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The Implications of Analytics for Teaching Practice in Higher Education

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Executive summary

Many strong claims have been made for Learning Analytics and the potential which it has to transform the education system, which deserve to be treated with caution, particularly as they regard teaching practice.

The introduction of these techniques cannot be understood in isolation from the methods of educational management as they have grown up over the past two centuries. These methods are conditioned by the fact that educational managers are limited in their capability to monitor and act upon the range of states which are taken up by teachers and learners in their learning activities. Strategies for simplification have been developed which classify the range of knowledge as a number of subjects, reduce the subjects to courses, and assign students to cohorts which carry out the same activities. Teachers, meanwhile, deal as best they can with the full variety of learners' needs in their practice. Over the years, an accommodation has developed between regulatory authorities, management and teaching professionals: educational managers indicate the goals which teachers and learners should work towards, provide a framework for them to act within, and ensure that the results of their activity meet some minimum standards. The rest is left up to the professional skills of teachers and the ethical integrity of both teachers and learners.

This accommodation has been eroded by the efforts of successive governments to increase their control over the education received by both school and higher education students. Learning Analytics radically reduces the effort involved in gathering information on the way in which lecturers deliver the curriculum, and also to automate the work of analysing this information. An alliance of these two trends has the potential to constrain teaching practice, and therefore it is necessary to take a systemic view when assessing the impact of analytics on teaching practice.

Three types of analytics intervention are discussed, in terms of their impact on practice.

- efficiency in the wider functioning of the institution, which has few implications for teaching practice,
- enhanced regulation of the teaching and learning environment, which has potentially negative impact on teaching practice,
- methods and tools intended to help lecturers carry out their tasks more effectively, which have the potential to be a useful tool in teaching practice.

It is concluded that Learning Analytics should not be seen as a short cut to providing teaching professionals with universal advice on 'what works', and that its use to increase the accountability of teachers to management may have unintended negative consequences. Rather, the most promising area for enhancing teaching practice is the creation of applications which help teachers identify which of the many interventions open to them are most worthy of their attention, as part of an on-going collaborative inquiry into effective practice.

1. Introduction

There is growing enthusiasm for the potential of analytics in education from researchers, institutions and providers of education services, and the claims made are sometimes sweeping. We may take as paradigmatic Pearson Education, one of the major players in creating momentum behind the market in Learning Analytics tools and services, who tell us that:

We've been listening to what students, educators and administrators have been saying about what they need in order to achieve success. We've learned that empowering them with understandable insights from data and

analytics accelerates student achievement, improves instruction and increases student retention (Pearson Education, 2012).

The enthusiasm expressed in Pearson's marketing materials is not qualified by any suggestion that educational institutions should consider applying Learning Analytics selectively, or that its impact could be anything other than positive. Similarly, when asked if she was hearing any arguments against the use of analytics, the only response from Ellen Wagner (a high profile promoter of Learning Analytics) was that it may seem heretical because "we've all been warned in research methods classes that data snooping is bad" (Wagner, 2012).

Moreover some involved in the field claim that to be effective analytics must penetrate all parts of the institution. This is the position maintained, for example, by Dwayne Harapniuk, VP Academic Concordia University Alberta, who stated in a conference presentation that "Analytics must be enterprise wide. Everything must be based on it, we all have to accept that we are evidence based." (Harapniuk, 2012)

Clearly, not all analytics work in education takes this unreservedly enthusiastic and uncritical position. But equally clearly (as we indicate above) in some cases it is suggested that Learning Analytics

- a) is an unreservedly positive development for education
- b) provides insights which should take priority over other understandings in decision making in educational institutions.

This white paper proposes an analysis of why these claims should be treated with caution with regard to the professional practice of lecturers. It is argued that, firstly, current norms of educational practice are the result of a historical accommodation between the requirements of regulatory authorities and the practicalities of teaching practice; secondly, that this accommodation provides flexibility which is necessary in teaching practice; and thirdly that unless a conscious effort is made, this accommodation will be disturbed by the introduction of Learning Analytics, to the detriment of lecturers' professional practice. An implication of this line of argument is that some educational questions are un-decidable by data-driven processes, and that seeking to make them so implies the marginalisation of the skill and judgement which constitutes professional practice. The location of the line between decidability and un-decidability is, of course, an important theoretical and practical question.

It is not claimed that the present circumstances of professional practice in higher education are ideal, nor that Learning Analytics can do nothing to improve them. Rather the purpose of the paper is to point out some aspects of the introduction of analytics which may otherwise be ignored, and to consider their implications.

2. The Management of Pedagogic Activities

2.1 THE HISTORICAL CONTEXT

Educational practice is today coordinated by means of a complex set of instruments and processes, involving planning of curricula and learning activities, their enactment, and submission of reports to the competent authorities who then make supervisory interventions. This paradigm of planning and enactment is now ingrained in education, but it is not, as it may appear, an inevitable characteristic of education, as in the past there have been other paradigms. Socratic dialogue (Plato, 2008) is a method of teaching through philosophically rigorous conversation, often in a particular place (hence the *groves of academe*). Clark describes how, in contrast, medieval education was coordinated around the public reading of books and

disputation and 'The lecturer did what the word means: he read the text' (Clark, 2006, p.72). Clark goes on to place the origins of educational planning and enactment as we would recognise it today in the development of public policy in Germany in the Eighteenth Century. He describes how Johann Justi, in his *Grundstatze der Policywissenschaft*, called for ministerial supervision of university lectures to ensure their appropriate content and successful delivery. An approach which relied on direct inspection would clearly have been too labour intensive. Consequently

To this end, all instructors must report their upcoming lectures on time, so that one [that is the ministry] can judge whether there is a lack in the presentation of this or that discipline. (Justi, in (Clark, 2006, p58).

In the course of the two centuries since Justi, authorities around the world have, almost without exception, followed the strategy which he established, and set up an inexorably expanding repertoire of supervisory instruments and bodies in order to exert control over the educational process. Among these is the Quality Assurance Agency (<http://www.qaa.ac.uk>) which regulates UK higher education, while the schools sector in England is the responsibility of the office for standards in education (<http://www.ofsted.gov.uk/>).

2.2 STRATEGIES FOR SIMPLIFYING THE TASK OF EDUCATIONAL MANAGEMENT, AND THEIR IMPLICATIONS

The manager of an educational process, be it at institutional, regional or state level, is confronted with organisational problems which have much in common with the management of any other process. The manager is unable to respond to every change which occurs in the system. This is not simply because of the need for sleep, coffee and pizza, but rather because of the logic governing the exercise of control. Ashby's *law of requisite variety* tells us that a manager is only able to exercise control if the number of states which they can take up is equal to the number of possible states of the system to be controlled. The multiple actors and environments in the educational process are able to take up a very large number of combinatorial states as they plan and undertake learning activities. From the activities of each learner and teacher in each moment of each activity emerge issues to be addressed and problems to be solved. This generates a huge variety of states within the system to be managed, which are orders of magnitude beyond the ability of the manager to respond. The manager therefore needs a strategy for reducing the number of states of the education system to which they will pay attention. Liber (Liber, 1998) identifies three strategies for simplification by means of which educational managers achieve this.

1. knowledge is reduced to a number of categories or subjects (mathematics, psychology, history, etc.) which are embodied in schools or departments
2. students are categorised into available subjects, and levels of study
3. subjects are reduced to a set of courses, each with a curriculum, a lecture programme, reading lists and so on, with performance measured by assignments and examinations. Students are restricted as to which courses can be done in which order, and timetables enable the whole to take place.

Other strategies are possible, for example peer teaching and assessment, but the three identified by Liber have special status because they are mandated in Higher Education through quality assurance mechanisms allied with control of charters which authorise universities to carry out their business, access to student funding, and the international movement of students. The strategies have resulted in a set of instruments and processes with which educational managers seek to (a) achieve the best learning outcomes, and (b) to achieve this in the most effective way with the resources at their disposal. In these tasks, however, the effectiveness of this regulatory apparatus is constrained by two factors;

- In most management contexts the identification of successful outcomes is not intrinsically problematic (though verification may be time consuming). The criteria may be, for example, profit in the coming quarterly reporting period,

the tolerance of a ball bearing, or the failure rate of a component. However the verification of educational outcomes is contested, with school and university qualifications being continuously subject to scientific and political critique regarding whether or not they are a true or sufficient test of learning having taken place.

- The strategies for simplification make the management of education feasible, but they do not reduce the underlying complexity of education. Individual learners and groups of learners retain their own prior understandings, histories and preferences. Consequently, when applying educational plans in the classroom, teachers frequently find that they need to carry out revisions to the planned activities, either adjusting them in advance (to take into consideration local circumstances), or improvised (in order to respond as best they are able to the emerging needs of learners) (Sawyer, R Keith, 2011). These changes are in general either only partially documented and reported, or not documented at all, and consequently the regulatory apparatus of education cannot provide a full picture of the way in which educational resources are being applied. Indeed if they were reported, this would counteract the benefits which the simplification provides for managers.

These restrictions on the effectiveness of the regulatory apparatus which is at the disposal of educational management do not demonstrate that the instruments and processes employed are useless. Rather the implication is that, firstly, the effectiveness which they may have in reaching desired educational outcomes is entangled with the undocumented aspects of teachers practice (among other factors), and, secondly, that educational managers find themselves in a position where there is no possibility of disentangling this.

The consequence is that there is a level of recursion in the system which presents itself to managers as a black box, and within which management defaults to the professional practice of teaching professionals. We may add that even if an educational manager decides on a strategy for articulating professional practice, their ability intervene in this is further constrained (certainly in the UK context) by established and entrenched working practices reinforced through established measures of productivity and contracts of employment.

2.3 THE PROFESSIONAL PRACTICE OF LECTURERS

Within this context, what constitutes the professional practice of lecturers, and how is it impacted by changes in management practice and technology? The identification of certain categories as being professional in nature, and the characteristics which give them this status, has changed over time, and is highly contested. Cheetham and Chivers provide a valuable analysis of this complex topic, and we adopt their definition. According to this the purpose of a profession is '...to apply skilled service or advice to others, or to provide technical managerial or administrative services to, or within, organisations...' (Cheetham & Chivers, 2005). What is the nature of the skilled service or advice provided by lecturers? To qualify as being skilled it must surely involve something more than the mechanical delivery of curricula and learning content according to an established recipe.

It is proposed here that a large part of this professional practice can be characterised as mediating between the strategies for simplification of management and the variety of the learners for whom teachers have professional responsibility. In carrying this out, an accommodation has developed between regulatory authorities, management and teaching professionals: educational managers indicate the goals which teachers and learners should work towards, provide a framework for them to act within, and ensure that the results of their activity meet some minimum standards. The rest is left up to the professional skills of teachers and the ethical integrity of both teachers and learners. In this UK HE practitioners are typically supported to some degree by professional development units funded by the institution, although provision varies greatly across the sector.

From this perspective the weakness of the instruments of educational management in handling the detail of educational interactions may be seen as a merit, as it is this which provides the flexibility which teachers and lecturers need in order to be able to make valuable interventions with learners. However, this accommodation between management and practice depends on two conditions:

- that educational managers and regulatory agencies understand the limits of the effectiveness of their interventions
- that teachers and institutions are trusted to take up responsibility for educational success beyond those limits.

2.4 EDUCATIONAL MANAGEMENT AND MANAGERIALISM

Anthony Crosland was Secretary of State for Education and Science for the two years 1965-67. When he had recently completed his term of office, he stated that:

The nearer one comes to the professional content of education, the more indirect the minister's influence is. And I'm sure this is right ...generally I didn't regard either myself or my officials as in the slightest degree competent to interfere with the curriculum. We are educational politicians and administrators, not professional educators. (Kogan, 1971) cited in (Bassey, 2005) p.10

Teachers and lecturers entering the profession in the 1970s will have found by the time they reached retirement that this view of the role of political control over education had moved around to its polar opposite, in both school and higher education. Government officials now take responsibility for managing what shall be studied (for example by adjusting higher education funding arrangements) and the way in which courses are articulated (through the validation process, which is subject to the QAA). A full investigation into this change is beyond the scope of this paper, but two related developments which have contributed to it are worth mentioning here: the growth of evidence based policy, and the application of business management techniques to education at all levels.

Coe's Manifesto for Evidence Based Education claimed that Education 'is too important to allow it to be determined by unfounded opinion, whether of politicians, teachers, researchers or anyone else' (Coe, 1999). Coe carried on to identify controlled field experiments and the means of obtaining evidence, and this was also the approach mandated by the US Department of Education (United States Department of Education, 2003). In this we see education aspiring to the condition of pharmacology, with randomised trials determining precisely what professionals should or should not do in specified circumstances. There are two problems with the extension of this approach to education.

- As we have noted above, the outcomes of educational processes are contested to a much greater degree than are death rates or numbers of remissions. Not everyone is convinced, for example, that improving completion rates or retention is inevitably linked to greater learning or improved skills in the economy.
- There are serious methodological concerns about the cumulation of studies in the social sciences. Pawson provides a particularly cogent critique (Pawson, 2006). In his view causal efficacy is not an attribute of a policy intervention, but rather the product of a hypothesised mechanism operating in a particular social context. This reintroduces into the equation both educational theory (which hypothesises about the mechanism) and teachers' practice (which is a key part of the context).

Be this as it may, evidence based policy has become ubiquitous in educational administration, with cross party support. Michael Barber, who was head of the Standards and Effectiveness Unit and chief advisor to the Secretary of State for School Standards in the UK, attested to this in an interview, stating that 'I think one of the best things Blair did was design his

education reform to build on the important Conservative reforms.’ (Education Sector, 2006) He went on to characterise his methods as:

Large-scale reform driven from the top down; designing all the materials at the national level and training everybody in a cascade out; using the accountability system to publish results and school inspection to check that people were adopting better practices.

We also had a very tough agenda for dealing with underperforming schools...

This approach squeezes out the educator’s role in adapting the instruments of educational management to the needs of the learners who they have in front of them. As Furedi warns,

...the justification for the invention of procedures is to ensure that there is little room for context informed judgement. When lecturers are asked to leave paper trails and follow procedures, they are in effect forced to act in accordance with a template rather than on the basis of their accumulated practical wisdom (Furedi, 2011)

In order to implement this, new management techniques were required which could operationalize the criteria for recognising success. These were brought in from private industry, and according to Head, ‘the management tools which have been most widely applied in UK education has been the ‘Balanced Scorecard’ (BSC), with its Key Performance Indicators.’ (Head, 2011).

The present Conservative government has followed a similar approach. Michael Gove, current Secretary of State for Education in England, declared his intent in 2010 (Gove, 2010):

I want to see more data generated by the profession to show what works, clearer information about teaching techniques that get results, more rigorous, scientifically-robust research about pedagogies which succeed and proper independent evaluations of interventions which have run their course. We need more evidence-based policy making, and for that to work we need more evidence.

This message was reiterated in the paper *Test, Learn, Adapt: Developing Public Policy with Randomised Controlled Trials* published by the Cabinet Office in 2012 (Haynes, 2012). Within this framework the present government has adapted its strategy, with an attempt to delegate responsibility back to institutions. This is being done through free schools and academies, and, in HE, through the encouragement of new institutional identities for Universities, such as the move from ‘higher education corporation’ to ‘company limited by guarantee’ being pioneered by the University of Central Lancashire, and support for progress towards university status for the private Regents College, London.

It may be, however, that a looser managerial relationship between the state and institutions encourages an increased focus on evidence, indicators, and use of the regulatory framework to achieve changes in educational practice, hence the government’s commitment in 2011 to ‘put in place a new regulatory system that protects standards and quality’ for HE (Department for Business, Innovation and Skills, 2011). It can be argued that in this way HE institutions are being moulded by regulation into the image of contemporary businesses, and that the staff which they employ will apply the kind of management tools which they see as being business-like. In line with this trend, the Quality Assurance Agency (QAA) has published its intention to move towards a ‘risk-based approach’, stating that ‘these principles call for organisations like QAA, who have a direct responsibility for holding higher education providers to account, to ensure their activity: encourages efficiency and effectiveness; has a clear purpose and justification; relies on reliable and transparent data ...’

(QAA, 2013, paragraph 23). A reliance on 'reliable and transparent data' on the part of the QAA would no doubt further encourage HE institutions to gather analytics data which met these requirements, and, inevitably, to manage teaching and learning activities so that they maximised the generation of favourable data. Thus, whether or not detailed objectives are imposed at a state level, an effect of analytics on teaching practice seems inevitable.

The policy developments which we have alluded to in this section have eroded the conditions for maintaining the accommodation between educational managers and teachers identified in the previous section. More specifically we argue that

- Whatever the wider merits of evidence based policy may be, its application to educational management encourages educational managers and regulatory agencies to place greater (we would suggest unjustified) faith in the effectiveness of their own interventions.
- The status accorded to management tools such as the Balanced Scorecard and Key Performance Indicators has had a strong influence on what constitutes success in education. This has tended to move responsibility for this judgement up the hierarchy, from individuals to institutional managers, and from institutions to state regulators.

2.5 THE RELATIONSHIP BETWEEN LEARNING ANALYTICS AND MANAGEMENT PRACTICE IN EDUCATION

Education has a long history of taking technological innovations which have been developed in other areas, and applying them to its own problems, sometimes with hopes which appear exaggerated in retrospect. This is true, for example, of artificial intelligence techniques, multimedia, computer supported workflow systems, and mobile learning. Learning Analytics is both a continuation of this trend and a departure from it.

- Learning Analytics is a continuation of the trend in that it involves the education sector in catching up with new technologies which have been highly successful in transforming other fields. For example Wagner and Ice, in a high profile piece for Educause, have described Learning Analytics as being;

the learning world discovering what Internet professionals working in other market sectors have known for years: The 'digital breadcrumbs' that learners leave behind about their viewing, reading, engagement, and assessment behaviors, about their interests, and about their preferences provide massive amounts of data that can be mined to better personalize their learning experiences. (Wagner & Ice, 2012)

- Learning Analytics is a departure from the trend (while recognising fuzzy edges to this distinction) in that some proponents claim to provide insight into the educational process which is more extensive and reliable than that of education professionals. Previous technologies, while they may have had an impact on the educational process, were largely designed as tools to improve the capacity of educational managers and teachers to carry out their tasks (for example, computer programmes as a classroom resource), or, in some cases, to entirely replace human interventions (for example, tutorials using adaptive learning methods).

Learning Analytics may indeed provide insights which help understand the educational process. There is, however, a danger that the Business Intelligence (BI) techniques applied to explain what is happening in educational processes may carry with them explicit or implied models which make visible and prioritise certain categories of interaction. They may also determine the logic which leads to recommendations and actions.

Faith in the correctness of answers which emerge from technology in general, and the prestige and novelty of BI techniques in particular, may also erode the first of our conditions for maintaining the accommodation between educational management and teachers, by tending to reinforce managers' faith in the efficacy of their interventions.

The pressure on the second condition (that teachers and institutions are trusted to take responsibility for achieving educational success within the framework established by management) is increased when the techniques of Learning Analytics mesh with a management approach such as Barber's Deliverology. As Seddon argues (Seddon, 2008) these techniques represent the imposition of top down targets for public services, bringing with them a de facto purpose. Thus there is pressure to pay attention only to those aspects of education which are given significance and are the deliverable indicators.

The use of Key Performance Indicators is historically entwined with technology, although this may only have become apparent in education in recent years. According to Head (Head, 2011) the central insight of Kaplan and Norton, the originators of KPIs, was that 'with the IT revolution and the coming of networked computer systems, it is now possible to expand the number and variety of KPIs well beyond the traditional corporate concern with quarterly financial indicators...'. Education departments can now, like the US Department of Education, aspire to 'The goal of creating an interconnected feedback system ... to ensure that key decisions about learning are informed by data and that data are aggregated and made accessible at all levels of the education system for continuous improvement.' (US Department of Education, 2010). Learning Analytics is the means whereby this goal is to be achieved.

When outcomes of management intervention to improve indicators do not match expectations, the only explanations which make sense without breaking outside this conceptual framework are that:

- there is a problem in the design of the curriculum or planning of educational activities, or
- there is a failure on the part of teachers and lecturers to carry out to the letter the instructions which they have been given.

The response to the first of these has been a continuous extension and revision of the instructions given to educational institutions through quality procedures.

The second has been more problematic, because, as we noted above, there are more teachers than there are inspectors, and we may hope that this will continue to be the case in future. The appearance of Learning Analytics changes this equation. It promises to radically reduce the effort involved in gathering information on the way in which lecturers deliver the curriculum, and also to automate the work of analysing this information. Consequently one of the impacts of some approaches to Learning Analytics (though not the only one) is to increase the degree to which teachers' compliance with the instructions which they are given can be enforced.

3. The Scope of Learning Analytics

The scope of analytics in the world beyond education is extremely wide. The underlying insight which informs this wide range of applications is that data is generated by many online interactions, and that this can be used to inform understanding and support decisions, often in ways which were not foreseen by the designers of the systems. In 2007 McKinsey identified 'Making business from information' as a trend to watch, explaining that

... the aggregation of data through the digitization of processes and activities may create by-products, or 'exhaust data,' that companies can exploit for profit. A retailer with digital cameras to prevent shoplifting, for example, could also analyze the shopping patterns and traffic flows of customers through its stores and use these insights to improve its layout or the placement of promotional displays. It might also sell the data to its

vendors so that they could use real observations of consumer behaviour to reshape their merchandising approaches. (Manyika, Roberts, & Sprague, 2007)

A substantial business sector has grown up providing services to clients who would like to take advantage of this potential. As David Steier, Director, Information Management, Deloitte Consulting LLP, has said;

We work backwards from the (client's) questions, and then try to figure out what data sources does the client have in their possession that might be relevant to this, ... probably the set is broader than they thought' 'We do a data inventory ... and then trying to see from that which of the questions ... those pieces of data are relevant to. (ABDC, 2012)

This approach to analytics is opportunistic, in which the interventions carried out are dependent on technological decisions which were taken for another purpose, and on the questions which are the highest priorities for the client. These vary greatly according to the responsibilities which that person is charged with. From his experience Steier provides an indication of this range:

Executive	Top of mind questions (illustrative)
CEO / BU Leader	How do I get insights from different touch points to run my business better and enhance peripheral vision to identify new opportunities
CFO	What are the risks to performance from a revenue or cost perspective? Is there potential to identify challenges early?
Sales / Marketing officer	How can I measure sales and drivers of productivity by channel and individual sales person? How do I get a clearer view of who my customers are? What do they buy (e.g. individual vs. bundled products)
Chief Risk Officer	How do I predict and prevent potential errors and exceptions in my business processes?
Chief Talent / HR officer	How do I attract, grow and retain key employees?
CIO / CTO	How can I best support varied and dynamic business needs more rapidly

Table1: Adapted from David Steier's keynote to Big Data and the Cloud, Edmonton 2012

Two questions immediately present themselves:

a) Who are the clients in Learning Analytics?

Steier's experience shows that the use made of analytics is a function responsibility of the sponsor of the intervention. A recent report from Educause agrees with Steier that 'analytics efforts should start by defining strategic questions and developing a plan to address those questions with data'. (Bichsel, 2012). It goes on to identify the constituents involved: institutional research (IR), information technology (IT), functional leaders, and executives. To this list we can add the regulatory agencies which are not within the remit of Educause. Lecturers do not feature on this list, either individually or at departmental level or through representative organisations. This is, perhaps, unsurprising. Lecturers and their representatives do not have the access to the data, nor the resources to exploit it, which would enable them to pose their own questions. Consequently Learning Analytics interventions address one or other of the following areas of questions and concerns:

- The **efficiency in the wider functioning of the institution**, in areas which are not directly related to lecturers and their practice
- **enhanced regulation of the teaching and learning environment**, according to the priorities and questions relevant to of regulators, managers or researchers
- provision of **methods and tools intended to help lecturers and students carry out their tasks more effectively**, informed by the best efforts of researchers or managers to determine what information will be valuable to them.

For any of these the relationship with teachers practice, and the questions which are of interest to them is at best a matter for constructive discourse and negotiation, and at worst an imposition of inappropriate agenda serving someone else's interests.

b) What kinds of answers is it possible to obtain from the data, and what is beyond its reach?

The data available to Learning Analytics is generated by institutional systems. The most commonly used is the Virtual Learning Environment system (also known as a Learning Management System), but library systems, student record systems and the institutional web (among others) also provide valuable data. In an online environment these systems document many, or perhaps all, of the interactions between teachers and learners. In a face-to-face environment, however, many aspects of teaching practice are simply invisible to these systems (as they are to the management instruments described in 2.2 and 2.3 above). Learning Analytics applications in face to face environments can be designed either to ignore this blind spot (with the danger that they will constrain or counter teachers' practice), or to recognise that the insight they provide can only aspire to being a valuable, but partial, support for practice.

4. Examples of Learning Analytics Interventions, and their Impact on Professional Practice

Our discussion so far argues that Learning Analytics should not be understood as simply another tool available to educational managers and teachers. Rather, it is entangled with evolving changes to the professional role of teachers, and to the nature of state management of the education system. It also has the potential to undermine still further the already crumbling accommodation which we have identified between educational management and teacher's practice. Some readers may find

this view unduly pessimistic. However, this paper does not seek to demonstrate that Learning Analytics is inevitably counterproductive for teachers practice, but rather that,

- there are coherent reasons for caution in the application of these technologies in teaching and learning
- there is a need to take a systemic view of their impact within both the educational institution and the regulatory framework which seeks to control it.

Many different types of intervention come under the banner of Learning Analytics, and they vary widely in the degree and nature their relationship to the concerns which we have raised. In the light of this, in following sections we will look at examples of Learning Analytics interventions and consider the potential opportunities and dangers which they offer for professional practice. We discuss these in terms of the three concerns of analytics identified in the previous section:

- efficiency in the wider functioning of the institution
- enhanced regulation of the teaching and learning environment
- methods and tools intended to help lecturers carry out their tasks more effectively.

4.1 ANALYTICS ADDRESSING THE WIDER FUNCTIONING OF THE INSTITUTION

As we have discussed in the previous section, the scope of analytics within educational institutions is wider than teaching and learning. Customer Relationship Management (CRM) was perhaps the first area applied to education to go make use of the data generated by institutional IT systems. By 2002 Wilson was already arguing that CRM acknowledge ‘the power of individualisation, the need to concentrate on the whole relationship and the ability to exploit IT-enabled channels’ (Wilson, Daniel, & McDonald, 2002). In the UK the JISC has made a substantial effort to support this work, see (Perry, Corley, Perry, Corley, & Hollins, 2011) for an overview, and the CETIS CRM site for more information¹. CRM applied to education is now a relatively mature field which makes use of many widespread business analytics techniques, and packages are marketed to education by industry giants such as Oracle² (REF) and Microsoft³.

A more recent innovation has been to use analytics to monitor student’s progress and to deter them or encourage them in their choice of courses. For example, Austin Peay State University has developed Degree Compass, which is ‘Inspired by recommendation systems implemented by companies such as Netflix, Amazon and Pandora’ to pair students with appropriate courses. In doing this it “uses predictive analytics techniques based on grade and enrolment data to rank courses according to factors that measure how well each course might help the student progress through their program’ (Austin Peay State University, n.d.) There may be concern at the appropriateness of the use of technology to carry out this task, or its ability to perform it well. But at present many lecturers and students do not engage in these conversations, and so the provision of an automated system supplements existing professional practice rather than constraining it.

¹ <http://jisc.cetis.ac.uk/support/relationship-management>

² <http://www.oracle.com/us/products/applications/peoplesoft-enterprise/crm/052827.html>

³ <http://www.microsoft.com/gulf/dynamics/crm/education.aspx>

There is also scope for analytics in the efficient use of estates, and energy consumption. A press release from EnerNOC claims that their services are used in four Californian universities to monitor, analyse and manage energy usage (EnerNOC, 2010).

Thus, while there may be concern about privacy, or about the reduction in estates which such analytics informed facilities management makes possible, there are many analytics interventions in education which are largely independent of teachers' day to day practice. Moreover in many cases they would be welcomed by teachers as improving the financial health of their institution (and hopefully doing the same for their job prospects). An exception to this is retention, an important aspect of CRM which will return to below.

4.2 ANALYTICS AS ENHANCED REGULATION OF THE TEACHING AND LEARNING ENVIRONMENT

In section 2 of this paper we have shown how management practices and have become aligned in a way which creates the potential for the exercise greater control over teaching practice. Little research has been carried out to establish if this is the case, which we ascribe to the invisibility of much of teaching practice to the instruments of educational management. Indeed, one of the purposes of this paper is to provide a rationale for the need for this to be undertaken.

At the policy level, however, there is clear evidence that it is the questions and priorities of regulators and managers which are primarily driving the adoption of analytics. Educause, a non-profit association whose mission is to advance higher education through the use of information technology, has been a key organisation in promoting Learning Analytics. An Educause expert panel on analytics recently stated that analytics in education is 'driven by increasing accountability, along with a proliferation of tools and data. More people have access to relevant data and can make decisions to yield improvements more quickly' (Educause, 2012).

That universities should focus on accountability is understandable, as it can have major financial consequences for institutions. To take perhaps the largest scale example, in the United States 'for-profit colleges enrol less than 10 per cent of the nation's students, but get almost a quarter of the \$24 billion the government provides in Pell grants and Stafford loans. And students at for-profit institutions have a higher default rate than those who attend public or non-profit colleges' (Lewin, 2010). The US government is seeking to restrict the flow of these funds to colleges which have high default rates, by means of 'metrics for assessing graduates' ability to repay their student loans as a way of judging whether an academic program is truly fulfilling its mandate'. Ensuring that these metrics are met is therefore of the highest importance for institutions, and analytics become the territory within which success is both facilitated and defined. These institutional financial concerns are tightly linked to the performance of lecturers and students, and this fact intervenes in any other pedagogical discussion. Wagner states this clearly:

Our hope is to do a great job creating the type of data resource that we can use to demonstrate, using our own questions, ways to help maximize probabilities of student success--with a keen eye on the national college completion agenda. (Wagner, 2012)

It is also understandable that private for-profit universities have taken a significant role in the application analytics in education. This is the case, for example, of Phoenix, the largest for-profit university, where metrics have a particular importance, as it has a default rate almost twice the US average (Verbrigghe, 2012). Similarly the American Public University System (confusingly a private for-profit institution) has contributed extensively to the Predictive Analytics Reporting Framework initiative (Wagner, 2012). Given the regulatory framework and the pressure from the department of education, it seems almost inevitable that educational managers will focus analytics on issues such as retention and successful

completion while other pedagogic concerns are squeezed out, bearing out Seddon's contention (above) that targets bring with them their own de facto purpose purposes. There is a danger that such initiatives will force teachers to focus on the achievement of a constrained set of criteria for successful outcomes, and the expense of the pedagogic interventions which have traditionally formed the core of their practice.

4.3 ANALYTICS INTENDED TO HELP LECTURERS CARRY OUT THEIR TASKS MORE EFFECTIVELY

Institutional and professional priorities

In the previous section we have seen confirmation that the environment within which educational managers operate places them in a position where accountability and indicators become the highest priority. As education professionals, however, they are also concerned that students learn and develop. One response to this double focus is simply to dissolve it by maintaining that both amount to the same thing. This position was neatly summarised by Dwayne Harapniuk, VC Academic Concordia University Alberta, when he said, making a connection which will not be self-evident to all educationalists: "We are student centred, so we go by student grades." (Harapniuk, 2012). In this section, however, we will look at some analytics interventions, and consider how they serve these two goals.

The goal of analytics is not only to react to the present, but also to predict future trends and respond accordingly. For example **Rio Salado University** claims that they can predict with 70 per cent accuracy, after 8 days of class, whether a student will score a 'C' or better. (Parry, 2012). Similarly the **American Public University System** (APUS) monitors and analyses student participation in online systems and as a result 'has watched retention rates at the 97,000-student online school steadily climb with the continued analysis of in-depth information that shows when a student might be on the verge of dropping out' (Carter, 2011). Given that this information is available, how should we respond to it? At the LAK12 conference I asked this question over dinner to a leading figure in Learning Analytics at a private university. Their response was that the best students will pass anyway, whatever you do; the poorest students will fail anyway, whatever you do, so, the logical strategy for a university manager concerned about completion rates is to focus efforts on those students who are on the borderline. This raises clear issues for the practice of lecturers, who under this policy are requested to abandon a section of their class. In this way they are guided to focus on average pass rate, rather than distributing their effort more equally in an attempt to maximise the intellectual and academic achievement of each student. There are, however, alternative ways of making use of this data which can avoid these problems, or enhance lecturers practice.

Supporting professional interventions

We have argued above that a key aspect of lecturers practice consists of mediating between the strategies for simplification of educational management and the variety of the learners for whom teachers have professional responsibility. The institution, through the curriculum and the cohort, treats all students as being the same. However, in adapting their teaching and guidance to the needs of their students, lecturers have to develop an approximate model of the capabilities, engagement and learning of their students, and to use this to inform their interventions. The degree to which lecturers are successful in this will determine the retention and pass rates on which they will be judged, and it seems reasonable to assume that support in this will be welcome.

A number of well-known applications of analytics in the US have made use of predictive analytics to provide automated services, which relieve the lecturer of the burden of providing academic guidance to their students. A good example of this approach is the **E2Coach system at the University of Michigan**. This provides guidance to physics students, building on

the Michigan Tailoring System, an open source toolkit developed to provide health advice. E2Coach analyses a voluntary questionnaire filled out by students at the start of the course, information drawn from their grade books, and historical data generated by nearly 50,000 students in introductory physics courses over the 14 years. The result is a service which provides:

... the interface between students and the extensive and powerful resources available in each course, customizing recommendations for study habits, assignments for practice, feedback on progress, and encouragement they receive. At important points in the course, each student receives detailed feedback on their current status, along with normative information about how their work compares to their peers and predictions for what final grade they are most likely to receive if they continue to approach the course in the same way. A significant strength of this system is its ability to realistically predict how much better each student might hope to do if they improve their approach to the course. (Mckay, Miller, & Tritz, 2012)

One can see how such a system, if effective, has the potential to reduce the load on lecturers, and improve pass rates. However, the link with lecturers' practice appears to be weak. E2Coach seeks to automate the provision of guidance, with no intervention by the lecturer. It remains to be seen if this will enhance the practice of lecturers, by freeing up time, or if it will squeeze out an aspect of interpersonal practice, and replace it with a cheaper automated service. It thus stands or falls by the quality and power of the artificial intelligence techniques which it applies.

In this respect it is relevant to consider Dillenbourg's advice to anyone wanting to make a difference in education: 'Don't try to invent something smarter, more powerful, bigger, something that predicts or guesses what people think or want. Instead, go for the simplest solution, something that can almost be unnoticeable in the classroom'⁴ (Daily Adventures, 2012). What would a Learning Analytics system which adopts this advice look like, and how could it support lecturers' practice?

The **Course Signals project at Purdue University** (Arnold, 2010) is a useful indication how this approach could be implemented. It enables a predictive student success algorithm to be run on-demand by instructors. The algorithm is applied to four categories of data;

- performance, measured by percentage of points earned in course to date
- effort, as defined by interaction with Blackboard Vista, Purdue's LMS, as compared to students' peers
- prior academic history, including academic preparation, high school GPA, and standardized test scores
- student characteristics, such as residency, age, or credits attempted.

The output is a red - yellow - green indication of the prospects for success. Lecturers can then implement an intervention schedule they create, possibly consisting of:

- Posting of a traffic signal indicator on a student's LMS home page
- E-mail messages or reminders

⁴ Thanks to Eric Duval for pointing out the relevance of Dillenbourg to Learning Analytics at LAK12 .

- Text messages;
- Referral to academic advisor or academic resource centres
- Face to face meetings with the instructor

The Course Signals team provide a valuable (though unfortunately unusual) evaluation of the impact of the analytics on lecturer practice, concluding:

In general, faculty and instructors have a positive response to CS but many approached the system with caution. Before using Course Signals, faculty initially expressed concern about floods of students seeking help; however, few actually reported problems after they began using the system. The most commonly reported issue being an excess of e-mails from concerned students. In addition, faculty reported concerns about creating a dependency in newly arrived students instead of the desired independent learning traits. A final faculty concern was the lack of best practices for using CS, demonstrating that instructors and students share the same concern about the lack of best practices. (Arnold & Pistilli, 2012)

More specifically, two lecturers report that the system is valuable to them because:

“...you can track how many people have moved from a red to a yellow or a yellow to a green or vice versa.” and “This past fall I had sixty students, so I can't remember how they are all doing, so the signal colours really help”. (Course Signals, 2012)

The Sherpa system developed at South Orange County Community College is a similar system, but with a customisable algorithm for identifying at risk students. It is ‘an academic recommendation engine that combines human expertise and predictive analytics to provide students with the right information at the right time to facilitate better academic decisions’. (Bramucci & Gaston, 2012). The system includes a dashboard with which an administrator can search the data held on students to identify a particular subgroup, for example [At-Risk Athletes = [Student Athlete] + [GPA < 2.0]. A ‘nudge’ can then be generated, which consists of a message which can be sent to these students by a variety of means (portal RSS email Facebook mobile), and rated by the recipient.

In the UK the **Open University** is developing an initiative building on the Signals approach. In this case, since the Open University is a distance teaching institution, the key issue was ‘how to identify potential difficulties based solely on student data, so that lecturers could be more strategic by targeting interventions towards students who are most in need’ (Wolff, 2012). They report that:

The key finding of this investigation has been that a student's behavior on the VLE is generally consistent, until they hit a problem. ... Therefore, better predictive power is gained by detecting changes in a student's behavior compared to their own previous behavior, rather than trying to build a profile of an ‘average student’ as a benchmark. ... It is not only students who are unique. Each module also has a distinct profile that causes learners to act differently from one module to another. ... It is important to know where these points of engagement are expected to occur and what form they take so that this knowledge can be used to improve prediction. (Wolff, 2012)

This raises some important points that are relevant to teaching practice.

1. This automated approach follows teachers' practice in watching for dips in performance as a trigger for intervention, rather than simply relying on benchmarking, is maintained in this automated support. It seems reasonable to suppose that this gives the technology a better chance of being assimilated into teachers' practice.
2. The need to identify 'where points of engagement are expected to occur' constitutes recognition that the meaning of data generated by students in one learning context is not directly comparable with that generated by the use of the same learning application in another learning context, or with another group of unique students. This is not problematic if one is looking for changes in a student's behaviour. But it means that in order to identify 'what works' we need a hypothesis which explains the differences between contexts. Consequently there are strong contextual restrictions on the identification of 'best practice', and its justification by means of Learning Analytics.
3. In view of point 2, Learning Analytics does not offer a way to cut through the confusion generated by educational theorising, but rather a new set of data which can feed into both theory and experimentation in practice.
4. In order to determine 'points of engagement' Learning Analytics has to take account of the design of learning activities. For existing courses this will depend on retrospective analysis, but there is an implication that the design of learning activities should increasingly consider data analysis as a facet of design. From the perspective of point 2 this will aspire to establishing not simply 'what works', but rather 'what works for whom, in what circumstances, and why'. The answers to these questions would certainly be of relevance to professional practice. See (Griffiths, Richards & Harrison, 2012) for a further discussion of this.

5. Conclusions and Recommendations

The task undertaken in Learning Analytics of taking techniques drawn from Business Intelligence and applying them to education is complicated by two principal factors. Firstly, education, like medicine and other public services, the collection and response to analytical information is subject to ethical concerns. Secondly, the identification of successful outcomes in education is contested, to a greater degree than other public services, hence the long standing debate about what constitutes a good education, and how it can be measured. Differences of opinion about these two factors will inevitably extend to the application and interpretation of Learning Analytics as they apply to teaching practice. Moreover, we have also argued that the educational context, in all its variety, can determine if practice is successful, and that consequently the results of Learning Analytics initiatives require interpretation if they are to be generalised. Our first conclusion is, therefore, a negative one: that **Learning Analytics does not offer a means of cutting through the confusion of educational theory, nor a short cut to providing teaching professionals with universal advice on 'what works'**. We suggest that any initiative which believes, on the contrary, that this is possible will have a negative impact on teaching practice.

We have shown how Learning Analytics offers opportunities for educational managers to deploy new methods, as one might expect for a technology developed in a business management context. More specifically we have argued that **analytics techniques have the potential to disturb the balance between educational managers and the practice of teaching professionals, by extending the ability of the former to gather and process information about the latter**. This aligns with the wider trend towards increased managerial control in education. An approach to educational management which sees teaching practice as being in need of improvement through careful and detailed regulation is now presented with a range of

new tools with which to act. The result is a potential threat to the exercise of professional skill and judgement in teaching practice, because areas which could not previously be supervised are now open to automated inspection and control.

There are, however, contrary views of the function of teaching practice, which focus on the way that teachers can facilitate the development of individual strengths based on personal history of learners, and mediation of this with the structure and processes of the education system. Following this approach, **Learning Analytics holds promise for the creation of applications which help teachers identify which of the many interventions open to them are most worthy of their attention**. Such systems can send nudges to lecturers, for example alerting them to the need to pay attention to students or interactions that may have slipped below their radar. Many analytics techniques can contribute to this, including using sentiment analysis to flag up posts and messages on institutional systems which need urgent attention, or analysing patterns of engagement to **identify students who are in need of timely support, and may suggest possible actions**.

We may conclude from the discussion of Learning and the examples given in this report indicate that any Learning Analytics system implies a particular view of what constitutes good teaching. We believe that this should be made **explicit as a model of pedagogic practice in the design and deployment of the system**, which should be informed by an agreed pedagogic strategy. Similarly, the effectiveness of the system will be increased if its capabilities are **taken into account in the design of learning activities**. Finally, if the Learning Analytics system is not to become a straitjacket for practice, there is a strong case for **designing systems jointly with the teachers who will use them, and for revising them as part of an on-going collaborative inquiry into effective practice**.

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