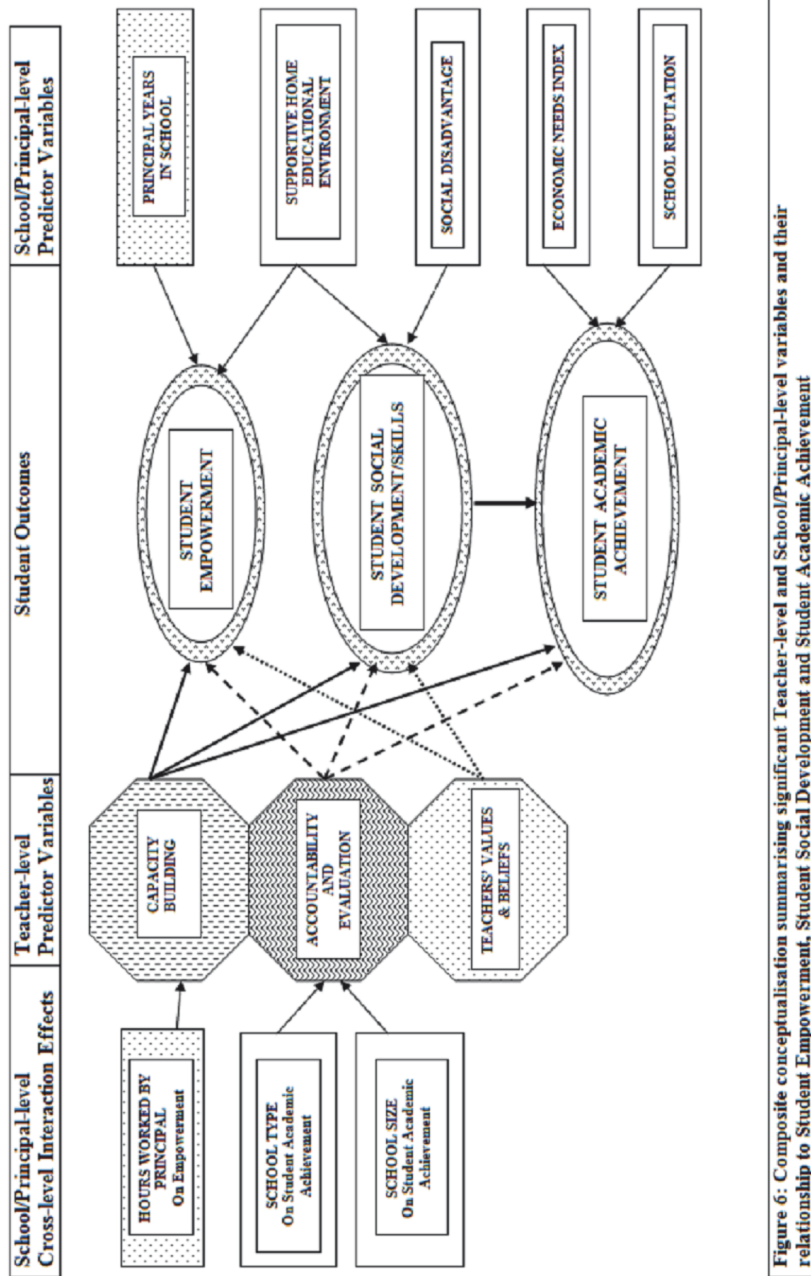


Figure 6: Composite conceptualisation summarising significant Teacher-level and School/Principal-level variables and their relationship to Student Empowerment, Student Social Development and Student Academic Achievement

Conclusion

Our journey exploring successful school leadership for improved student outcomes has been a long one. It started with a review of the literature which when combined with case studies of successful schools resulted in a preliminary model of successful school principalship. A survey developed in part from this preliminary model was administered to a population of schools. Among a range of significant findings from an analysis of survey responses was a strong relationship between school capacity building and student outcomes.

In addition to the factors trust and respect, empowerment and shared and monitored mission, school capacity building was found to include a factor that reflected adaptivity as a transformative disposition of schools, or what we called supported experimentation.

In addition to literacy and numeracy results, student outcomes included a factor that we argued more closely related to student learning in the 21st century, student social development.

As expected, a strong relationship was found between school socio-economic status and the various student success measures. We demonstrated how socio-economic status was taken into account in our analysis. We also noted that in comparing student social development and literacy/numeracy results it was in social development where schools could make the greatest difference in student outcomes irrespective of socio-economic status.

We found that the four school capacity building factors were additive, or developmental, starting with trust and respect, moving through empowerment and shared and monitored mission, and ending with supported experimentation. These results are important to this article's focus about the relationship between adaptivity as a transformative disposition of schools for learning in the 21st century. In brief, it cannot be assumed that adaptivity (supported experimentation) is the first focus for success. Supportive experimentation depends first on a school achieving trust and respect, then empowerment and then shared and monitored mission.

The final part of our journey involved model building and powerful multi-level statistical re-analysis of the principal and teacher survey

data. These analyses sought to examine all the variables and relationships among variables that may influence a school's success with student outcomes, including the relationship between supported experimentation and student social development.

The re-analysis resulted in a redefinition of student outcomes to include a third factor, which we titled empowerment. Empowered students were perceived by teachers to be involved in meaningful participation in decisions about school directions, self-direction and in the evaluation of teaching and learning. We believe it could be argued that empowerment is another important student learning in the 21st century.

Our re-analysis also identified two (not one) themes in students' social development. These themes were student self-efficacy and social efficacy.

The results also included a redefinition of school capacity building to include three (not four) sequential factors, namely trust and empowerment, shared and monitored mission and practice and supported, collaborative experimentation. Each dimension provides information that helps to identify specific approaches and strategies that help promote school capacity building. The dimensions are very similar to our earlier research in Tasmanian and South Australian secondary schools on organisational learning (Mulford & Silins, 2010; Silins & Mulford, 2004; Silins et al, 2002).

It is worth noting the variables that were not found to have a significant effect on the student outcomes (all non-asterisked variables in Table 1) including:

- the values, beliefs and characteristics of the principals;
- a number of demographic characteristics of the principals and the teachers, such as age, gender and qualifications;
- decision making autonomy of the principals; and,
- leadership tensions and dilemmas.

Although principals' values and beliefs were tested, they failed to achieve significance as direct predictors of student outcomes. However, these results do not lead us to assume that principals' values and beliefs

are insignificant. On the contrary, this study supports our earlier findings (for example, [Silins et al, 2002](#)) that effective principals influence student outcomes indirectly through teachers' work with students in their classrooms and school. These are clearly all areas in need of further research. Hopefully this research would reflect the complexity of the real world of schools and illustrated by the research detailed in this article and take a wide range of dependent and predictor variables into account.

The results of the final phase of our research identified the significant school and teacher-level factors that fostered student academic achievement, student social development and student empowerment. The strongest predictor of student academic achievement was in fact students' social development (and not vice versa). Next teachers' perceptions of the level of their school's capacity building and accountability and evaluation systems in their school were found to be significant factors in promoting all three student outcomes.

Principal's who, in collaboration with their staff, promote both capacity building (including supported, collaborative experimentation) and systems of accountability and evaluation to the extent that their teachers perceive these two factors as characterising their schools, are also advancing student empowerment, student social development and student academic achievement. In addition, in schools where capacity building and systems of accountability and evaluation are evident, student empowerment and social development were found to be further promoted and influenced by teacher values and beliefs of respect and high expectations for all and that all can succeed and be involved.

Schools that are successful in promoting student empowerment and social development are advancing students' social skills because of the close relationship between these factors. Schools that advance social skills as well as establish systems that promote capacity building and accountability and evaluation, have been shown in our study to be the most likely to also succeed in fostering student academic achievement. However, as we have argued earlier in this article and elsewhere ([Mulford, 2008](#)), these student empowerment and social skills outcomes of schooling are vital in and of themselves for students' future life success in learning in the 21st century, whether or not they

are related to student academic outcomes. Nevertheless, the reality is that schools continue to be pressed to prove themselves through their students' academic success. The crucial findings of this study are best expressed in the following paradox, that is, that the most direct route for a school to achieve academic success for their students, is the indirect route through the fostering of student empowerment and social development.

The size of the interaction effects in our models (see [Mulford and Silins, 2009 & 2011](#)) although significant and larger than reported by many other researchers does not result in one effect dominating. This situation is consistent with the results of international research in the area (for example: [Day et al, 2009](#); [Heck & Hallinger, 2009](#); [Sammons et al, 2009](#)) and reviews of the area (for example: [Anderson et al, 2007](#); [Leithwood, et al, 2004 & 2006](#); [Leithwood & Levin, 2010](#); [Mulford, 2007 & 2008](#); [OECD, 2008](#); [Robinson et al, 2007](#)). Along with others, we do not see this situation as cause for concern.

For those seeking successful and constantly improving schools, including promoting adaptivity as a transformative disposition for student learning in the 21st century, the challenge is to create synergistic effects ([Creemers & Kyriakides, 2006](#)); the accumulation of a number of effects developed with others over time in the same direction, even though this direction may change as a result of feedback on performance. But success also depends on which areas of school life the school chooses to focus time and attention. As we have clearly demonstrated in our research, success will be most likely if the school chooses areas they can actually influence – areas such as school capacity building, evaluation and accountability, teacher values and beliefs, and student social development and empowerment. Success will also be more likely if the interactive effects of these areas over time are understood and acted upon.

Notes

1. From the Australian state of Tasmania.
2. Figure 1 transposes the variables we examined into our preliminary model of successful school principalship. There is a good coverage of the areas and their interrelationships, except for outcomes of teaching and learning and community social capital.

3. For full details of the survey demographics and methodology see Mulford and Edmunds (2009) and/or the earlier listed references.

4. As this article is concerned with adaptivity as a transformative disposition of schools, details are only provided for the matching factor of supported experimentation. For details of the other factors see Mulford and Silins (2009 & 2011).

5. Tasmanian schools are classified according to an economic needs index (ENI) ranging from 1 (low needs) to in excess of 12 (high needs). The Index for each school is derived using socioeconomic data from the Australian Census, size of centre (town, locality), distance from the Department of Education district administration office and the number of students receiving government financial student assistance.

6. This multi-level statistical analysis and model building was carried out by Associate Professor Halia Silins from Flinders University. The full details can be found in Mulford & Silins (2009 & 2011)

7. Our previous research (Mulford et al., 2007) had also shown teacher perceptions of success to be more predictive than principal perceptions.

8. Given the need to employ data from schools where we had both the principal and sufficient number of teachers to make our analysis meaningful, missing data reduced the number of suitable cases (see Mulford and Silins (2011) for details)

9. The possibility of alternative models must be recognised. This research focused on Student Academic Achievement as a key outcome. Under other circumstances, it may be desirable to look at effects of Academic Achievement on other variables. Procedures such as Mplus can be employed to explore reciprocal effects with longitudinal, nested data (Heck & Hallinger, 2009).

10. For comparative purposes, the patterns employed in the revised conceptualisation (Figure 6) parallel those from the Preliminary Model (Figure 1):

- white for context;
- dotted for principal characteristics (with Teacher Values and Beliefs being added as a new variable);
- vertical dash for school capacities (including vision and mission);
- zig zag for evaluation; and,
- divot for student outcomes.

11. Teacher perceived accountability and evaluation involved one factor of six survey questions involving:

- Evaluation as a critical/reflective process, informed by evidence and used for improvement and change within a school culture that supports it; and,
 - Formal systematic planning, monitoring and evaluation of teaching and learning processes are undertaken to meet external requirements.
12. The values and beliefs of teachers were identified by two factors:
- Respect and high expectations for all; and,
 - All can succeed and be involved.
13. For full details of these effects see Mulford and Silins (2009 & 2011).

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