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Data systems in secondary schools: The state of play

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Abstract

While the teachers in most secondary schools in New Zealand recognise the importance of the student management system (SMS) for compiling and organising student achievement data, actually gathering and then using data appears to be less consistent. The present study examined the data systems that are in place for supporting teachers in building a comprehensive profile of student learning. A data audit protocol was developed by the researchers to analyse the responses from key personnel from secondary schools (N=16) in the Auckland region in relation to SMS data organisation and use. The results indicated that schools were rich with data but lacked a systematic and coherent approach to school-wide data collection and use. To this end, three implications for practice are suggested.

Keywords: data systems; student management system; data utilisation; data audit

Introduction

The growing emphasis on evidence-based teaching and learning as part of the "teaching as inquiry" cycle (Ministry of Education, 2007, p. 35) means that schools need to find better ways to use their data for improving learning outcomes (Campbell & Levin, 2009; Earl & Katz, 2006). Secondary schools have traditionally collected a wide range of data; student demographics, attainment results, extra-curricular records, class reports, and so on. In New Zealand, these data can be stored in the student management system (SMS), a repository which facilitates collection, retrieval and organising of large amounts of student information. These repositories can generate tabulated or graphical reports on student performance that can be used to communicate with various stakeholders (Tolley & Shulruf, 2009). Despite the importance of data use for accountability purposes and its pivotal influence on changing classroom practices, there is little research on what kinds of data New Zealand schools collect, and what supports are in place to help teachers access and use student achievement data.

In this article, we examine secondary school practices of data collection and utilisation as they begin their involvement with Starpath to make better use of their data to inform and enhance teaching and learning. The overall aim of the Starpath Project is to minimise or remove barriers that contribute to lower rates of participation and success in degree-level education by Māori, Pacific and other students from low-income backgrounds. Through research in five Starpath pilot schools from 2005–2010, the Data Utilisation, Academic Counselling and Target Setting (DUACTS) programme was devised and then rolled out to 16 new schools in the second five-year phase of the project. A key component of the Starpath DUACTS toolkit is the development of a longitudinal evidential database (EDB), which is used to provide a comprehensive picture of what learning looks like at the given school. In order to build the EDB database for a school, it is important to gain a thorough understanding of how each school assesses student learning, how the results of those assessments are stored, and what is done with achievement data by way of analysis,

interpretation and action. Consequently, a data audit is conducted in each new school prior to the implementation of the DUACTS protocols, to provide a platform for launching the programme.

The purpose of this article is to present findings from a survey about current data systems and approaches adopted in selected secondary schools using a data audit inventory designed within the Starpath Project. It is guided by the underlying research question:

> To what extent do secondary schools have data systems in place for building a comprehensive profile of student learning over time?

Challenges for data utilisation in schools

While educators recognise the importance of school-wide data for decision making (ERO, 2011), the research and practice literature has indicated that schools face a number of challenges which influence data use: the types of data accessible to school staff; staff competencies; information system capacity, and in-house data management.

Relevant data accessible to staff

A common concern for schools is how to access the data relevant to their needs, and how this can be effectively translated into useful information and knowledge to inform teaching and learning (Bernhardt, 2004). There is often too much data, but not the right type or not in a format that facilitates interpretation and use (Lachat & Smith, 2005; Schmoker, 2003). Relevant data are also not accessible to staff when they need it, and often staff are unsure of what they need, when to use it and how best to make sense of it (Schildkamp & Kuiper, 2010). For example, Shulruf, Tumen, & Tolley (2008) found that only data forms relevant to institutional management were stored centrally, mainly for summative rather than formative purposes. The lack of access to meaningful disaggregated data meant that

teachers were unable to determine how various subgroups of students were performing over time.

Staff competencies

Teachers require the knowledge, skills and willingness to interpret and use data. They need to realise that the nature of 'data' as classroom-based evidence consists of test scores, student attribute ratings, teacher judgement, performance portfolios and other diagnostic and formative evidence which influence *their own* instructional decisions, rather than a limited notion of 'evidence-based decision-making' that is focused narrowly on the rigour of collecting the 'right' kind of data. In short, "It is the judgements or interpretations based on these data that is of most interest" (Hattie, 2005, p.14). There is a growing need to develop secondary school teachers' skills in collecting, analysing and using data meaningfully. For example, intervention studies conducted to raise Māori and Pasifika students' achievement in reading comprehension found that systematic and collaborative support for school leaders and teachers in collecting, analysing and interpreting rich classroom data enhanced their use of such data to meet the diverse needs of their learners (Lai & McNaughton, 2008; McNaughton, Lai & Hsiao, 2012).

Information system capacity

Longitudinal data use, in addition to cross-sectional data, for monitoring and tracking student progress means that the SMS must be robust data repositories and allow for ease of retrieval of pertinent data in an organised format (Breiter & Light, 2006; Kerr, Marsh, Ikemoto, Darilek & Barney, 2006; Wayman & Stringfield, 2006). In addition, analysing disaggregated data requires the SMS to integrate or link multiple types of student level data to facilitate the interpretation of student progress and improvement (Johnson, 2002). Wayman, Jimerson and Cho (2012) suggest that one of the key organisational considerations for improving data use is an integrated, centrally supported data system

which is perceived by teachers as accessible, easy to use and adds value to their work. Inherent in this view is the focus on interactivity between teachers and the data system, where questions on teaching and learning can be explored and examined in relation to multiple data levels (student, class, school) retrieved from the SMS in an efficient, timely manner.

Data management

Data management is about fostering the collaboration of teachers and school leaders in handling data, managing its transfer between individuals, facilitating its dissemination and usage, and thus having the information to engage in analysis and interpretation. The traditional arrangement of transfer of data to teachers may, more often than not, lead individual teachers and subject departments to abstain from ownership of the data. Instead, teachers see themselves as passive end-users that data are collected for someone else's purposes, and they fail to see data analysis and interpretation as a school priority or to inform teaching and learning in their classrooms (Lachat & Smith, 2005). The obvious consequences of this data management approach is the dependency of 'know-how' or expertise on a selected few (data gatekeepers), with teachers feeling less confident and satisfied with the analysis or interpretation of others. Rather than taking a 'top-down' perspective, data managers and senior staff can engage teachers in in-house data conversations, creating opportunities for collaborative inquiry (Kelly & Downey, 2011; Huffman & Kalnin, 2003). Love (2000) supports this view, emphasising the importance of establishing a collaborative decision-making process that is based on inquiry, where data becomes a catalyst for constructive dialogue, where staff, parents and students can become better informed and more supportive, and where there is shared understandings and ownership of the issues and solutions being pursued.

Method

Schools

In 2011, the Starpath Project invited 16 low to mid-decile state schools (decile 1: 5 schools, decile 2: 2 schools, decile 3: 3 schools, decile 4: 1 school, decile 5: 4 schools, and decile 6: 1 school) in the Northland and Auckland regions to participate in the second five-year phase of the project. These schools had a large proportion of Māori and/or Pacific students on the roll, and NCEA success rates (on average) that were at least ten percentage points below the national average. The schools formed three clusters, one around a Starpath pilot school in Whangarei, and two clusters around two pilot schools in Auckland. One school (classified by the Ministry of Education as rural) had students from Year 7 to Year 13, and the remainder were Year 9–13 schools. Two of the schools were single-sex. The student roll ranged from small (N~200) to large (N~1800).

Data collection tool

The Starpath team developed an inventory to assess each school with regard to five indicators: their student management system, the types of data the school held, the state of the raw data, the infrastructure to support teachers working with data, and data generation and use. Each of these indicators was expanded into a set of criteria (see Table 1), and each criterion was rated using a three-stage developmental scale (see Table 2 for a sample of the descriptors for these ratings). Classification on each criterion was made by the project team members who visited the school.

Table 1: Starpath data inventory: Indicators and criteria

Indicator	Criteria
Student management system	Functionality of the SMS Data entry person Staff use/access SMS
Types of school data	Demographic data Achievement data (up to Year 10) Achievement data (NCEA) Attendance data
State of raw data	Unique ID (suitable for data merging) Location of raw data Systematic conventions for student names Missing data (i.e. completeness) Cleanliness of data Duplication of data files Duplication within data files
Infrastructure	LAN networked computers Accessibility onsite Accessibility offsite Wireless access Laptop programme (for teachers) Broadband capabilities Software tools for analysis (e.g., Fathom, Tinkerplots)
Data generation and use	Scheduling of assessments Protocol for recording data Data collected together Accessibility of achievement data Data analysis Student achievement manager (SAM) capability

Table 2. Descriptors for selected indicators and criteria.

Indicator	**Criteria**	**Stage 1**	**Stage 2**	**Stage 3**
Types of data	Demographic data	Basic student records (e.g. gender, date of birth, ethnicity)	Basic student data plus parent/caregiver occupation at time of enrolment.	Comprehensive student record including SEN and ESOL status.
State of raw data	Systematic student naming conventions	No consistent process for downloading student names and details from SMS	Most files use a consistent form of student name, and generally use unique ID/NSN	All files use unique ID or NSN in addition to specified form of student name
Data generation and use	Assessments conducted according to schedule	School has assessment schedule but conduct is haphazard.	NCEA assessments occur according to schedule, but other assessments are haphazard.	All assessments (NCEA and other) are monitored so they occur according to schedule.

Data collection

The data audit in each of the 16 schools consisted of a series of short meetings over half a day designed to ascertain what data the school held (and where), with respect to four specific data types (Bernhardt, 2004); demographic, student achievement, perceptions, and school process data. The meetings were held with key personnel such as the person in charge of the school assessment programme, the principal's NZQA nominee, the person responsible for maintaining the electronic student records, and the head of department for English and Mathematics. We met with other personnel in cases where the school felt this was appropriate. Later in the school year, we revisited each school to obtain copies

(electronically wherever possible) of the data that the school held. These data were used to create the comprehensive longitudinal evidential database (EDB) that the school would use in 2012 as part of the implementation of the DUACTS programme.

The classifications for each criterion were made based on the responses of individuals at these meetings, and from the data files that we obtained. A rating of 1 was assigned to Stage 1, 2 to Stage 2 and 3 to Stage 3. A rating of zero was assigned for any criteria where the school had not yet developed that aspect of their data management.

Results

Overall data utilisation capability

A composite score was calculated for each school by averaging the ratings assigned for each criterion. The composite ratings ranged from 1.33 to 2.21. At present, only five out of sixteen schools (Schools A to E) have demonstrated the capability to work with their data at the proficient level (ratings $\geq$ 2), while most schools are still in the most basic developmental stage (Schools F to P) (see Figure 1).

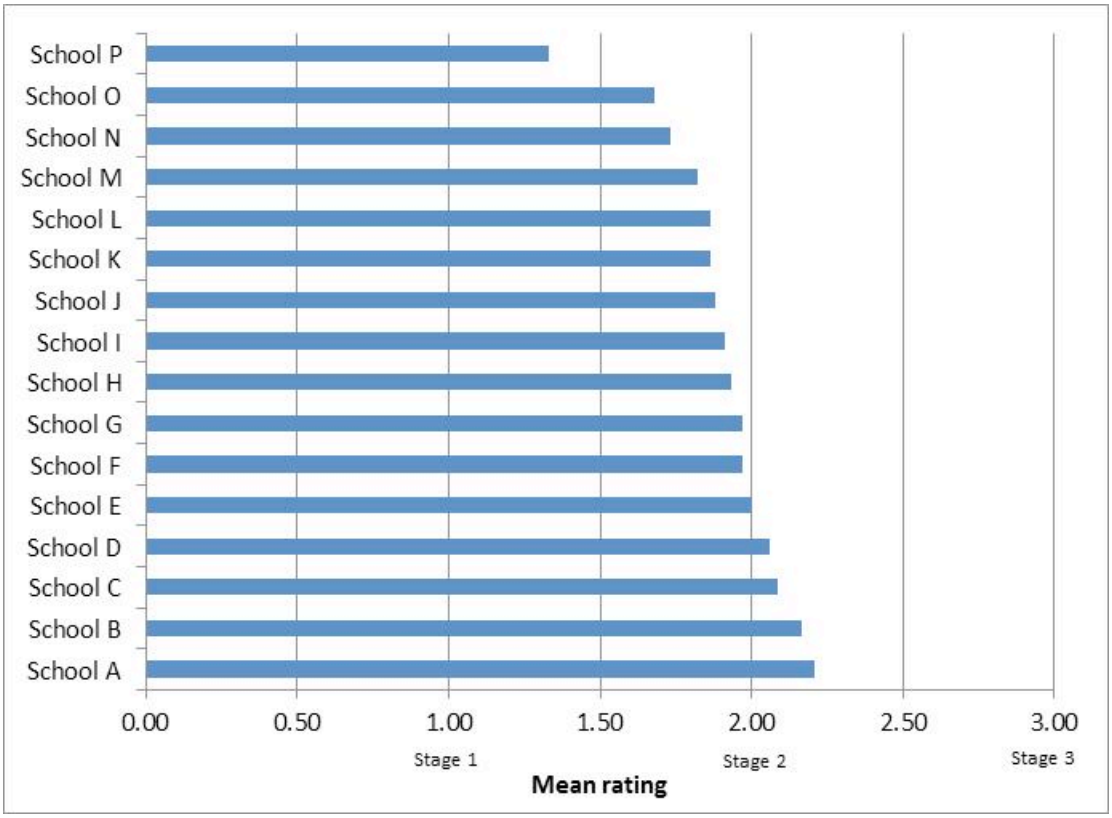

Figure 1. Overall mean ratings of data utilisation capability

As with most summaries, they tend to hide more than they reveal. In the remainder of this section, we examine each of the five indicators and their respective criteria in our data audit to provide a more detailed snapshot of school-wide data management and processes.

Indicator 1: Student management system (SMS)

We looked at the school's SMS plus the personnel who used and accessed the system. Of these 16 schools, the most favoured SMS was *Kamar* (adopted by 11 schools), followed by *MUSAC* (adopted by four schools) and one school used *PC School*. Figure 2 shows the proportion of ratings for the three SMS criteria. Findings from each of these criteria are detailed next.

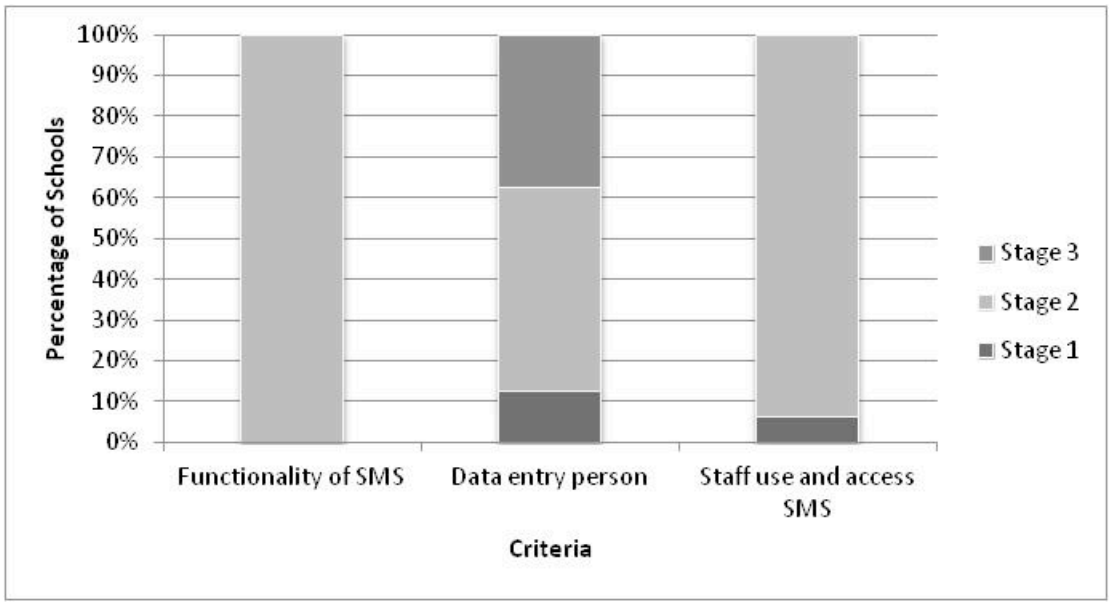

Figure 2. Percentage of schools rated based on student management system criteria

Functionality of the SMS. All schools had an SMS that was compliant with Ministry of Education requirements for filing roll returns. Each system has a range of other functionalities, although there are many features in common. While the SMS providers are responsive to client requests for additional features, there are functional limitations that restrict some uses of the SMS, such as the inability to load all historical data. For Stage 3, we were looking for the ability of the SMS to analyse data in multiple ways to explore complex patterns of teaching/learning in the school.

Data entry person. We assessed each school for the data entry person's range of capabilities. It was not unusual for this role to be split among several of the school's administrative staff. At two schools (12.5%), the data entry person entered data and little else (i.e., Stage 1). In half of the schools, the data entry person supplied data requested by

others for analysis, such as patterns of attendance, credits achieved to date and so on. Just over a third (37.5%) of the schools had very competent administrative staff who required little oversight and supervision with regards to data and providing data for analysis (i.e., Stage 3).

Staff use and access. We ignored the most common use of the SMS of looking up information about a student (e.g. phone number, timetable) as these are solely administrative functions. In one school (6.3%) there was considerable resistance by teachers to using the SMS, especially for entering NCEA achievement data for the students in their classes. They tended to hand their results to the data entry person (i.e Stage 1). All other schools were at Stage 2, where teachers took responsibility for NCEA data entry, but the SMS was used solely as a repository. There was no evidence of widespread use of the SMS to analyse assessment results. To be rated as Stage 3, teachers would need to be confident and competent in accessing and downloading a range of data for analysis. No school was yet at that stage.

Indicator 2: Types of school data

Only four of the seven criteria were examined in detail in the audit process (see Figure 3). There was insufficient time to audit perception, school processes and teacher data as these would not initially be included in building the EDB. Findings based on the four criteria: demographics; student achievement to Year 10; NCEA achievement; and attendance are reported below.

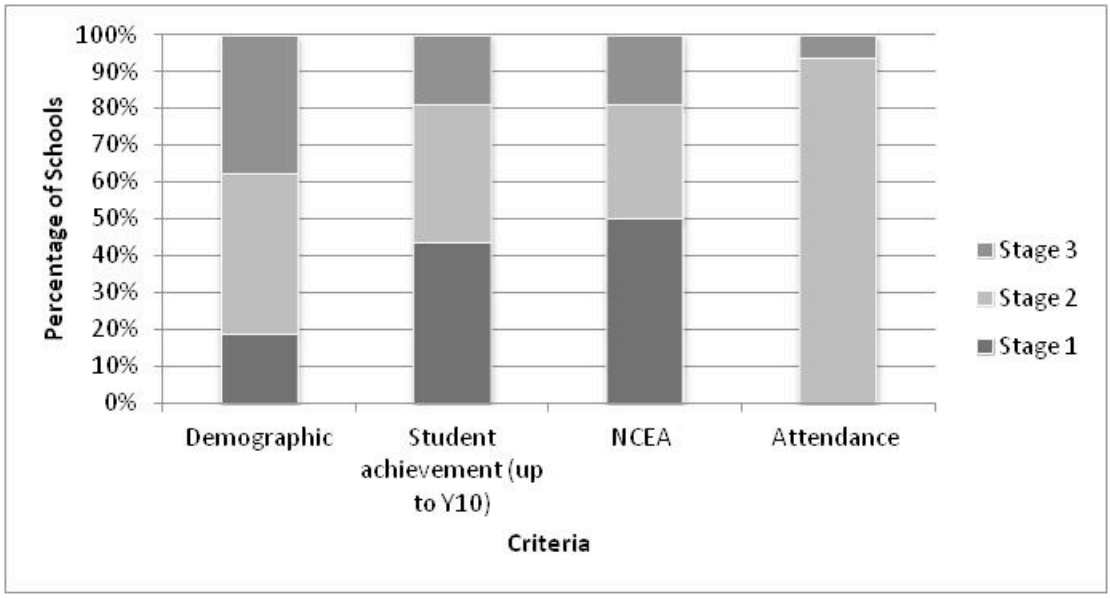

Figure 3. Percentage of schools rated based on types of school data criteria

Demographic. At the time of enrolment, all schools collected and stored student demographic data in the SMS. However, some important data that could be used purposefully in analysing and interpreting patterns in achievement were held outside the SMS or not collected at all, such as a student's ESOL status, special needs status, and parental occupation. Slightly more than 40% of the schools held a comprehensive set of demographic data (i.e., Stage 2), while less than 20% of the schools had the minimum of demographic data (i.e. gender and ethnicity) in their SMS (i.e. Stage 1).

Student achievement (up to Year 10). Almost a half of the schools were rated as Stage 1 (i.e., 43.7 %). They administered standardised assessments such as PAT or e-asTTle to students up to Year 10, but we found the data in subject silos that were not connected. Such records were usually in paper form. A similar proportion of the schools connected these data, usually in spreadsheet form, but only occasionally in their SMS. This finding was also true of non-standardised assessments, such as teacher-made unit tests. It was not very common to rate a school at Stage 3 (18.8%). Such schools have gone beyond PAT/asTTle

reading/mathematics assessment data to include other subjects such as science (e.g. the new *Science: Thinking with evidence*) or PE (e.g. the beep test).

NCEA. In this criteria, we refer to the way a school handles NCEA data on a year-by-year basis, and not how they handle results generated during the current year. About 50% of the schools were not able to retrieve the results files for any previous years without resorting to downloading from the NZQA website (i.e. Stage 1). Their practice was to upload files in to the SMS (which updates each student's achievement status), then dispose of the original files. There were no archival records independent of the SMS to show what an individual student actually achieved during a given calendar year. Fewer than 20% of the schools held records in such a way that student's achievement in any calendar year could be retrieved (i.e. Stage 3).

Attendance. All schools were rated as Stage 2 or better for attendance records. While most teachers were able to complete attendance online, there were a few teachers in the Stage 2 schools who were not able to do that (e.g. lack of computer access in their teaching space or classes off-site). In one school, all teachers were supplied with a mobile phone so that, irrespective of their location, they could complete an attendance return for each lesson.

Indicator 3: State of the raw data

To establish a single data repository from the multiple sources of data in each school, the state of the raw data is very important to ensure that data is assigned to the correct student, so inferences made are appropriate. Figure 4 shows the proportion of ratings assigned for this indicator. Findings from the seven criteria in this indicator are reported next.

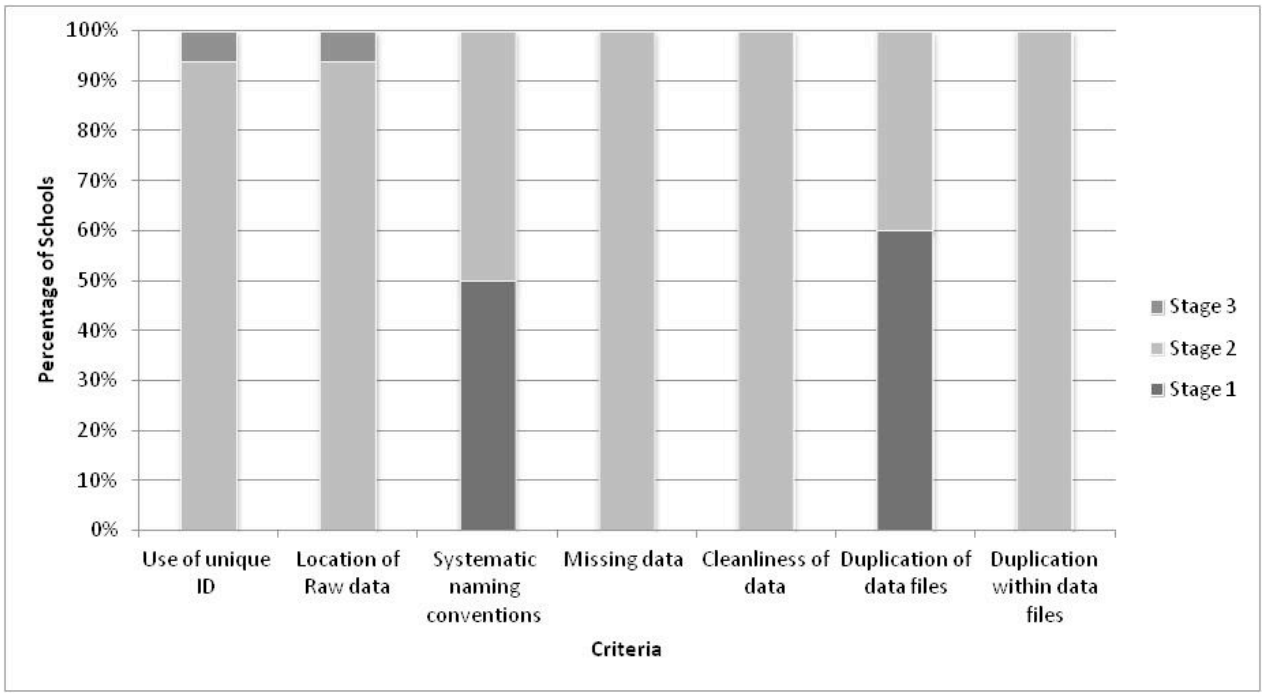

Figure 4. Percentage of schools rated based on state of raw data criteria

Use of unique ID. In only one school did all the files obtained have a unique ID available for each student to facilitate data matching (i.e. Stage 3). In all the other schools (93.7%), this was a hit-and-miss affair, with some (usually a very small number) files available with IDs (i.e. Stage 2). This was not too surprising as teachers interpret results by referring to a student by name, and not by any numerical ID.

Location of raw data. None of the schools made a practice of storing achievement data solely on third-party servers/websites (e.g., PAT or e-asTTle websites) (i.e., Stage 1). However, if teachers could not locate a particular file onsite, they resorted to retrieving data from these websites. Otherwise, their practice was to store achievement data onsite, but as we found, only one school had all the data collected in one location (i.e. Stage 3). In all the remaining schools (93.7%) data were located in subject silos, and were rarely available for

sharing beyond a few teachers in a given subject department (i.e. Stage 2). Even then, it was not unusual to find data in multiple locations within a department.

Systematic conventions for student names. Where a unique ID was missing from source data, matching had to be completed using the student's name. Schools typically gather four types of student name: 'legal surname'; 'legal first names'; 'known as surname' and 'known as (or preferred) first names'; resulting in four different name combinations. These combinations are compounded by incorrect spelling of names. Exactly a half of the schools presented multiple data files with inconsistent naming conventions (i.e. Stage 1), while the other half had only an occasional lapse (i.e. Stage 2).

Missing data. Large amounts of missing data can render the dataset useless for detailed and meaningful interrogation. All schools were rated as Stage 2, which meant that missing data was usually between 10% and 25% of a school's year level cohort. It is not easy to obtain a full dataset where absences and transience are high, but follow-up on students who miss school-wide assessments will ensure that the school has a comprehensive record of achievement throughout a student's school career.

Cleanliness of data. In building the evidential database, we consistently check the cleanliness of the data supplied for systematic errors (e.g., stanines greater than 9, out of bounds asTTle scores, student name matches given ID) that can occur, usually through manual data entry. We rated all schools at Stage 2, which meant that we encountered less than 10% of files with these errors. No schools were at Stage 3, which required less than a 5% error rate.

Duplication of data files. In retrieving files from multiple data sources, multiple copies of the same file were regularly supplied, not always with the same file name. In 60% of the schools, this occurred more with more than 10% of the files (Stage 1). In the other 40% of

schools, less than 10% of the files were duplicated. No schools (including the one with data stored in the one location) were able to avoid duplication (Stage 3).

Duplication within data files. There was much less duplication of data within a file (e.g. a student with two or more results for the same assessment), and all schools rated as Stage 2.

Indicator 4: Infrastructure

In this section, we looked at the technical capacity at the school to handle data, and to make data accessible to all teachers for the purpose of teaching as inquiry. Each of the criteria examined under this indicator is detailed next.

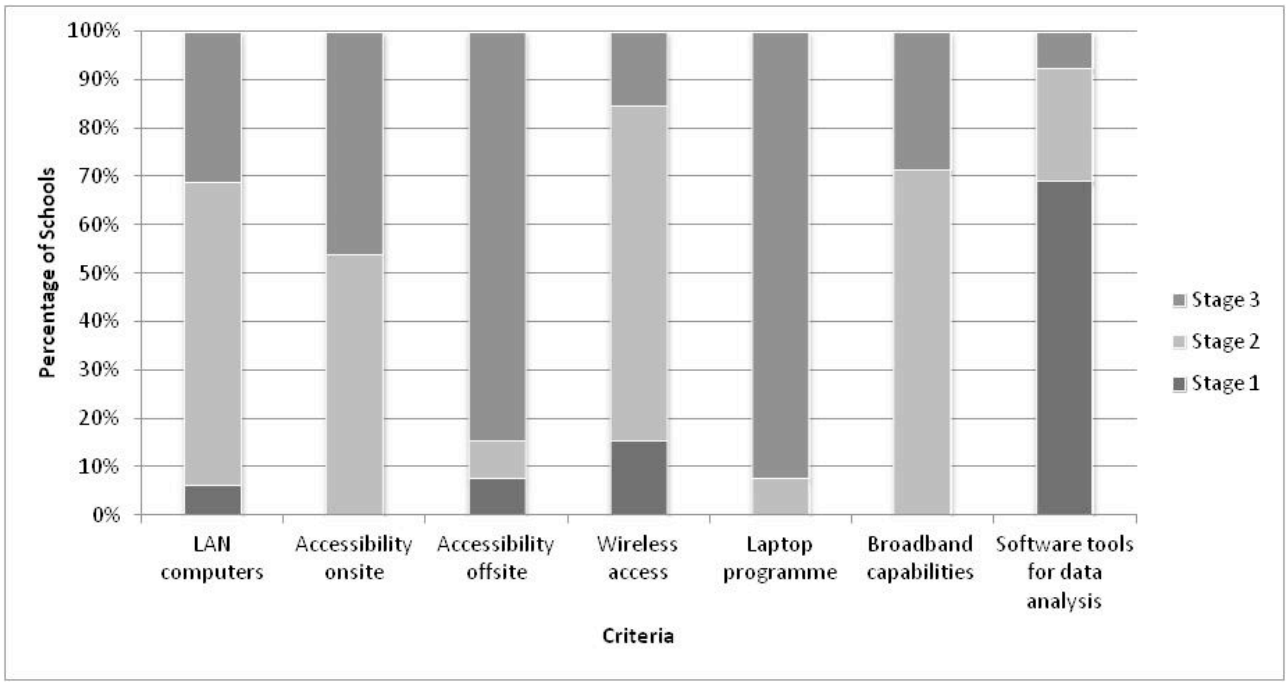

Figure 5. Percentage of schools rated based on infrastructure criteria

Local area networked computers. In one school, the local area network (LAN) was reported to be slow and unreliable, and that not all computers in the school were connected to that network (i.e. Stage 1). Thus the exchange of data among teachers was severely handicapped. The majority of the schools (62.5%) reported a reliable but slow LAN (i.e. Stage 2), while about a third (31.3%) reported a high speed reliable network running in the school (i.e. Stage 3).

Accessibility onsite. None of the schools had networked computers available solely in the staffroom (Stage 1), but over a half had access restricted to a number of resource areas around the school. Teachers in the remaining schools (46.2%) reported that they had a networked computer available in each classroom (i.e. Stage 3).

Accessibility offsite. We encountered one school where teachers had no remote access to the school database, and another where this was restricted to some of the senior staff. In all of the rest (84.6%), teachers had off-site access freely available (i.e. Stage 3).

Wireless access. Two schools (15.4%) had no wireless access anywhere in the school, while the majority (69.2%) had some hot-spots available around the school (i.e. Stage 2). At two further schools (15.4%), the entire campus had wireless access (Stage 3), and for one of these two schools, the entire local community had wireless access.

Laptop programme. All schools had some provision for supplying teachers with laptops. In one school, this was for a few teachers (e.g., deans, senior management) (i.e. Stage 2), but the other 15 schools (92.3%) made laptops available for all teachers if they wished to have them (i.e. Stage 3). Not all teachers took up this option, especially if they had to cover part of the cost personally.

Broadband capabilities. With the availability of online assessment tools, broadband capability is important to conduct an assessment programme in a timely, stress-free manner.

The majority of schools (71.4%) were able to run (for example) an e-asTTle assessment, but only for a limited number of students at a time (i.e. Stage 2). The remaining schools could schedule assessments without any concerns about the ability of the network to function appropriately for all students (i.e. Stage 3).

Software tools for data analysis. Beyond commonly available software such Excel and the SMS, we asked whether schools employed other software tools to analyse data. Here our focus was on exploratory (e.g. Fathom or Tinkerplots) rather than analytical tools (e.g. SPSS or R). Approximately 70% of the schools had no additional software tools for analysis (Stage 1). Of the remaining schools, all but one had a limited number of licences available, while the one remaining school had multiple Fathom licences (i.e. Stage 3).

Indicator 5: Data generation and use

In this section, we examine the way in which teachers in schools report that they generate and then use data. Figure 6 shows the scheduling of assessments, protocols for recording data, the extent to which data are collected together, accessibility of achievement data, data analysis, and an assessment of the capability of the person who was going to fulfil the role of student achievement manager. Each of these criteria are reported next.

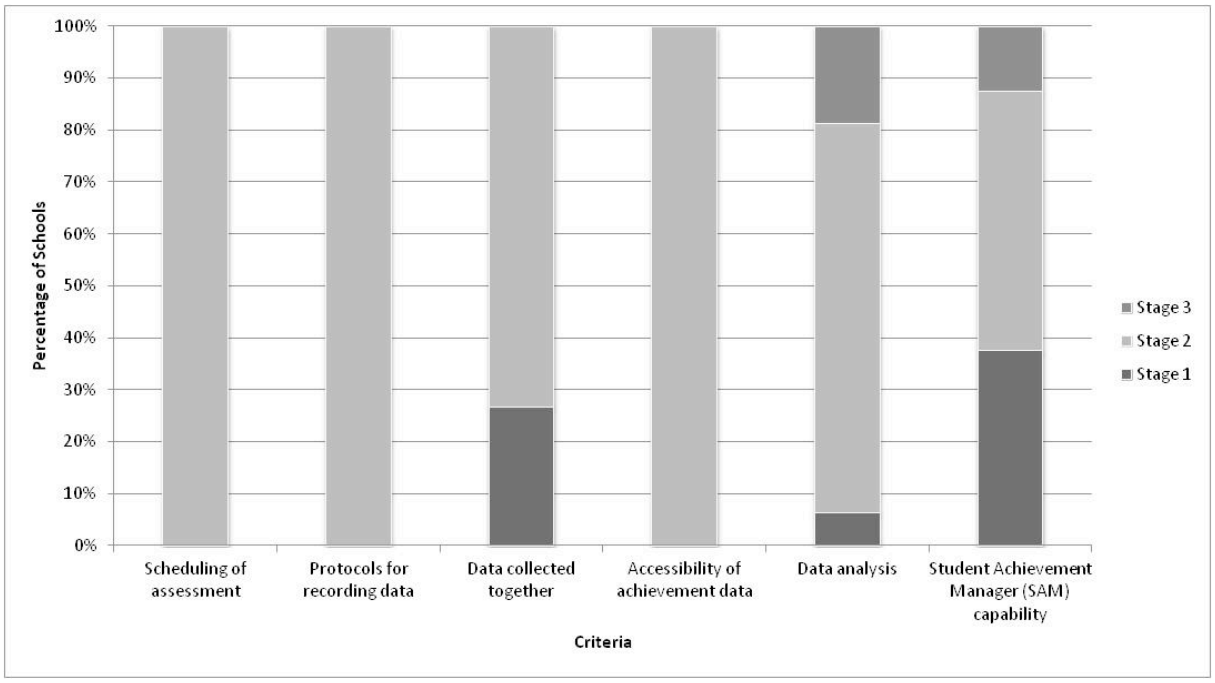

Figure 6. Percentage of schools rated based on data generation and use criteria

Scheduling of assessments. NCEA assessments usually occurred according to schedule, but the conduct of other assessments was haphazard (Stage 2). This was mostly because there was no school-wide assessment plan for junior students.

Protocols for recording data. No school was at Stage 3 which required articulated protocols for recording data across all levels of the school, and that these were adhered to. All of the schools had established protocols for recording NCEA data, but other data were recorded in an ad hoc manner, i.e. the inclusion of ID and specified form of student name were highly variable (i.e. Stage 2).

Data collected together. About three–quarters of the schools (73.3%) consistently collected NCEA data in their SMS, but did not do the same for data for junior class levels, and monitoring of data entry in those schools was erratic (Stage 2). Furthermore, with the

exception of one school (see also the next criteria), junior class assessment data were stored in a series of disconnected 'silos' around the school in the remaining schools audited.

Accessibility of achievement data. The very nature of these silos meant that student achievement in one subject was ring-fenced from teachers of other subjects, except when reports were being prepared and written. Thus all schools were rated as Stage 2. Even in the one school that had all data together in one place, this was in an Excel spreadsheet held by the deputy principal. Moves to incorporate all data in the SMS would improve data accessibility for those who are involved in the teaching–learning process (Stage 3).

Data analysis. In one school (6.3%), data analysis was restricted to NCEA data only, consisting of bar graphs comparing current performance with the previous years (Stage 1). In three other schools (18.8%), there was a greater sense of inquiry around achievement data from all sources, and to do this, data were analysed and interrogated in much greater detail (Stage 3). In two of those three schools, an ancillary staff member took the initiative to explore and analyse the data in detail including tracking and monitoring progress through the year, presenting their findings to senior management for consideration. In all other schools (75.0%) the analyses included the performance of sub-groups such as combinations of gender and ethnicity (Stage 2).

Student achievement manager capability. The student achievement manager (SAM) is the person with responsibility for overseeing all aspects of student achievement. We asked whether the SAM had the skills and capacity to carefully analyse achievement data and lead discussions where data were central to thinking about and improving student achievement. In six of the schools (37.5%), the designated SAM felt that they needed support and instruction in data analysis as well as leading data discussions (Stage 1). In exactly half of the schools, the SAM felt confident about their ability to analyse (with some guidance from the Starpath team), but not in leading data discussions (Stage 2). In two schools (12.5%), the SAM felt confident about both analysis and leading inquiry (Stage 3).

Discussion and conclusion

This study utilised an inventory developed in the Starpath Project to audit existing data systems in 16 schools new to the Starpath Project for the purpose of building a comprehensive profile of student learning.

The findings illustrated that the 16 schools surveyed had a general SMS system in place that focused on organising and storing student demographic and achievement data. However, the picture of data storage, management and use in schools is extremely varied, and this is closely linked to the inconsistent use of the SMS as a data repository. Instead of being able to go to the SMS and download all the data that the school has concerning a student's achievement, such data were found in many places: in paper files held in different parts of the school; on the computers of different personnel around the school; on protected drives on the school's server; and on off-site systems (e.g., "my personal laptop", the PAT scoring website). This was especially true for achievement data up to and including Year 10, where the data held about a Year 9 student in English were not connected to their achievements in mathematics/science/PE or any other aspect of their learning at school. The nearest that schools came to collating such data in a single place was in the reports to parents, which summarised students' learning to date.

For Years 11 on, the imperatives of NCEA took control, and systems were in place to ensure that the monthly reporting of credits earned to NZQA could be completed seamlessly and (reasonably) efficiently. The compartmentalised nature of these data silos is almost certainly a reflection of the way that secondary schools are organised around subjects and disciplines, for example, whether a student can solve a linear equation is of immense interest to a mathematics teacher but probably has little or no meaning to a visual arts teacher. Even then, the subject data silos were like a hydra. The data were not systematically stored in one location but in many locations and the data files had to be dug out of those locations.

The downside of students' achievement data in data silos rather than in a data repository is the fragmented opportunities for teachers and leaders to garner a comprehensive picture of student achievement in the school, or for any individual student. There is a need to develop a systematic entry of all achievement data in the SMS, and then making good use of those data. Without a meaningful purpose, there will be little buy-in by teachers to entering data in a timely manner. Thus, a more concerted effort is required to communicate the urgency of accurate and timely data entry into SMS and having a comprehensive assessment policy that is shared and practised across departments (Irving, 2012). Much work needs to be done to assist staff to become regular and confident users of the SMS, and then in building competencies in data literacy to better use the reports that are generated.

A common theme that emerged from this review suggests that for data to inform decisions about teaching and learning, schools first need to build a systematic approach to data that involves collaborative effort from all levels of the organisation. Drawing from the findings of this school data audit and the literature review, we propose three implications for practice.

Improving infrastructure support and fostering a coherent data system

The varied picture of this data audit suggests that some schools are more proficient than others in terms of having systems in place to facilitate and support staff in data management and utilisation. One main observation consistent with other research (e.g. Lai & McNaughton, 2008), is that a robust infrastructure allows for ease of access of relevant data and supports teachers in analysing and interpreting disaggregated data at multiple levels (see Figure 5). A coherent data system in which teachers have a clear understanding of the location, type and purpose of data has the potential to enhance teachers' confidence in meaningful data usage. This also strengthens teachers' belief in the school's data system for adding value to professional judgement and experience.

Generating and using data purposefully

The findings of the data audit suggest that the investment of more school resources into generating, organising and preparing data may be beneficial to the subsequent analysis and interpretation of data by staff. The prevailing picture is one where the tools and expertise are limited in terms of systematic data analysis; that is, analysis that allows teachers to interpret and make judgements that inform and change their practice. There is little value added to data in solely collecting and storing it, or in transferring it in pre-interpreted form from one teacher to another. Instead, the value is added through converting data into useful practitioner-focused information by the teachers themselves, which can be used to inform and change practice (Hattie, 2005; Kelly & Downey, 2011). With support from school leaders, teachers will be able to actively engage with data, to generate questions and respond to feedback as part of an inquiry and feedback cycle, and to focus on using data to improve student learning. As highlighted in previous literature, training is a prerequisite for staff data literacy (e.g. Campbell & Levin, 2009). A starting point may be the collaborative inquiry approach, which is championed by school leaders: the principal; deputy principal; teacher leaders; department heads; and school administrators, and focused on constructive dialogues directed on key student performance questions (Holcomb, 1999).

Creating opportunities for data analysis and interpretation at school, classroom and student levels

Besides hardware and know-how, teachers need time and learning opportunities to use data to explore and investigate their classroom practices. The on-going work by Starpath provides opportunities for schools to build staff competencies in data utilisation (University of Auckland, 2011). For example, the learning profile of the students drawn from data in the school's evidential database creates a platform for constructive discussion in conversations with the student (academic counselling) and in three-way conversations with

the student and family/whānau (McKinley, Madjar, van der Merwe, Smith, Sutherland, & Yuan, 2009).

Future developments in the Starpath Project will see the expansion of the data audit inventory to include more indicators and criteria in determining how well a school is placed to undertake 'teaching as inquiry' using data. These indicators would include a closer examination of school policies (especially concerning data collection, storage and management), and an assessment of the school's readiness for data-informed improvement (e.g. a stock take of the multiple programmes in the school that are intended to positively impact on student achievement, an assessment of the capability of teachers to inquire into practice using data, or a check on the timely entry of achievement data into the school's SMS). These are vital to the way a school prepares for and carries out one of its fundamental educational roles which is to promote the success of all students.

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