

School Data: not fit for (re)purpose

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Abstract: Schools are rife with data, not least data relating to student performance. However, most data are unseen, or seen by only a few, often for accountability reporting goals. The data practices within schools are largely for descriptive purposes rather than strategic, that is, there is a great deal of latent potential for the data to be used to inform strategic evaluation and future planning. The potential of data in schools has become a hot topic with discussions of ‘learning analytics’ and recent initiatives to develop online portals to school performativity data. However, the reality is that the very nature of the data combined with the strictures of the organisational context almost invariably result in underwhelming (re)presentation and applicability. This paper reports on findings from an internationally funded project investigating the benefits and challenges associated with ‘opening’ access and repurposing school-generated and school-related data to meet the needs of the school community. Unsurprisingly the repurposing of data is fraught with challenges including the disparate nature of data and their systems, as well as financial, legal and regulatory concerns including duty of care. Consequently, the goal of this paper is to engage the readers in a critical approach to current data conditions in schools, and propose that data may be socially repurposed, whether it is for personal analytics, or for broader goals. In addressing this need the project adopted a participatory design methodology and worked with administrators, teachers and students to co-design new ways to use currently held student progression data to meet their pressing needs, whether it is to improve learning, track performance or identify ‘at risk’ students. In particular, this paper reports on a series of findings relating to the nature of the data currently maintained in schools and their [lack of] suitability for usable, useful and sustainable repurposing.

Introduction

Schools and education systems collect data about students, families, and teachers. The extent of data collection is startling when you consider data streams such as network log-ins, email traffic, web browsing, attendance (staff and student), students’ grades (and the teachers who gave the grade), photocopying and printing usage. These data are used for a variety of purposes – including internal school administration; target-setting; performance management; and student tracking. However, schools also collect data such as waste management, budgets, heating costs, canteen stock and sales, electricity usage, etc. The list of data surrounding a school, or an individual in that school, is extensive. However, most of the data, particularly in its raw form, is unseen, or seen by only a few. Indeed, those whom the data describe are often unaware of the data being collected, or have no access to the data, let alone understand the potential for using the data to better their own experiences and meet their own needs.

Although ‘data work’ is a core feature of contemporary schooling, Coburn and Turner’s (2011) observation that “the practice of data use is out ahead of research” (p.200) continues to be true. On the whole, researchers have reported school use of data as largely regulatory and ‘top-down’ - serving primarily to control the activities of those who work within schools (Selwyn 2011). Despite the expansion of school-related digital data, most data germane to the better running of schools remain inaccessible to many people within school organizations - particularly those outside of school administrative and managerial structures, such as classroom teachers, students and parents. However, the potential of democratized access to data within school communities is now beginning to be acknowledged (Graham et al., 2014). For example, it has been argued that the sharing of data throughout all school stakeholders is a means of empowering individuals to make decisions about their own performance, as well as the general ‘democratization’ of decision making, particularly in relation to those historically located at the periphery of school communities (for instance, see: Boudreau, 2010; Yoo et al. 2012). Such initiatives have also been argued to facilitate transparency and accountability within schools, which in turn has been associated with increased efficiency, productivity and collective innovation (Manyika et al. 2013).

Despite the claims of potentiality for ‘opening up’ data in schools, there has been little empirical research. As Rob Kitchin (2014) notes: “we lack detailed case studies of open data projects in action... and the messy, contingent and relational ways in which they unfold... which will provide answers to more normative questions concerning how they should be implemented and address issues of sustainability, usability and their inherent politics” (p.66). This need for empirical research is also highlighted by the considerable hype surrounding data and their potential for the more effective running of schools. For example, it has been claimed that data can be used “to enhance efficiency, increase transparency, support competitiveness, and as a tool to evaluate performance” (Eynon, 2013, p. 237). In addition, there has been significant interest in the use of Learning Analytics to leverage data surrounding student performance (whether it is generated by teachers or through student interactions with digital technologies) to provide useful and actionable insight for teachers, administrators and students (see Siemens, 2013; Pea & Jacks, 2014). However, there are relatively few critical studies of learning analytics in the school sector. Indeed, the field is largely focused on higher education and dominated by claims of potentiality; hinting that digital data is the panacea for the educational challenges and problems that face us. The current study addresses the need for empirical research; exploring if, when and how data could be ‘opened up’ and re-purposed to meet the authentic needs of school students, teachers and administrators.

Research Method

This paper reports on a component of a larger twelve month research study which sought to explore the potential of ‘opening up’ data within two large government-run, coeducational, suburban secondary schools in the Melbourne metropolitan area of Australia. The study adopted a ‘participatory design’ approach (see: Blomberg & Henderson 1990; Bodker et al., 1993; Sanoff, 2007; Spinuzzi, 2005) that moved iteratively through the phases of exploration and co-interpretation, discovery, prototyping and evaluation with the aim of supporting groups of different stakeholders within each school to design alternate ways of accessing and processing school data. The ultimate justification for adopting this approach is that participatory design (sometimes referred to as co-design) helps ensure that any result is designed specifically for the needs of the users while at the same time provides authentic co-creation of knowledge that leads to new situationally relevant insights (Bergold & Thomas, 2012).

The researchers in this study worked with groups of teachers, administrators and students to co-design new data applications and systems which related to their tacit knowledge and everyday experiences of school, as opposed to the official priorities and agendas of school authorities. While there was always a chance that a usable and useful product might be the result, the limited funding and exploratory nature of the project meant that the primary purpose was to use the participatory design activities as a research methodology to investigate the potential and realities of data re-purposing within the organisational confines of two school environments.

The first phase of investigation involved the researchers conducting detailed site visits and ‘data audits’ in conjunction with 10 interviews of key administrative and IT staff within each school. The goal was to identify the existing data sources that might be reconfigured along ‘open’ lines. In order to retain a manageable remit, the study focused on all data relating to the schools’ teaching and learning activities (as opposed to finance, workforce and other organisational data).

The second phase of investigation involved a series of workshops conducted separately with groups of teachers, administrators, and students in each school. During these workshops the researchers and participants (4-6 in each group) engaged in a series of iterative activities including: becoming familiar with the available data-sets; identifying ‘real world’ problems that the available data-sets might relate to; cooperatively designing paper prototypes for how they wanted to access and use the data to meet the identified problems. These workshops used an adaptation of the participatory design progression from exploration and co-interpretation, to discovery and prototyping. Research data was collected from the workshops in the form of observations, recorded discussions and analyses of the artefacts from the design processes (e.g. sketches, plans, storyboards). The research team acted as scribes for the drawing-up of the final designs.

The final phase of the investigation involved an application developer working as part of the research team ‘building’ and beta-testing simple versions of the open data applications designed in the workshops. The programmer also observed first-hand two of the design workshops so that they could understand the key issues and needs of the participants and better interpret the paper prototypes. To facilitate sustainability, ownership and maintenance, the project attempted to avoid complex application development in favour of the development of software tools that were already licensed, free or open source and cloud/network based. However, as will be discussed, the nature of the data and the prototype design necessitated considerable amounts of work ‘cleaning’ the data and in developing the application.

From the outset it became apparent that it would be highly problematic to co-design and develop an application for the student groups. In one school we could not access the students, and in the other the access was limited due to pressing curriculum and timetabling demands. Moreover, the nature of the data which students wanted to gain access to created tensions with the institutional culture. Specifically, the students wanted to compare their progress and achievement against that of their peers, however, the school leadership and teachers felt that students should focus on improving themselves, without over emphasising any comparison with others.

The four remaining paper prototypes resulted in two applications being developed: one for each school. During the prototyping workshops it was realised that the desired features with the prototype designs by the administrators and teachers were quite similar. The main distinction was that the teaching staff wanted to see their own classes, and the individuals within their classes while the administration staff wanted to see similar information at the year level, and across subjects. Therefore, it made sense to combine the administration and teaching prototypes, but to include filters so that the users can access their desired level of granularity.

Those applications that were developed successfully were then evaluated in the two schools by administrators and teachers. In this phase the teaching and administration staff were presented with the working applications and then interviewed to develop a sense of how successful the applications were in meeting their needs. This paper reports on a line of inquiry that ran throughout the project and which culminated in the development and evaluation of the applications. In particular, this paper focuses on the question of whether school maintained data can be re-purposed for teachers and administrators to meet authentic needs in their schools and classes.

Results and discussion

The project revealed the messy and contingent nature of school maintained data and has highlighted issues of sustainability, usability and their inherent politics involved in any attempt to repurpose that data. Tellingly, even though we were successful in developing working applications, this paper will explore how they were unsustainable and ultimately ineffective in meeting the needs of the very stakeholders who designed them. Findings relating to issues of democratisation, roles of data within organisational structure and the politics of open data approaches has been reported elsewhere (see: Selwyn, Henderson & Chao, 2015 & 2016). This particular paper focusses on issues of the nature of the data itself and its suitability for repurposing.

In addition to externally mandated data collection processes such as the NAPLAN test, it was found, rather unsurprisingly, that large volumes of data were being generated through both schools' use of their whole school administration package which was provided by the education department, accessible online and used by teachers, students and parents, as well as school managers and administrators. This system supported day-to-day school administration in terms of student attendance and personal records, internal assessments of student academic performance and behaviour reports. In addition, smaller specialised systems also involved on-going data work relating to class scheduling and room allocation, the monitoring of student attendance, engagement and welfare, and the production of student reports.

Both schools were also engaged in their own forms of in-house data collection. For example, one school had initiated a monthly cycle of internal data collection and reporting for all of their classes. This included teachers inputting indicative grades for student progress, as well as administering brief online surveys to their classes. This data was then reviewed by school leaders and provided to parents in what was described as a form of "real-time reporting" [participant#1]. In comparison, all teachers in the other school were required to create their own class surveys on a termly basis using Google Forms. These surveys were designed to generate data on student progress, engagement and opinions. This policy stemmed from concern within the school's leadership team that all teachers should be using evidence as part of their professional development obligations. In both schools, these internal data collection processes were motivated by concerns around accountability as well as improving learning and teaching through collecting evidence. However, while they satisfied the immediate need of being seen to collect evidence, the nature of the data being collected and the lack of data literacy on the part of the survey creators and consumers (e.g., the teachers) meant that diverse and arguably inefficient data practices were being created to try and make sense of the data that was generated and use them in meaningful ways.

Even in relation to the department mandated data collection processes using the centralised administration package the administration in both schools were finding ways to work with the data outside of the system because it was not deemed useful for their purposes. For example, participants referred to data being "sucked up" by the State Department and only later "spat back in report form" with limited usefulness because it was no longer timely and also system-wide rather than individual or cohort specific data. While individual data such as grades or behavioural reports were stored in the administration database it was laborious to access and not designed to provide

comparisons over time or across cohorts. As one teacher explained: “For us to get student grade data requires us to go into a [electronic] report, scroll through each one and in our head remember what was on that page and what was on the next page”. As a consequence school administration and teachers had begun to develop their own forms of in-house data work. For example, in one of the schools a senior leader had tasked himself with regularly exporting data and collating it in a excel spreadsheet which had over 200,000 rows of data and was described by several of the participants as “the biggest spreadsheet in the world.”

It is unsurprising that both staff and students had a desire to view data, particularly relating to student performance (which in the case of teachers and administrators included behavioural, attitudinal and wellbeing data). However, it was immediately apparent to the researchers that they also wanted to see that data in context over time and in relation to markers of success, particularly the performance of others. For instance, the teachers wanted to know how an individual student was progressing over time and in comparison with the rest of the class, without going through individual monthly term or semester reports. In other words they revealed that despite the significant amounts of data being collected on student activity, most of the data were disconnected from each other. They were aware of the latent potential of such data to help inform them to meet their needs and it was this potential application of the data which eventually became the focus of the participatory design workshops and application development.

Figure 1 shows a paper-based prototype of one school’s application, co-designed by the teachers and administrators with the research team. The teachers and administrators had identified a real need for quick and simple views that showed student performance (including wellbeing and behavioural) over time and in context of class, year and discipline.

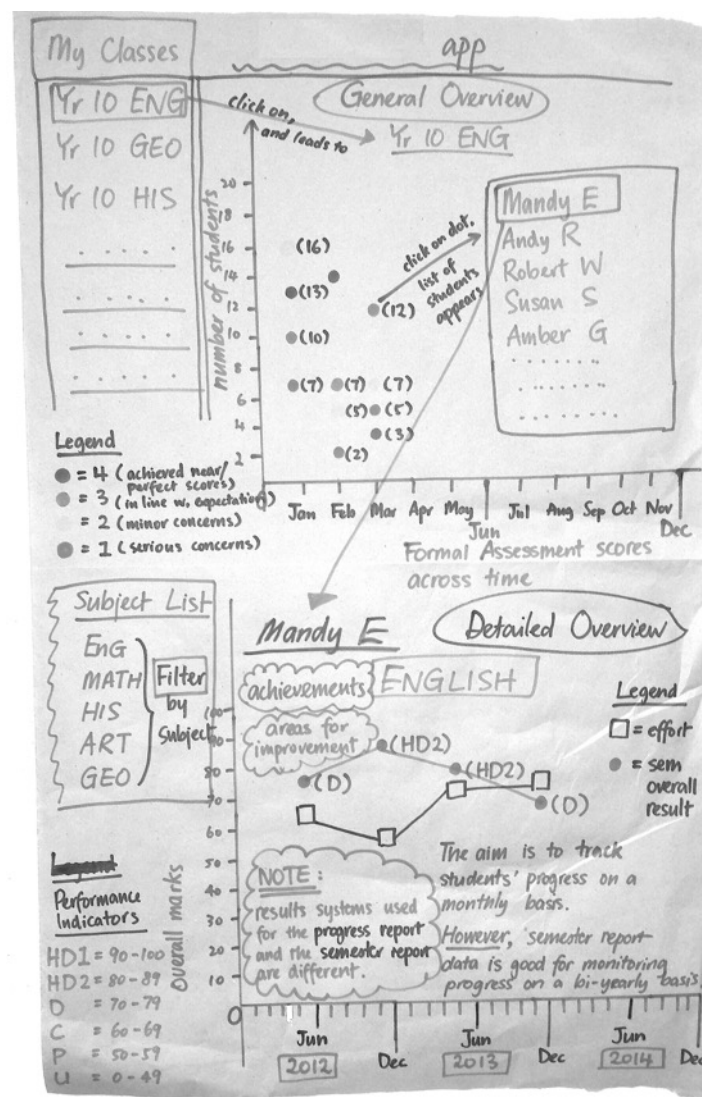


Figure 1. Paper-based prototype design for teachers and administrators at School A.

However, despite the participants' enthusiasm for re-purposing the school data to meet their different needs, the workshops and application development revealed several serious constraints particularly in relation to the nature of the data itself. For the most part, many of the available datasets were not linked at the level of the individual pupil, with identifiable ID numbers and codes used inconsistently and thereby compromising the interoperability of the various datasets. This was in part due to the creators of each dataset using different schemas (e.g., teachers used their own student codes when creating their own surveys or mark books), or the fact that the exported datasets from proprietary systems did not include data schema to allow linking of data. In many cases the only export option was to a pdf format which could not be easily integrated into a data system for re-purposing. In other cases, while the open-ended text data was supplied in full (i.e. as inputted at source by students and teachers such as mid-semester report comments), much of the closed numerical data had been modified into aggregate and composite scores or even reported as grades (i.e., representing a score range). A further constraint was the lack of automated 'real time' updates. All these datasets had to be downloaded manually by the school administrators rather than being automatically harvested which restricts the potential for longer-term practical sustainability of any developed application. It became immediately apparent to the researchers that the majority of the masses of data created by, or made available to, teachers and administrators could not easily be combined or compared. In other words, the data in schools were largely unfit for sustainable and meaningful re-purposing.

Eventually, the researchers were able to identify two primary data-sets that were available to them in each school and which could be manipulated for re-purposing, albeit with considerable difficulty: these were the term reports (also referred to in the schools as progress or interim reports) and semester reports. The remainder of this paper will focus on these two data sets and their re-purposing to meet the needs of the teachers and administrators.

Nature of the Data

The data that was provided was mostly a 'raw' view of the scores, separated into two different spreadsheets: one for the term data and the other for the semester data. When attempting to bring these two data sets together, significant developer time was spent cleaning up the data, for example removing duplications such as the student ID and the teacher ID. These had to be categorised and sorted into separate tables within a database so as to facilitate future manipulation and filtering. Another problem with the exported data was that way in which student names were exported, in some cases as a full name which made sorting according to surname difficult. In some of the data sets while student names or student ID were included, their teacher's identifier or year level was not, which meant that while we knew a student had completed an Maths test, we could not easily identify the teacher or year. This is an obvious oversight in the export process. Although time consuming these errors were relatively simple and obvious, however, other categories of data such as subject code, curriculum strand, and assessment items were problematic since they had not been normalised, often using different abbreviations or represented in different ways.

Figure 2 provides an example of the term (interim) and semester report data that were available to the administrators and which formed a large part of the data sets in our application development. An example of the messiness of the data can be found in School B's semester reporting which allowed the teachers to create any descriptor for assessment tasks which varied across the years and was only meaningful to the teachers themselves since the descriptors did not reveal the particular achievement standards being addressed by the assessment task. In addition, the score for each task is an aggregate of the individual marks that were awarded for demonstrating a range of skills. The lack of granularity or detail in the data immediately undermines any attempt to use the data to identify specific strengths or weaknesses. The data is inherently meaningful only to the teachers who inputted them—for everyone else any interpretation is general and unspecific. For example, in a focus group discussion of teachers and administrators in School B it was explained that the scores for assessment tasks do not provide the whole picture: "look at that 70%, it doesn't tell you that you got 70% because you didn't show any of your working out for any of the questions; that you got the right answer most of the time [and] would've got [more] points if you had of shown your working out." The focus group continued to discuss this issue with a senior leader suggesting that in terms of meaningful and actionable data, the "semester reports are a waste of time."

Arguably the reports have a primary function of communicating a student's progress to their family or carers. However, even this was questioned by the administrators and teachers in School B:

an interesting blip that has happened – we released progress reports and just recently we've had an issue with the database at the backend – which we don't run – but the database has mixed up classcodes and nobody has picked up on it. Parents haven't picked up the fact that a teacher's name is not the same as the teacher that taught [their child]. It's just a recent problem that's come up that made me think 'how many parents are indeed looking at this data?' Which

then makes me think ‘what’s the purpose of parents looking at this data?’ which then makes me think ‘well, how do we help them to take the data, understand it, and give them [tools to aid their child’s educational growth]?’

It appears that there is a real risk that the processes for documenting and reporting student progress may be deeply flawed: the data are generic and apparently of little actionable use for teachers and administrators, and potentially misleading to parents who assume such measure are valid and reliable.

School A semester results (per-subject sample)

Category	Label	Result
Work Habits	Effort	Acceptable
Work Habits	Behaviour	Very Good
Work Habits	Meets work deadlines	Acceptable

School A interim results (per-subject sample)

Academic Progress	Attitude & Effort	Organisation	Overall
Needs Improvement	Very Good	Very Good	4.45

School B semester results (multiple subject example)

AI.Code	AI.Desc	EnteredValue	DisplayedValue
AT1	Topic Tests	78	B+
AT1	Practical Reports	95	A+
AT1	Outcome 1 Performance	V	V
AT1	Assessment Task 1: Creating and Presenting	67	C+
AT1	Tests	85	A
AT2	Cardiovascular/Energy Systems Task	84	A
AT2	Research tasks	82	A
AT2	Outcome 2 Performance	V	V
AT2	Assessment Task 2: Oral Text Response	76	B+
AT2	Workbook	80	A
AT3	Biomechanics Task	75	B+
AT3	Tests	89	A
ATTOTAL	Overall Grade	80	A
ATTOTAL	Overall Grade	88	A
ATTOTAL	Overall Grade	76	B+
ATTOTAL	Overall Grade	76	B+
STUGOAL	Student Goal	This semester,	This semester, I would like to
STURFLC	Student Reflection	Over the past se	Over the past semester, I ha

School B interim results (per-subject example)

Attitude to Learning	Formal Assessments	Organisation for Learning
3	3	3

Figure 2. Samples of exported Term (interim) and Semester Report data from both schools

During the final interviews, both schools made comments of the value of using the data to perform historical analysis either to spot trends with student behavioural issues, or even to see whether or not they could effectively gauge a student’s performance during their time at the school based on a small set of data points captured early on. However, School A, for example, denied teacher access to students’ end-of-school examination results: “because in many cases some of the students are eighteen, it’s not your business.” It was also pointed out that significant markers of student performance were not included in the systems available to teachers, including NAPLAN results. Thus, another tension is revealed: key data are being left out, including final outcomes in a student’s school life.

There were also gaps in the data, such as when students did not complete an assessment or left the school. These gaps caused problems when using systems to create visual representations of performance over time, for example, we had to make decisions about whether to indicate a gap in the data as a drop in the line graph, an omission of a line or as an average between the two points. Each decision had an impact on the way the participants interpreted the progress of the student. However, the visualisation of data gaps did result in teachers identifying those anomalies quickly “We have two students there with no term three interim [data] – does that mean they left the school?” There is therefore some potential for visualisation mechanisms to help teachers observe anomalies in the data. However, as will be discussed later in this paper, the visualisations were largely flawed due to the validity and reliability of the measures being used.

Validity and reliability of measures

Validity refers to the degree to which the items measure what they are supposed to measure. Reliability is the degree to which the measures are consistent. In the report data there were many items which were assumed to be a valid and reliable measurement of student performance. However, validity is undermined when performance is measured according to ordinal categories that are presented as a scale. For instance in Figure 2, School A interim reports used measurement categories such as “needs improvement” and “very good” which arguably belong to two separate scales. Moreover the interim data for School A reports on three significantly different domains of performance (academic performance, effort and behaviour, organisation) which is then treated as a numeric scale and presented as a single “overall” numeric average. The conflation of three different domains of performance measured with dubious scales and averaged on a 5 point scale hints at a fundamental problem: the data is unlikely to be a valid representation of what it claims.

Another of the challenges with School A was that the teachers and administrators wanted to see if the data could reveal a pattern of performance across the year for the students. However, the semester report and interim report did not contain the same items to allow comparison. For instance, as indicated in Figure 2, the interim data reported on “effort and attitude” while the end of semester data reported on “effort” and “behaviour” separately. Clearly the data cannot be treated as comparable. Despite the fact that masses of performance data are being collected about students over time, the categories of data have not been planned to allow for tracking or comparison. This then raises the question: what is the point of the interim “progress” report if it is not a valid or useful representation of progress?

Reliability was also an issue with the data. In particular it was noted by leaders in the both schools that they were cautious about inter-rater reliability, that is, they felt the grading on various items (such as behaviour or attitude) may differ according to the particular teacher. Interestingly, this concern led administrators in School A to deliberately choose small scales to force teachers to avoid detailed scales the choice of a four point ‘scale’ for most items was explained as a deliberate choice to force teachers to not sit on the fence; “to make a commitment one way or the other.” It was felt that a gradual or detail scale would have resulted in confusion and indecision:

we could have gotten more gradual and said: ‘sublime’, ‘outstanding’, ‘commendable’, ‘very good’, ‘good’, ‘almost good’, and have ten-point scale. Then teachers would’ve said ‘well, where am I going to put them?’ How do you differentiate? Whereas - by having relatively few increments that becomes easier for teachers to distinguish ‘that’s excellent’ and ‘that’s very good’, it was an easier distinction to make.

Although this design decision in the generation of report data was purposefully chosen to support reliability of ratings, it was at the same time made unspecific and thereby resistant to any useful tracking of change.

Resisting visualisation and analytics

In most cases the data was converted into condensed or summarised form such as an end of term or end of semester report with no thought for meaningful comparison across semesters, students, or grades. However, this is exactly what the teachers and administrators co-designed the data applications to do. An obvious first insight is that any attempt to re-purpose the data is likely to fail. To highlight this point more clearly: a key function in the prototype designs was to be able to use the data to track a student’s progress over time and that some form of analytical process could be developed to create a warning system for teachers and administrators. Subsequently a traffic light system was developed within the prototype to track student’s progress; simplistically, it compared formal assessment results from the previous reporting period. Changes (either up or down) in their marks (in this case out of ten) would result in the cell background to change to a different colour (see Figure 3). However, while this was a co-designed feature of the application, the teachers and administrators found the reality to be less than satisfying. For example, in relation to one such traffic light system developed for School A:

It’s useful, but one thing it highlights is that one student that has gone from a 10 to a 9.5 is highlighted as having issues [by the system], when really they’re at the other end of students. So maybe being able to differentiate between the high students and the low students could be helpful. To see that they’ve gone backwards is helpful but maybe to compare that student to a kid who’s at a 3 and then going up to a 3.2, that child’s going to look like they’re doing better.

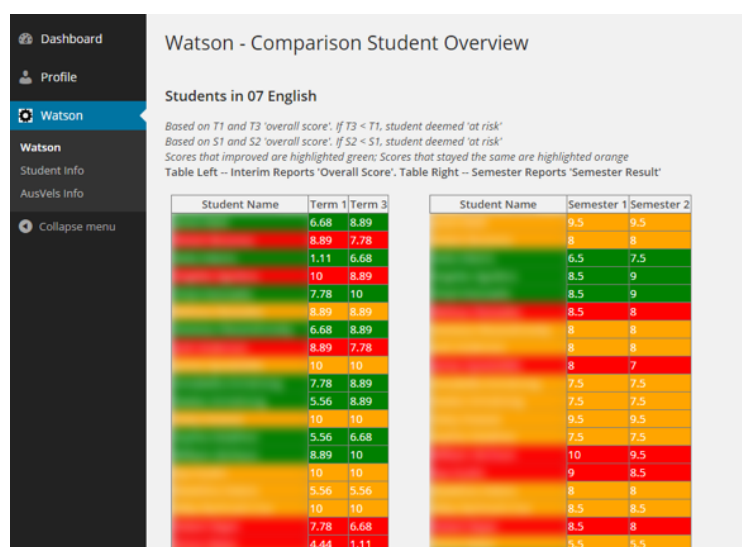


Figure 3: Prototype 'traffic light' system

Another requested feature of the application was to have visualisations of student progress over time with 'at a glance' views of their progress. In addition the teachers and administrators wanted to be able to see that progress in relation to the student's progress in other subjects, and in contrast to other students in their class and year. Figure 4 is one such visualisation and reveals the limited value of 5 point scales and the implications of data gaps (in this case, a student was enrolled in subjects in an atypical sequence which appeared to be data gaps and which could not be explained through the data since their enrolment sequence was not contained within the data).

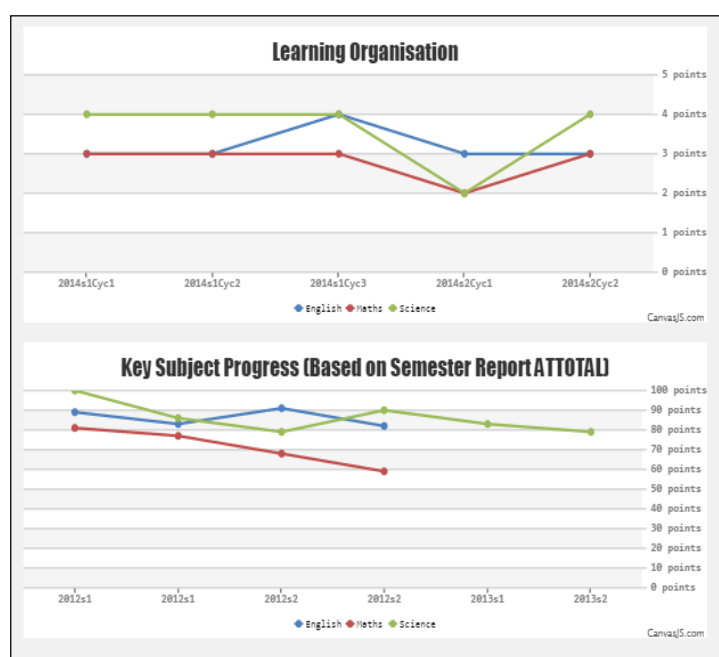


Figure 4: Example of visualisations of student progress with a filtered comparison across 3 subjects

School B's application revealed similar problems when trying to re-purpose the data for visualising progress over time. The participants in one focus group noted that each reporting period included or represented different sets of tasks that students had to complete. Some students would complete these tasks in a different order, while some sequences of tasks within the same subject had little relevance to each other since they focussed on different skills. As one participant pointed out: "The assessment tasks themselves don't have a linear progression in them necessarily; so you wouldn't necessarily see a linear progression." This was clarified by another participant who said: "This is assessment task scores, it's progression data because it's in some type of chronological order, but the skills between them might be entirely different; AT3 could be an oral presentation, and AT2 could be a written essay."

An interesting observation through the project was that the process of creating visualisations of the data to meet the needs of the stakeholders, such as line graphs and traffic light systems, generated considerable discussion amongst the teachers and administrators about the flaws in the data and the inherent deeply contextualised nature of the data. In response to the apparent inability of analytics and visualisations provide useful information from the school-wide data, a teacher from School B proposed that such school-wide data could be a red herring, and in fact we should consider how learning analytics could help teachers to leverage their own data generation:

we all keep our own markbook, and spreadsheets... You can imagine as a teacher actually having a selection of those widgets [from the prototype system] to say 'here's my data, can I look at this' and it helps you graph it. What that absolutely would change would be a shift towards personalisation, assessment for learning, really knowing your kids, really knowing the story of your kids, and allowing you to make changes which are on a much smaller scale very, very rapidly.

Conclusion

Large amounts of digital data about students are regularly being generated in schools, whether it is in whole-school administration packages or in individual teachers' markbooks. This project has revealed that teachers, administrators and students recognise that there is a potential for these data to be re-purposed to meet several needs, such as identifying undesirable variations in student performance over time and within cohorts. Indeed, we found that in the two schools in this project, both teachers and administrators are already trying to find their own 'hacks' to extrapolate meaning in a way that the data generation was never originally intended. In one case this resulted in a regular manual extraction of data from the administration package into a spreadsheet of over 200,000 rows to allow filtering and comparison of student data unavailable in the original system. However, it was also clear that the schools were limited in time and programming skills to create their own working systems to meet their needs. In addition, we have come to the conclusion that even if schools had such skills these attempts would be severely limited in what could be achieved with fundamentally problematic data generation. The data that are currently being generated are for specific and narrow purposes, such as to feed into a summarised reporting format in which details of assessment tasks, individual curriculum standards and skill performance give way to single line headings and grades or simplified descriptors. However, this also means that the data sets are riddled with gaps which impede effective tracking and comparison. Moreover, the various data generation goals have not been designed with each other in mind, which has resulted in uncoordinated approach to the types of data being generated and use of various measurement indicators that cannot be compared with a strong degree of validity. The measurement or performance indicators are also significantly flawed, not allowing fine grained analysis of student performance. Finally, the data systems being used have been shown to be isolated and non-interoperable often providing limited accessibility to the raw data that was inputted in first place.

Together, these flaws in the design of the data generation process, data storage and data access significantly limit how the data can be meaningfully re-purposed. Despite these limitations the project developed applications based on the designs of the teachers and administrators. The teachers and administrators appreciated the potential of these applications but confirmed that the data could only be meaningfully understood by those who are closest to the original input. For example, a teacher knew why a particular grade was given to a student, whereas someone further removed from the data could only interpret the data in a most general format. The validity and reliability of the data was therefore compromised.

This inherent optimism for the potential of data was maintained by all of the teachers and administrators in both schools, despite them also recognising the current data were not fit for such re-purposing. They recognised this tension, with one teacher claiming that implementing any data analytics is "a genuine waste of time unless it produces some change." Moreover, that there is a need to ensure that any data generation process and data analytics are not burdensome: "Data is another thing to throw onto a teacher's plate, on top of an already overloaded [schedule]."

We need to reconsider how and why data is generated before we can achieve the much promised potential of data analytics to improve school education, and in particular student learning and outcomes. As one of the teachers from School B highlighted, there is a need to reappraise what schools are trying to achieve through their data generation practices:

It's about agency of students to improve their own learning using this data, for parents to support their children's learning using this data, and for teachers to

support their [students] through using this data - that's what we really want to do with it.

The contingent and messy reality of school data means that much of it is not fit for such re-purposing. Schools and education systems need to resist the pressure to capture data simply because we can. Instead, data generation needs to be carefully designed to meet the immediate and broader needs of all stakeholders.

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