Investigating principal leadership of pedagogic renewal using Rasch and LISREL analyses

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Abstract

School principal leadership of pedagogic renewal was conceptualised to include five behaviours: engaging teachers; expressing expectations of teacher instruction; sharing curriculum decision-making; developing a sense of common purpose; and effecting school renewal. Rating scale data on teacher observations of principal behaviours was analysed using Rasch and structural equation modeling techniques. Rasch analyses of data showed the items were eliciting data on a dominant trait. *LISREL* was applied to test the factorial structure of a five-element model and also the postulated relationships between variables within the model. The prevalence of pertinent leadership behaviours was revealed and the associations between these behaviours were examined. The empirical results of the investigation are discussed in terms of school leadership, pedagogical practise and school renewal.
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Introduction

The purpose of this research was to examine how school principals lead the renewal of learning and teaching in their schools. The empirical data analysed in the investigation was collected as part of an instrument development phase within a large Australian Research Council (ARC) Linkage Project into improving school leadership and educational change. The project was designed in 2001 and commenced in 2002. The conceptualisation of leadership and change applied to instrument development was relatively broad - grounded in previous research and literature, and shaped by the project goals. As a result, data were collected on multiple dimensions of pedagogic leadership and educational change. (Cavanagh, Reynolds, MacNeill & Romanoski, 2004). The instrument development objective in the ARC project was achieved by a methodology based on scale construction and scale validation techniques. This research was essentially developmental and analytic methods were applied for scale construction purposes rather than as investigative tools to fully explore conceptual issues.

Some aspects of the conceptualisation underpinning the ARC research have been the subject of recent studies that have applied a more sharply focussed understanding of educational change and school leadership. Specifically, the notions of school renewal and leadership of school renewal have been shown useful for studying educational change and school leadership (Silcox, 2004: Silcox & Cavanagh, 2004; Silcox, Cavanagh & MacNeill, 2003). The researchers assumed that the previously developed scale had elicited data pertinent to leadership of pedagogic renewal - items eliciting data on pedagogic renewal could be identified by some relatively minor re-specification of the previous theoretical frame. Implicit in this approach was recognition that the re-specified frame required validation by analysis of data from the relevant items.

In summary, this study was essentially a post-hoc investigation using data from a previous study with the objectives being expository rather than developmental and the theoretical frame being more specific than in the original research.

Background

School renewal and principal leadership of school renewal

The notion of school renewal is proffered as an alternative approach to traditional conceptions of educational change such as school development, organisational restructuring, educational reform and school improvement (Silcox, Cavanagh & Dellar, 2003). The ontological basis of renewal is Gardner’s (1963) view of self-renewal - assumptions about the maturation of individuals and society. In schools, renewal is characterised by teacher responsibility concerning a moral obligation to "create and nurture learning environments for their students as well as themselves Sirotnik (1999, p.608).

The epistemology of school renewal has developed from the application of a dichotomy-based technique to contrast aspects of educational reform and educational renewal (Reynolds, Cavanagh & Dellar, 2003). The dimensions of the dichotomy and the polarity within the dimensions can be summarised as follows: reform assumes compliance with prevailing values - renewal assumes questioning and redefining values about social structure, democracy and freedom; reform initiatives are often based on political fashions and band-wagoning - renewal initiatives are grounded on enduring values about the future of schools and society; reform involves organisational accountability - renewal involves teacher responsibility; reform is top-down - renewal is bottom-up;
locus of reform control sits with senior educational system bureaucrats - locus of renewal control resides with schools and teachers; the change process in reform is episodic - change in renewal being continuous (Silcox, 2004; Silcox, Cavanagh & Dellar, 2003).

Smith (1999) identified the critical skills and components of leading school renewal. These were: establishing a shared mission; change agency; collaboration; inclusivity; and connecting theory with practice. The problem with this description is the generality of the terms since they could be applied to describe school leadership approaches other than renewal. Consequently, Silcox (reported in Silcox, Cavanagh & MacNeill, 2003) studied the leadership dispositions of 49 principals in a Western Australian school district in an attempt to identify specific behavioural orientations unique to renewal. He was able to differentiate between four distinct leadership orientations of which one was considered to concern proclivity for engaging the school in renewal. The dominant trait in the school renewal orientation was found to be a strong sense of purpose about changing the role of education in society, the learning and welfare of children, and the need to create a non-toxic (Deal & Peterson, 1999) school culture. Not surprisingly, this trait was manifest in a variety of leadership attributes commonly cited in contemporary school leadership literature. For example: change agency; coaching; discovery of issues; people focus; team approach; and visioning. However, the study also revealed four unique attributes that appeared to be a consequence of the leader’s personality - proactivity; risk-taking; dominance and lack of conformity. Silcox (2004) concluded that the driving force of school renewal leadership was the strength, determination and conviction of the principal to effect renewal irrespective of professional hardship or resistance from the staff.

The fundamental assumption in educational renewal leadership is belief in the capacity of schools to improve the lives of children and of the social institution of education to transform society - a philosophical stance. Leaders of school renewal, as distinct from leaders of educational change, are anticipated to communicate and share this philosophy with others and apply it in all aspects of the professional life of the school (Glickman, 1993).

Principal pedagogic leadership

The literature on pedagogy encompasses four, inter-related conceptions (MacNeill, Cavanagh, Dellar & Silcox, 2003): an inclusive view of all aspects teaching, not simply instruction (Mortimore, 1999; Newmann & Associates, 1996); student centred learning and teaching, which specifically excludes didactic teaching (Hamilton & McWilliam, 2001), student-teacher relationships (van Manen, 1999); and pedagogy being seen as a political tool for the enculturation students (Freire, 1977; Smyth, 1985; van Manen, 1999). Cavanagh, Reynolds, MacNeill and Romanoski (2004) viewed these conceptions as the core constructs in the leadership of pedagogy. They asserted that pedagogical leadership was a more comprehensive notion than instructional leadership and that the utility of pedagogic leadership as a type of leadership, derived from the socio-political dimension of pedagogy. That is, pedagogic leadership is exercised within a socio-political environment necessitating the principal attending to matters peripheral to teacher practise and student learning. These matters concern educational vision, school educative mission and building community within the school. Consequently, they postulated that principal pedagogic leadership was characterised by five leadership behaviours: developing a shared sense of educational purpose; improving teacher pedagogic practise; developing school culture; engaging staff; and committing to mission realisation.

The previous study

The five postulated behaviours were empirically investigated in the development of the Rasch model scale of teacher observations of principal pedagogic leadership (Cavanagh, Reynolds, MacNeill & Romanoski, 2004). Rasch model analysis of data from 208 teachers about their observations of the principal’s behaviours identified 82 items measuring principal pedagogic leadership. These were organised into five dimensions consistent with the five-way
conceptualisation. While the data from the scale complied with stringent measurement criteria including testing that it fitted the original conceptualisation of principal pedagogic leadership, the five dimensional structure was not empirically tested. The scale measured the trait investigated but the conceptual structure hypothesised to constitute the trait was not statistically validated.

So there was a need to conduct further research into the characteristics of pedagogic leadership and as was noted in the introductory section of this report, merit was seen in sharpening the focus of the new research. That is, concentrating on leading renewal of the pedagogy in comparison to the more general notion of leading the school pedagogy.

**Objectives**

The objectives of the research were to:

1. Develop a theoretical model comprising elements of principal leadership behaviours associated with pedagogic renewal;
2. Statistically validate the model;
3. Identify elements of principal leadership of pedagogic renewal that were common and uncommon in local schools; and
4. Examine the relationships/inter-dependency between these elements.

**Research methods and results**

The research proceeded through five sequential stages: development of a theoretical model; classification of data; testing fit of data to the theoretical model; specifying and testing a measurement model; then, specifying and testing a structural model.

**Theoretical model**

The leadership of pedagogic renewal was considered to comprise multiple dimensions and the intersection or convergence between these dimensions was assumed to identify the elements that might constitute a theoretical model - a process of hypothetico-deductive reasoning. The dimensions were defined by dissecting the notion of leadership of pedagogic renewal into the separate constructs of leadership, pedagogy and school renewal and then teasing-out the meaning of these constructs. For example, leadership is the principal influencing others to behave in certain ways and it can be considered in terms of: the object of the influence (teachers and students); the subject of the influence (pedagogy); and the reasons for exerting influence (improving pedagogy). Pedagogy concerns: assumptions about why student learning is important; the anticipated outcomes of learning; how teachers facilitate student learning; and how students learn. School renewal is about educational change: providing a rationale for change; targeting what needs to change; identifying who is responsible for change; and selecting change management strategies.

The points of intersection or commonality between three constructs centre on working with teachers, learning and teaching processes, a rationale for engaging in certain activities, and the actions constituting these activities. Consequently, the leadership of pedagogic renewal was viewed as four elements of principal behaviours: engaging teachers; expressing expectations of teacher instruction; developing a sense of common purpose; and effecting school renewal.

**Data classification**

Data from the 82 items in the Rasch model scale of teacher observations of principal pedagogic leadership were examined by conducting exploratory factor analysis (EFA) (SPSS, 2002) to
identify items that could be eliciting data on a similar construct. The principal components method with oblique rotations was applied to identify items that loaded strongly on one component. Note was made of items with loadings greater than 0.33 provided the loading was higher than the loading on other components by at least 10% of the respective squared values. The factorial structure of the data was then examined in conjunction with item semantics to classify these items into groups. Data from the items within each of the groups were examined by calculating the group variance and item inter-correlation. Note was taken of items contributing to low group variance and high group item inter-correlation.

At the conclusion of this empirical process, 27 items and five groups of items were identified. These elicited data on:

- Gaining teacher cooperation by attending to their personal and professional needs;
- Expectations of instruction;
- Curriculum decision-making;
- Values, visioning and the school mission, and
- Questioning the status quo and effecting change.

The five groups corresponded to the four-element conception of leadership of pedagogic renewal although two groups (expectations of instruction and curriculum decision-making) were associated with the single element of expectations of teacher instruction.

**Testing the fit of data to the theoretical model**

Although the 27 items were selected from a pool of 82 items that were shown in the previous study to be measuring one trait (pedagogic leadership), the data from the 27 items were analysed to check that it too measured a single trait - in this instance, leadership of pedagogic renewal.

A Rasch model analysis was conducted using the computer program Rasch Unidimensional Measurement Model (RUMM) (Andrich, Sheridan, Lyne & Luo, 2000) to calculate RUMM summary test of fit statistics. Both the fit of the items (item measures) and the teacher observations of the principal (person measures) to the model were good. The difference between the actual teacher responses and the expected responses as specified by the model were low (item fit residual was 1.46 and person fit residual was 1.75). Also, the distribution of item measures (mean 0.00, standard deviation 0.63) matched the distribution of person measures (mean 0.83, standard deviation 1.48). The separation index of 0.94 showed the overall fit between the data and the model was very good.

RUMM was also used to show the extent to which the behaviours expressed in the items were characteristic of the school principals investigated. Item locations as measured in logits (logarithmic units based on the logarithmic odds of answering positively) were calculated. The logit for each item is presented in Appendix 1 and these are explained in the forthcoming Discussion section of the report.

**Specifying and testing the measurement model**

Structural equation modeling (SEM) LISREL VIII (Jörneskog & Sörbom, 1992) was applied to test a hypothesised measurement (factorial) model by confirmatory factor analysis (CFA). The same data were analysed in the CFA as in the EFA due to the small sample size preventing the preferable practice of splitting the data for separate analyses. CFA in LISREL requires specification of at least two indicator (observed) variables for each latent variable. The five groups of items were assumed to be eliciting data on five latent variables and the respective item semantics and data were examined to identify particular items or combinations of items that would constitute indicator
variables. Inter-item covariance and correlation were calculated to test the associations between the indicator variables for each latent variable. Twelve indicator variables were specified (see Figure 2). For example, the latent variable of engaging teachers was indicated by: supporting teachers; ascertaining teacher ambitions; and coaching.

![Figure 2: Measurement model](image)

When the above measurement model was tested by LISRELL VIII, the 27 item data fitted the model well. In SEM, the data fits the model well when the comparative fit index (CFI) is greater than 0.90 (Kelloway, 1998; Rigdon, 1996), and when the root mean square error of approximation (RMSEA) index is less than 0.10 (Kelloway, 1998). The CFI of 0.99 was above the recommended standard of 0.90 and very close to indicating an ideal fit. The RMSEA was 0.08 and below the Kelloway (1998) standard for a good fit (RMSEA < 0.10). These results show that for these data, principal leadership of pedagogic renewal had five dimensions and 12 sub-dimensions.

**Specifying and testing the structural model**

In comparison to a measurement model, a structural model specifies relationships between latent variables. The procedure of testing a structural model treats the relationships between the latent variables as hypothesised dependencies and these are tested. The dependencies between the five latent variables were examined separately by conducting a series of multiple regression analyses leading to proposition of the hypothetical structural model that was tested by SEM. The data fitted
the hypothesised structural model well, the CFI was 0.99 and the RMSEA was 0.08. The structural model is presented in Figure 3.

![Diagram of validated model of principal leadership of pedagogic renewal]

The double arrows show two-way relationships (mutual dependency) between many of variables. The strength of these relationships is shown by the respective correlation coefficients (p <0.001) situated alongside or below the respective arrows. For example, teacher engagement strongly correlated ($r = 0.90$, $p <0.001$) with sense of common purpose suggesting these two attributes are highly mutually dependent.

The absence of arrows between certain pairs of variables and the absence of one-way arrows in the model are significant. The good fit of the data to the model is due to the specification of the particular relationships within the model and the inclusion of additional ‘paths’ could lower the fit. Indeed, there was no evidence from the regression analyses to support inclusion of additional ‘paths’ and this view was tested by post-hoc SEM - adding additional paths decreased data to model fit significantly. Consequently, the model does not show direct relationships between: teacher engagement and school renewal - the interaction between teacher engagement and school renewal is mediated by sense of common purpose. Nor between teacher engagement and shared curriculum decision-making - the interaction between teacher engagement and shared curriculum decision-making is mediated by sense of common purpose. Nor between shared curriculum decision-making and school renewal - the interaction between shared curriculum decision-making and school renewal is mediated by sense of common purpose.

**Summary**

At the conclusion of the empirical research, the results of the Rasch and SEM analyses provided information on the attributes of pedagogic renewal leadership. This included the relevant principal behaviours, the prevalence of the behaviours, and relationships between the behaviours.

**Discussion**

The following discussion is based on the confirmed relationships between the groups of behaviours (latent variables) from the SEM analysis and on the prevalence of the behaviours (item logits) comprising this classification from the Rasch analysis.
Inter-related behaviours and motives

The leadership trait was shown to be a system of inter-related behaviours. The five groups of behaviours were inter-dependent and the dependencies were bi-directional due to the absence of simple cause-effect relationships. Consequently, behaviours directed at only one dimension of pedagogic renewal without attending to the other four dimensions will have a limited effect on renewing a school’s pedagogy - teacher engagement, expectations of teacher instruction, shared curriculum decision-making, sense of common purpose, and school renewal all require concurrent attention when attempting to improve the school’s pedagogy.

Principals need to understand the motivation for their behaviour and be aware of their motives for behaving in certain ways. According to the model, when attention is given to all five dimensions, the behaviours in one dimension influence the behaviours in the other four dimensions. This suggests the motives are inter-related and are shaped by a common intention. An obvious example is the nexus between instruction and the curriculum with assumptions about how children learn (the rationale) influencing both expression of expectations about teacher instruction and curriculum decision-making (the behaviours). In general, the collective and cumulative effect of the leadership behaviours on pedagogic renewal will be maximised when there is congruence between the respective behavioural motives - effective pedagogic renewal requires identification of a coherent rationale for renewing the pedagogy and the renewal process should be informed by this rationale.

The connection between purpose and process is also shown by the positioning of developing a sense of common purpose amongst teachers in the centre of the model. Although this component explicitly describes behaviours, the central location shows it influences the other four behavioural dimensions and hence it could be implied that it embodies the rationale for pedagogic renewal. The reason(s) for engaging in the renewal process emerge when identifying the school vision and explicating the school’s mission - the renewal process is dependent upon the principal and teachers having a common vision of the school’s future and of how the vision will be realised.

The position of teacher engagement, expectations of teacher instruction and shared curriculum decision-making in the model also require comment. All three components depended upon and in turn influenced, developing a sense of common purpose, but there was no empirical evidence of direct relationships between the two instructional components and teacher engagement. This suggests a weak linkage between the strategies applied by the principals to influence teachers to work towards attainment of the school’s instructional goals and the methods they used to support teachers and facilitate the professional growth of teachers – there was disconnection between improving the instructional program and managing teacher development.

Differential levels of behaviour

The Rasch analysis ensured a match between the range of teacher observations of individual principals (person measures) and the range of leadership behaviours observed for all the principals (item measures). Consequently, the logits for the individual items show the relative prevalence of the respective behaviours as observed by all the teachers for all the principals (see Appendix 1). Negative logits resulted from teachers not affirming they observed particular behaviours as distinct from the positive logits that resulted from affirmation of observation of other behaviours.

The teachers’ view of principals gaining teacher engagement by supporting teachers, ascertaining teacher ambitions and coaching teachers was that these behaviours were not characteristic of the principals. The majority of the logits were positive and those for coaching teachers were highly positive. Supporting teachers, ascertaining teacher ambitions and coaching teachers were not common practices.

In contrast, expressing expectations of teacher instruction and sharing curriculum decision-making were more common behaviours as shown by the mainly negative logits. Teachers perceived
their principal as pro-active in leading improvement of teaching and the instructional program. Similarly, they also had positive views of the principal developing a sense of common purpose within the school (mainly negative logits). Developing a sense of common purpose was seen to be demonstrated by principals sharing their values orientation, articulating a vision of the school’s future, and by emphasising the school’s mission.

In comparison, the logits concerning challenging prevailing educational beliefs and values presented a ‘mixed’ view of this behaviour. Principal questioning of the effectiveness of existing school programs and policies was observed, and principal questioning of prevailing knowledge and understanding of the school was also observed. On the other hand, questioning issues about meeting the needs of students and of children was less commonly observed. Also, changing educational beliefs and values was less commonly observed.

Inferences

Some general inferences can be made about how the principals exercised leadership of pedagogic renewal.

First, while the principals attended to certain aspects of pedagogic renewal, other aspects were given less attention. For example, expressing expectations of teacher instruction was more common than engaging teachers. This suggests a fragmented rather than holistic view of their role.

Second, there was a disparity between intentions and behaviours. That is, principals expressing attitudes and values towards important issues, but not enacting their stance by causing change. For example stating values orientation was more prevalent than changing prevailing educational beliefs and values.

Third, principals have different understandings of the nature of pedagogic renewal and differing dispositions towards implementing pedagogic renewal in the school. There was significant variation in individual levels of pedagogic renewal behaviours across the sample of principals investigated as shown by the Rasch analysis variance in person measures.

Conclusion

Applying Rasch and structural equation modeling techniques to analyse the data evidenced a good fit between the data and the models. The results of the analyses provided an accurate and detailed view of how 208 teachers observed the behaviours of 25 school principals concerning renewing the pedagogy of their schools.

From a research perspective, empirically validating a theoretical model of principal leadership of pedagogic renewal is an important contribution to understanding educational leadership and educational change. Significantly, a conceptualisation including principal behaviours, pedagogy and renewal provides a unified and highly contemporary view of school leadership.

References


Appendix 1: Variables and items

**Latent variable 1: Engaging teachers**

*Indicator variable 1.1: Supporting teachers*
- 2 Is available and accessible to teachers requiring support: -0.53
- 4 Provides support for teachers even when not support is not requested: +0.30

*Indicator variable 1.2: Ascertaining teacher ambitions*
- 12 Identifies the aspirations of individual members of staff: +0.11
- 11 Talks with individual members of staff and groups about their aspirations: +0.17
- 48 Encourages particular members of staff to question specific aspects of school operations: +0.17

*Indicator variable 1.3: Coaching teachers*
- 41 Encourages particular members of staff to question specific aspects of school operations: +0.62
- 43 Provides timely and relevant advice to individual teachers on improving their teaching: +1.08
- 42 Observes individual teachers at work in their classroom: +1.30

**Latent variable 2: Expressing expectations of teacher instruction**

*Indicator variable 2.1: Expecting outcomes focussed instructional design*
- 76 Requires teachers to specify learning outcomes when designing programs and planning lessons: -0.04

*Indicator variable 2.2: Expecting developmental learning*
- 77 Expects teachers to ensure sequential development of student knowledge, skills and attitudes: -0.49

**Latent variable 3: Sharing curriculum decision-making**

*Indicator variable 3.1: Discussing assessment and reporting*
- 78 Convenes meetings to discuss how student progress will be assessed and be reported: -0.28

*Indicator variable 3.2: Discussing curriculum content*
- 79 Convenes meetings to ensure the school’s instructional program is sequential and balanced: +0.11

**Latent variable 4: Developing a sense of common purpose**

*Indicator variable 4.1: Stating values orientation*
- 24 Expresses the belief that this school can improve the lives of the students: -1.32
- 25 Assigns high importance to the role of education in improving society: -1.14

*Indicator variable 4.2: Articulating vision*
- 21 Clearly explains to others what he/ she values within the school: -0.90
- 61 Informs teachers of his/ her vision of the school’s future: -0.49
- 64 Ensures the school vision statement is reviewed: -0.16

*Indicator variable 4.3: Emphasising mission*
- 18 Explains why teachers should work towards attaining the school’s goals: -0.82
- 38 Uses evidence of external changes to generate support for change within the school: -0.22
- 80 Justifies the school’s instructional program in terms of theories about how children learn: +0.12
Appendix 1 continued

Latent variable 5: Effecting school renewal

Indicator variable 5.1: Challenging prevailing educational beliefs and values

<table>
<thead>
<tr>
<th>Question</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questions the effectiveness of existing school programs and policies</td>
<td>-0.25</td>
</tr>
<tr>
<td>Questions prevailing knowledge and understanding of the school</td>
<td>-0.16</td>
</tr>
<tr>
<td>Questions the capacity of the existing school curriculum to meet student needs</td>
<td>+0.39</td>
</tr>
<tr>
<td>Questions prevailing societal values towards education and the needs of children</td>
<td>+0.39</td>
</tr>
</tbody>
</table>

Indicator variable 5.2: Changing prevailing educational beliefs and values

<table>
<thead>
<tr>
<th>Question</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is committed to changing local community beliefs and values about education</td>
<td>+0.36</td>
</tr>
<tr>
<td>Is committed to developing an alternative curriculum to more effectively meet student needs</td>
<td>+0.48</td>
</tr>
<tr>
<td>Provides unconventional insights into issues</td>
<td>+1.04</td>
</tr>
</tbody>
</table>