

Learning Analytics to evaluate and confirm Pedagogic Choices

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ABSTRACT

This chapter will describe, evidence and critically evaluate a pedagogical journey which takes the reader from a traditional position of the “academic as a domain expert” to what turns out to be a far more effective position as the “academic as a Learning to Learn expert”. The evidence used to confirm the value and effectiveness of this changed approach by the author over a period of 5 years or so is based on Learning Analytics which demonstrate significantly improved academic results and achievements. The confirmatory evidence derived from the Learning Analytics is now being used to make informed choices by other colleagues to change their own pedagogical choices to also develop excellent achievement in their own modules and programmes. It is also being used to guide the design of new learning spaces in a new STEM facility that is in development at the University..

INTRODUCTION

Learning Analytics can be of great value in helping academics to evaluate the impact of different pedagogic choices. It should, therefore, be considered a standard part of academic continuous professional development practice, an aid to reflection, a guide to the continuous development of teaching practice and materials. If this is to be the case, then it is vital that the analytics techniques and tools and data employed do not impose an unnecessary burden on the practitioners themselves.

This chapter uses a case study evaluation of the author’s recent practice to demonstrate how changes to pedagogy have been shown to have unexpected and powerful consequences in terms of student achievement using very simple forms of analysis and data collection which imposed minimal workload on the author.

The pedagogic practice change that is evaluated for effectiveness is a change from the comparatively traditional perspective of the “Academic as Source of all Knowledge” to an approach of the “Academic as source of Learning to Learn Skills”. A consequence of this changed perspective is that the, so-called, teaching approach is no longer to concentrate on delivering the domain knowledge, facts and answers but on clarifying domain concepts, relationships and sets of important questions that the learners must be aware of and understand. This provides great freedom to use as much of the allocated contact time as possible or necessary for one-to-one and very small group formative discussion and feedback, there is little or no need to dedicate much time to delivering the domain facts which can be easily researched and read by the students, provided that suitable signposting is provided. It is an approach that stops trying to fill leaky buckets with information and replaces it with lighting the fires of inspiration and enquiry (to amend Plutarch (100 A.D.)).

The Learning Analytics demonstrate conclusively the significant increase in average marks achieved by the cohorts as a result of the change.

Comparison between different approaches to generating the analytics is presented to illustrate the value of simple Microsoft XL based analytics in aiding the understanding the basic messages of the data, and illustrating the additional insights that can be obtained through the use of more complex analytics based on using the SAS® statistical methods.

Key academic research based literature is introduced in the section entitled ‘academic as “learning-to-learn” expert’, where justification for researched and problem based pedagogy is introduced..

OBJECTIVES

There are three objectives for this paper:-

1. Outline and evaluate the pedagogic choices and implications
2. Identify and critically evaluate lessons from the application of Learning Analytics
3. Demonstrate the ease of applying relevant Learning Analytics to evaluating the consequences and impact of pedagogical choices

ACADEMIC CONTEXT

This section of the chapter provides an understanding of the context in which the pedagogic choices were being evaluated and the nature of the modules that were taught by the author in both styles of teaching. The application of Learning Analytics was an almost accidental side effect of providing information for the end of semester module report but became very important in terms of selling the changes to skeptical colleagues, as will be seen in this section.

BACKGROUND

The author started teaching at the University of Derby in 2002, following a thirty year career in industry.

This case study draws on the recent experience of the author, as the School Learning and Teaching Advisor (SLTA) for the School of Computing and Maths in academic years 2011/2013, during a period when Student Satisfaction scores in the National Student Survey (NSS) had to be improved rapidly for one particular BSc Programme. In addition, in common with many UK Higher Education (HE) institutions, there was the significant BMEI grade gap, which averages some 10 to 15% less than the White grade average.

The role of the SLTA was to identify new ways of engaging the students, delivering the academic content and introducing ways of assessing the students and to gather examples of great practice that were capable of being implemented across the programme and the School. At the same time, it was clearly necessary to build the most persuasive case for change.

In order to build this case for change, measures other than the NSS questions needed to be identified. One set of the metrics that needed to be developed was clearly the measurable impact on achievement in terms of grades and grade profiles. This is because changing teaching and assessment philosophies is often considered to be risky and colleagues need to have some re-assurance that achievement results will not be worse than before and should be improved.

In addition, they may also need to convince their external examiners of the validity of the proposed changes, particularly if significant changes are made to the assessment approaches and that the dramatic improvement in marks is not just a result of grade inflation attempts but, rather, is fully grounded in achievement of the required learning outcomes for the module and the programme. This latter aspect can be a concern in the UK HE environment, given the constantly rising numbers of high achieving students (grade inflation).

The Metrics

A critical consideration in choosing the set of metrics was that the data was already being generated, in large part, during the assessment marking process, thus delivering the data “for free”, a factor that figures significantly in all academics’ minds when new metrics are suggested. End of Semester and End of Year module and programme reports are a normal part of academic quality systems and will, if best practice is followed, consist of a reflection on all aspects of Teaching, Learning and Assessment, including objective evidence to support the reflection.

Achievement profiles and metrics are one of the most persuasive ways of proving the merit of new approaches. In other words, Learning Analytics is key to the persuasive case for change.

PEDAGOGICAL APPROACHES

The journey starts with traditional “Academic as source of all knowledge” approach, with long seminar / lectures, students who did not read or research, who only worked the minimum necessary to write the assessments. Grade profiles were similar to other modules across the respective programmes.

The journey then changes gear to the current “Academic as source of Learning-to-Learn skills”, with a research intensive approach, little direct teaching and outstanding quality of writing and e-publication of many of the assessed output articles, see <http://computing.derby.ac.uk/wordpress/student-publications/> . Grade profiles were fundamentally changed for the better.

THE MODULES

Seven different modules provide the data for this case study which span a period from 2004 to 2014. The basic data for each module is given in Table 1. All the 15 credit modules were taught using the Didactic approach and the new 20 credit modules were taught using the Socratic approach.

The 20 credit modules were designed as part of the diet for a fully re-designed BSc IT programme, which was necessary as a result of an institution wide change from 15 credit modules to 20 credit modules. The opportunity was taken at this point to take advantage the new validation process and very supportive academic management to change pedagogic philosophy to take advantage of some evidence which suggested that a different approach might be very beneficial.

All the module instances that form the basis of this analysis were taught and assessed by the author. This this controls for variations in teaching style or marking standards between different tutors which might perturb the clarity of the analysis. All the results in this evaluation have been both internally and externally moderated according to the institutional quality systems.

Table 1 Case Study Modules

Course Code	Credits	Course Title	Dates	Year of Degree
5CC006	15	Information Systems Management (ISM)	2005, 2012	Second year
6CC036	15	Systems Methods for Problem Solving (SMPS)	2004, 2005, 2006	Final Year
6CC044	15	IT Law and Governance (ITL&G)	2007, 2008, 2011, 2012	Final Year
5CC521	20	IT Services Management (ITSM)	2012, 2013,	Second Year
6CC506	20	Enterprise Systems (ES)	2012, 2013	Final year
6CC508	20	Information Security and Assurance (ISA)	2012, 2013	Final Year
6CC517	20	Sustainable Information and Corporate Governance (SI&CG)	2012, 2013,	Final Year

DEFINING ASSESSMENTS AND MARKING CRITERIA

All three 15 credit modules were assessed against “holistic” criteria, as was the standard for the institution. In 2005, the author, drawing on experience from working in the School of Business, introduced the use of the overall holistic criteria applied to different aspects or components of the work with identification of which elements would be most significant in forming the overall judgment of the final grade for the assignment, there was, however, no explicit use of weighting factors.

Information Systems Management

The standard form of indication of the grade levels is shown in Table 2. There was some discussion of the criteria during the lecture which introduced the students to the assignment.

Table 2 - ISM 2005 and 2012 Criteria

		A	B	C	D	Fm	F
1	Purpose of assignment achieved						
2	Writing and presentation style						

3*	Scope, depth and currency of the research						
4*	Quality and accuracy of analysis						
5*	Demonstration of understanding and application of the research						
6*	Clear representation of ideas and structured argument						
7	Referencing						
	* these criteria are particularly important in forming an opinion of the overall grade						

Superimposed on these criteria was a Business interpretation of the overall impact of the report as can be seen in Table 3, which is provided to give the students an understanding of the worth and impact of their reports in a business environment.

Table 3 - Business Impact Grade A

To achieve an Excellent Pass (A) you will have:-	
○	Shown excellent evidence of research and will have many relevant citations that examine the current limits of the topic field.
○	There is strong evidence of clear understanding, comprehensive analysis and effective application of the researched materials. Ideas are well represented and the arguments are presented in a clear, well-structured fashion.

LEARNING ANALYTICS OF DIDACTIC TEACHING

The Learning Analytics presented for the 15 credit modules taught using didactic pedagogy is based on the assignment grades.

GRADE PROFILES

Grade profiles are presented for SMOS as an example of simple analytics using vertical bar charts. This presentation allows a characterisation of the overall achievement levels resulting from the didactic approach, which were generally similar to many other modules taught in the School at that time. The initial data presented in Table 4 and Fig 1 was created very easily and quickly in MS Excel. The opportunity is taken to illustrate a factor that is of importance in the UK Higher Education environment of a considerable achievement difference between Black, Minority Ethnic and International students compared to White UK students in terms of gaining “Good Honours” degrees (defined as 2:1 and above or 60% and above).

Systems Methods for Problem Solving

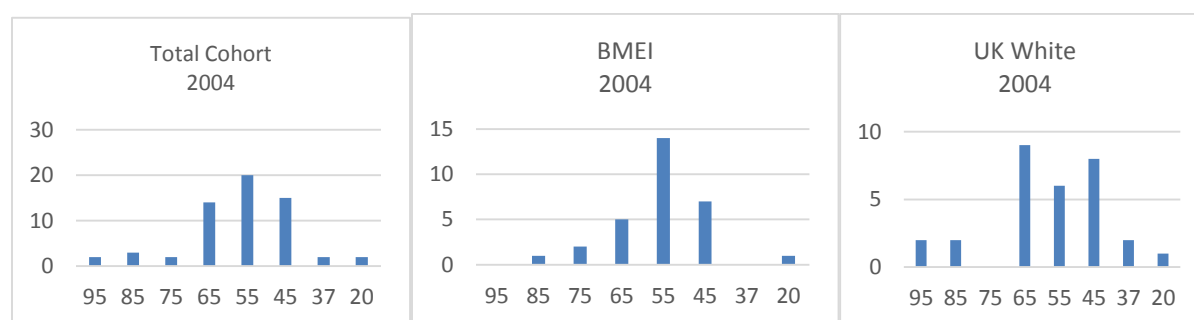
Table 4 - SMPS Analytics Data (Collated from Proc FREQ)

	Academic Year	2004	2005	2006
Cohort	Average for Cohort	56.5%	64.7%	59.0%
	Standard Deviation	13.5%	17.6%	13.8%
	Good Honours	35%	65%	58%
	Number in Group	60	51	33
BME	Average for Cohort	55.5%	61.6%	59.9%

UK White	Standard Deviation	10.6%	18.4%	12.7
	Good Honours	27%	62%	67%
	Number in Group	30	29	18
	Average for Cohort	58.8%	68.8%	57.9%
UK White	Standard Deviation	14.9%	15.7%	13.8
	Good Honours	43%	68%	47%
	Number in Group	30	22	15
	Average for Cohort	58.8%	68.8%	57.9%

Fig 1 illustrates the grade profiles for 2004; the overall cohort profile was considered fairly normal for the School. Table 7 clearly demonstrates that whilst there are changes in overall achievement levels, there is some evidence of a BMEI grade deficit in the 2005 instance but not for 2004 and 2006. Figure 1 is inconclusive and suggests that more complex analytics should be applied to the data, in order to provide a clearer story.

Figure 1 - SMPS Grade Profiles (MS Excel graphs)



ACADEMIC AS “LEARNING-TO-LEARN” EXPERT

This approach is based on the Socratic idea of posing questions and guiding research, debate and strongly engenders critical thinking and analysis of multiple perspectives to obtain a good answer in a specific context. It concentrates on developing the communication skills that are necessary to allow the persuasive presentation of the problem understanding, the existing knowledge that contributes to developing a relevant, context based solution and the persuasive presentation of the recommended solution itself.

SOCRATIC TEACHING APPROACH

Foundation

The fundamental approach is that ‘I do not teach; rather, I facilitate, catalyse and guide learning. I pose questions rather than present answers’ contrasting with ‘if I give you answers then you stop learning’, a deeply Socratic approach to learning and teaching.

To modify Plutarch’s words, the new approach is based on a view that successful education is about lighting fires, rather than filling leaky buckets. Experience with this approach shows that getting students to fill their own buckets mysteriously and magically repairs all the leaks as they learn by exploration and research and application. It is, in essence, an extreme flipped teaching concept (Educause, 2012) but does not use the video presentation aspect for self-study prior to seminars and workshops.

This approach leads to intense engagement in the subject during the supervised learning periods of seminars or workshops or tutorials. It draws on the ideas of experiential learning and the “learn by exploring” (Kolb 1984) variant of “learn by doing” which explicitly employs elements of problem-based

learning (Hmelo-Silver 2004) and enquiry-based learning (Edelson et al. 1999). It also leads to high student achievement and satisfaction.

Seminars and Workshops

In this learning model, seminars in computer labs provide the students with the opportunity to research and explore, within a relevant, defined context, for academic and industry sources which identify, explain and justify relevant theories and analytical frameworks. Students are expected to find at least five strong sources (which must be added to their module Working Bibliography using the Harvard referencing standard) for each part of the activities. The workshop that follows, then provides the students with the opportunity to apply their new-found knowledge of theories and frameworks to suitable case studies during the first week or two of the semester or, once the assignment has been launched, to their developing assignment, with regular, weekly opportunities to obtain appropriate feed-back and feed-forward in relation to the developing drafts.

An additional aspect of the teaching philosophy and reflected in the design of the curriculum and activities is that continual prompt and instant feed-back and feed-forward during the seminars and workshops is vital and generates very positive results.

The continuous exploration, researching and application that this approach requires the students to undertake, combined with the weekly feed-back and feed-forward provided on an individual level during the seminars and workshops also develops strong research and assignment bibliographies, as is shown in many of the module reports, with average bibliographies achieving around 15 to 20 sources for second and third year students, with the best assignments containing up to 40 or 80 sources.

Assessment Criteria

The final element of the Teaching and Learning Philosophy is to ensure that the assessments are strongly related to current, leading edge business issues and that the assessment criteria are extremely clear, are related to each task that is set within the assessment, and can be understood by the students (in language that they understand **and** feel) and that show the incremental nature of the assessment criteria, as the students attempt to achieve the higher level bands.

A further innovation in the 20 credit modules has been the introduction of employability relevant criteria related to excellence of presentation and meeting professional levels of compliance with report writing standards. Such standards are normally set by professional and business organisations for internal and external business reports. This innovation was introduced in response to the oft repeated criticisms from business leaders about the lack of communication skills seen in many graduates.

This has been set at 20% of the overall grade and is based on a set of criteria, which, if not achieved, have specified deductions from the presentation portion of the grade. The deductions for failure to meet the presentation criteria was also related to the editorial cost and time impact of correcting the presentational errors. An example is given in Table 5, the 6 page limit relates to the main content and excludes front page, table of contents and references sections. The minimum mark for the presentation is 0% and cannot be negative. The page length criterion is a limit that many academics meet in submissions to conference and journal papers, above the page limit, additional fees are often charged.

Table 5 – 20 Credit Module Presentation Standards Criteria (20% of grade)

Perfect adherence to the Springer LNCS template is worth 100%
Your mark will be reduced for each type of error from the following list by the specified amount
<ul style="list-style-type: none">• Errors on each line of the Title and Affiliation section – 5% each (maximum 30% deduction)• Formatting errors with the Heading styles - 5% each broken style level (maximum 15% deduction)• Failure to use a consistent Harvard standard for citations – 20% (-10% for too few citations)• Failure to use a consistent Harvard formatting of the References – 20% (-10% for too few references)

- Failure to use the body-text style - 15%
- Failing to meet the specified **six page** length requirement - 50% (+zero lines, -10 lines)
- Failure to use the template - 100% deduction

Use of Contact Time

The approach to the IT Service Management and Sustainable Information & Corporate Governance is somewhat different to that for Enterprise Systems and Information Security and Assurance. The former pair of modules are designed to introduce new domain areas to the students, whereas the latter pair, as capstone modules, concentrate on research, integration and deepening of existing knowledge, understanding and application to novel contexts.

As a result, the learning materials for ITSM and SI&CG are structured to provide research materials relating to critical concept areas of the domain, whereas the learning materials for ES and ISA structured around research and presentation concepts in order to develop a strong culture of researching the latest knowledge that is necessary to identify and solve a current business problem and to develop a strongly justified and very well communicated solution.

The impact of this difference drives different approaches to the use of the contact time in the seminars, whilst the workshops use the same approach for all four modules.

For ITSM and SI&CG, the semester provides weekly time to explore critical questions and frameworks relating to 8 or 9 of the most important aspects of the domains. Each seminar (composed of 20 students) will consist of no more than 15 to 20 minutes of tutor input, using no more than 6 to 8 slides which cover the context of the topic, two or three critical questions and guidance on what research is required, the topics of small group discussions and regular reminders to continue building their research bibliographies. After each small group discussion, time is taken for a short summary, plenary discussion. The workshops for these two modules are a continuation of the seminar but with the emphasis on applying the newly acquired frameworks and questions to developing the relevant section of their assignment. During this time, the tutor is actively involved with individuals and small groups in challenging ideas, offering advice in terms of the direction to develop ideas and analysis and reviewing presentation standards.

Because the primary focus of the pedagogy is towards learning to learn, mentoring and coaching in employability skills, the decision was taken to dedicate all contact time in two or three weeks of teaching time to individual formative and summative review and assessment of each student's final draft and final submission based on a published 15 minute review schedule. This is typically in week 9 or 10 for the formative review using the summative rubric, and discussion of the work, with a view to improving the strength and quality of the report. All relevant comments are recorded electronically and provide the basis for the improvement of the final draft, prior to final submission. The summative marking is typically performed, to a similar schedule, in week 12 or the first week of the exam period. This ensures that the students have instant feedback

For ES and ISA, large cohort based seminars are used with the weekly topics relating to aspects of communication, including topics such as understanding the intended audience, structuring ideas and reports. Much of the seminar time is used in small group activities designed to reinforce the learning and also, in some cases to develop the concept of group-work to improve overall achievement, thus duplicating the real world of employment in teams. The workshops are dedicated to working on the two components of their assessment and using the time for individual tutor review and feedback.

For similar reasons as above, 3 weeks of contact time are dedicated to formative and summative assessment. In week 5, the infographic posters are peer assessed; in week 9 or 10, the same scheduled, individual formative review and in week 12 or the first week of exams, the final scheduled individual summative assessment.

Defining assessments and marking criteria

The assessments are based on broad topics which address current issues challenging CIOs of SMEs and large organisations. They provide opportunities for the students demonstrate high level skills and attainment levels in the IT industry's various skills frameworks, such as SFIA. The criteria are designed so that students can critically evaluate their approach to ensure that their work meets the highest possible band, see Table 9. This particular example

indicates the need for novelty of approach as compared to the rather basic approach needed for the basic pass level of 45%.

Table 6 -- Example of 95% and 45% Band Criteria (SI&CG)

95% Criteria	<p>Critically and comprehensively evaluates and justifies the choice of governance frameworks and issues and the impact on the incorporation of location services.</p> <p>There is a clear and logical structure to the analysis and justification.</p> <p>Shows professional level of knowledge and understanding of the topic.</p> <p>Provides a novel approach with clear synthesis of a wide range of perspectives</p>
45% Criteria	Justifies the relevant governance issues and the impact on the incorporation of location services

Place of Research and Reading

Research and reading forms the foundation of this set of modules, the students obtain guidance in relation to context and analytical frameworks relevant to the modules. There are no reading lists for the modules. There are, however, often comprehensive bibliographies on the closing slide(s) for each week's seminar materials for ITSM and SI&CG which support the learning materials.

LEARNING ANALYTICS RELATING TO SOCRATIC TEACHING

This section will illustrate the use of more complex statistical analyses from the SAS system to demonstrate the more significant insights that can be derived from the use of more complex analytical environments. The author has imported all the grade data from all the subject modules into the SAS system from the original Excel spreadsheets.

GRADE PROFILE IMPACT OF CHANGE FROM DIDACTIC TO SOCRATIC

The following statistics demonstrate a highly significant improvement in both mean score and in a reduction in the standard deviation.

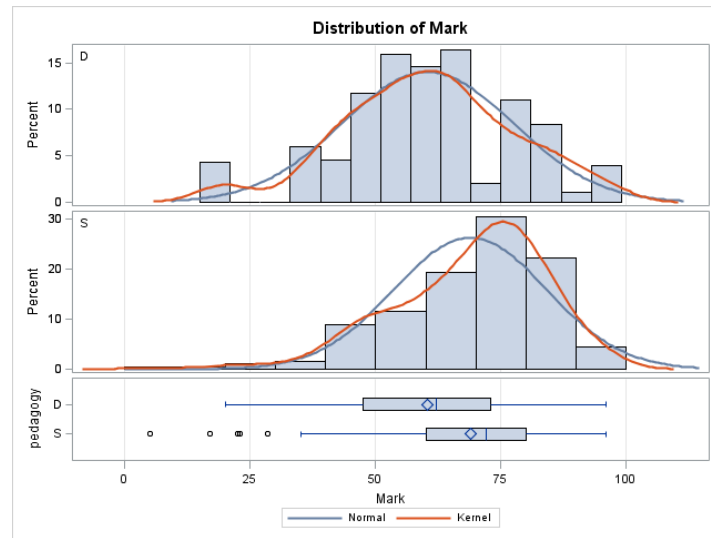
Table 7 - Impact of Changing from Didactic to Socratic Approach (Proc TTEST)

pedagogy	N	Mean	Std Dev	Std Err	Minimum	Maximum
D	573	60.3380	17.0730	0.7132	20.0000	96.0000
S	270	68.8604	15.2298	0.9269	5.0000	96.0000
Diff (1-2)		-8.5223	16.5058	1.2184		

Method	Variances	DF	t Value	Pr > t
Pooled	Equal	841	-6.99	<.0001
Satterthwaite	Unequal	585.38	-7.29	<.0001

As can be seen in Fig 2, observing the differences in the kernel profiles (which represents the distribution of the actual data), there is clear evidence of significantly improved achievement for the new 20 credit modules, with a strong skewing of achievement into the $\geq 70\%$ marks

Figure 2 - Change in Mark Distribution Profiles (Proc TTEST)



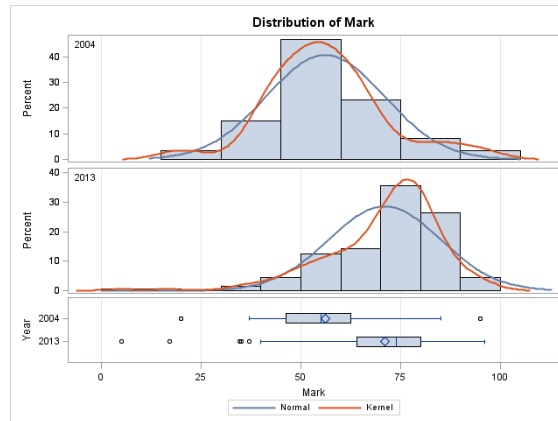
The impact of the changing approach can be better seen in Table 8 and Figure 3 which contrasts achievements in 2004 with that in 2013 and demonstrates with a high degree of confidence that the two cohorts have different mean grades of 56% and 71%, an improvement of 15%.

Table 8 - Mean achievement 2004 compared to 2013 (Proc TTEST)

Year	N	Mean	Std Dev	Std Err	Minimum	Maximum
2004	60	56.1083	14.7252	1.9010	20.0000	95.0000
2013	183	70.9563	13.9882	1.0340	5.0000	96.0000
Diff (1-2)		-14.8480	14.1722	2.1083		

Method	Variances	DF	t Value	Pr > t
Pooled	Equal	241	-7.04	<.0001
Satterthwaite	Unequal	96.343	-6.86	<.0001

Figure 3 Mean Achievement 2004 compared to 2013 (Proc TTEST)



CRITICAL APPLICATION OF LEARNING ANALYTICS RESULTS

This section summarises the key changes in achievement that can be seen from the Learning Analytics presented above. It identifies two critical impacts on the academic landscape. The first section is devoted to the impact on the levels of student achievement; the second section considers the impact on the academic.

PRIMARY IMPACT

This section provides the comparison and commentary relating to the Learning Analytics data presented above, identifying the issues that are apparent in the 15 credit Didactic modules and the significant improvements at cohort level with the change to the Socratic process in the 20 credit modules. This is followed by a commentary on the impact of the change from Didactic to Socratic learning.

Impact on Overall Grade Profiles

For the purposes of this section, whilst the graphical output in figures 2, 3 and 4 were actually generated in SAS, they could have been just as easily created in Excel from the basic data and the messages would be just the same.

Table 7 demonstrates with a high degree of confidence based on the pooled variance t test that there is a significant difference between the mean achievement levels between the old style of teaching and assessing and the new approach of the order of 8.5%.

SECONDARY IMPACT

This section provides a short commentary on the clear value of the change to the academic workload of the change to Socratic philosophy, followed by some observations relating to the value of Learning Analytics as a means of clearly demonstrating the impact of changes in teaching and learning strategies in terms of that most important metric of student achievement.

Academic Workload

There two very significant consequences on the academic's workload as a result of the Socratic approach incorporated in the 20 credit modules that form the basis of this case study.

The first is large reduction in the amount of preparation for the weekly set of slides, from between 50 to 70 very information dense slides that were required for the didactic, 15 credit modules to between 8 to 10 sparse slides for the weekly material for the Socratic 20 credit modules. The weekly material for the 20 credit modules was typically created in approximately 30 minutes, compared to the 3 to 5 hours per weekly set of material for the 15 credit modules.

The critical business issues and questions relating to the operation of IT today are very similar to those which exercised CIOs and IT managers 20 or 30 years ago. In the field of Computer Science the fundamental questions and issues change very slowly whereas the specifics of the technology change very quickly. As a result, because the Socratic approach identifies critical questions within the topic, the

consequence is that the seminar slides will not need to be reviewed or changed for several years. The only requirement is that the academic remains fully up-to-date with the current situation of the domain, through regular review of the business, IT and academic press, as is expected of all academics as part of their scholarly activity in order to provide the most up-to-date context for the questions in the seminars.

The second and very significant impact is that all assessment is carried out during contact/office hours or the exam period, on the university premises. There is no requirement to mark assignments at home, out of working hours, etc. This has a very significant impact on work/life balance, especially over the Christmas holiday. Learning Analytics conclusively demonstrates that the improvement in achievement is worth the time dedicated to individual mentoring, challenging and coaching students in the research process necessary for successful employment

Selling the Changes

During the academic year 2013/2014, the role of the SLTA was to lead by example and demonstrate the value of changes to pedagogy and forms of assessment that would enable students to achieve to their limits and also improve the NSS scores for all of the programmes in the School.

The Learning Analytics results were a powerful illustration of the benefits of the suggested developments to colleagues, who were able to feel more confident about beginning the journey of change to a more Socratic teaching style.

Finally, by better understanding the pedagogic drivers of the improvements in achievement, it is possible to design and provide better environments in both teaching spaces and academic staff accommodation which will facilitate the uptake of the improved pedagogic practices.

CRITICAL EVALUATION OF LEARNING ANALYTICS IMPACT

This section summarises two key factors in the deployment of Learning Analytics.

KISS PRINCIPLE

Most of the Learning Analytics data incorporated in this chapter were collected during the assessment process in the usual spreadsheets that academics construct for recording marks, prior to entry into the formal institutional Student Records systems. The basic statistics and the charts were created as part of the process to create the post semester, module evaluation reports, which form part of the institutional quality processes for continuous improvement.

In this respect, the Keep-It-Simple-Stupid (KISS) principle was the guide. There is little apparent need to develop any additional, more complicated metrics, if significant impact can be demonstrated with a simple set.

It is of interest that the simple graphical outputs that can be achieved from MS Excel generally provide a quick and easy way of gaining an overall picture of the impact of a change.

However, in order to gain deeper insight and a full appreciation of the degree of confidence in the analyses, it is necessary to develop some of the statistics, as has been done with the SAS® system.

OBJECTIVE ANALYSIS OF ACHIEVEMENT RESULTS

A review of journal articles covering academic research into pedagogic practice and theory seems too often to be based on qualitative research into student preferences and satisfaction, a highly subjective approach. There is often little connection between student preferences and achievement. However, students are the first to complain if they do not get a high enough grade to qualify them for jobs.

The use of Learning Analytics on achievement data provides clear, objective results which, in this case study, shows significant benefits for the changes made to pedagogy.

The use of the graphical output can provide a quick understanding of the attainment levels and impact of pedagogic choices. These can easily be developed with minimal effort in MS Excel by most academics.

Use of the more technical statistics, developed for this paper in SAS®, provides greater insights and confidence in the significance, or otherwise, of the data.

It should also be noted that once the data has been imported into a database, it is very much faster and easier to carry out a wide range of different analyses, which can be very tedious and difficult in spreadsheets unless macros can be used (a little known skill for most academics).

CONCLUSION

This final section summarises the key conclusions, relating to implementing Learning Analytics and using them to quickly and objectively evaluate experiments in changing learning, teaching and assessment strategies and pedagogies.

There are several conclusions that can be drawn about both the changing pedagogy choices and about the use of Learning Analytics.

1. Teaching “Questions” (the Socratic approach) significantly improves achievement.
2. The use of simple histograms can provide a quick means of evaluating learning achievements for individual modules and providing comparisons between modules.
3. The use of more complex statistics within an analytical system, such as SAS®, provides greater opportunities for more wide ranging comparisons between different modules and cohorts and between different categorisations, such as were used here with the BMEI / White UK, Year and Pedagogy criteria were used in different t-Test comparisons.
4. Use of Learning Analytics can clearly be used to evaluate the impact of changes in all aspects of pedagogy and to provide confidence to colleagues that the change is valid and worthwhile.
5. A clear understanding of the impact of the pedagogic changes can also be used as input to planning best practice design of both teaching spaces and staff accommodation to facilitate the chosen pedagogic styles.

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