Mathematics and Dumping Lectures?

Another Perspective on the Shift Towards Learner Pragmatism

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Abstract

A provocative report by Dolnicar [1] proposes that a shift towards learner pragmatism "defines the reality" of the current tertiary learning environment. It identified a group of so-called "pragmatics" (17% of the students investigated, and mainly Commerce and IT students) who claimed that they attended lectures almost solely to gain essential course information, as against enjoyment or to learn. This group is reported to have claimed the lowest levels of lecture attendance, yet delivered "the highest grade point average of the students in the study". Are Mathematics students pragmatic in the sense that they only come to lectures to obtain essential course information, not to learn or enjoy? Are Mathematics lectures valuable in that they have an effect on performance? I present data from 85 Mathematics and Engineering students in an Algebra & Calculus course in Australia, in which all resources were readily accessible outside of lectures. Students attending class two thirds of the way through the course achieved statistically higher levels of performance on all but one of the course assessment items (significant at the .05 level) than those not in class at that point. "Strategic" learning styles, which may characterise the "pragmatics" described in [1], yielded only small non-significant correlations with performance. Lecture attendance has diminished very little in this Mathematics course, despite full and easy access to all course information and materials, online and in hardcopy. Hence there was little evidence of the pragmatism reported in [1] for Commerce and IT students. A follow-up study indicated that mathematics attendees regarded lectures as an efficient and companionable way to meet new material and build understanding and confidence. Lectures were motivating, enjoyable, kept students on track, provided a sense of community and common purpose, and clearly suited those who prefer learning by hearing, seeing and asking, rather than reading. The strong relationship between attendance and mathematics performance indicates the value of explicit teaching. Clearly ICT alternatives need quality resourcing and careful support.

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1 Introduction: Students and face-to-face lectures

Awareness of tertiary students' changing goals, needs, preferences, and perceptions, is vital if educationists are to respond quickly and appropriately. Certainly we are in a period of change that may have an effect on learner pragmatism. Pursuit of studies directed towards professions, rather than general studies, impacts on students' learning choices and approaches. Advances in internet access have impacted strongly on the way we

gather and manage information, and claims of short attention spans (as low as 10 to 15 minutes) are being fuelled by a plethora of fast technology-based activities for both leisure and learning.

Questions arise about the value of one or two-hour lectures, no matter how stimulating and interesting. Explicit face-to-face teaching is offered on the grounds that it is effective and efficient to resource. However, ICT's and multimedia offer increasingly attractive packages for transmission of information, with full flexibility. Moreover, arguments about internet access no longer hold, with CD's providing an inexpensive and convenient alternative. Burning questions are:

- Are the benefits (real or perceived) of lectures largely lost on a body of Generation Y pragmatists?
- How can we tell if we are wasting time and resources designing and delivering classes to today's undergraduates?
- If the demise of lectures is inevitable, should we not advance the transition period by investing in the resourcing of technology alternatives?

Whatever the current trends and philosophies, there is substantial and documented evidence across a wealth of educational literature that teacher-centred learning has a strong positive effect on student performance. Hattie's meta-analysis [2], for example, confirms that quality face-to-face teaching has a strong positive effect on students performance. That study investigated the educational effects on performance of a full range educational interventions reported in 160,000 studies of more than three decades of education research covering more than 50 million students across all disciplines and levels. The highest effects were associated with quality direct instruction, and quality feedback and remedial help, with motivation to improve. Clearly this study does not include the effects of burgeoning experience of new pedagogies. Educational technologies provide a host of new opportunities, and online stimuli are replacing the role of teacher, and the effects of these are probably being felt most keenly at tertiary level.

What do reasonably recent studies reveal about undergraduate lectures?
Nothing surprising:

- That student variables (affect, cognition, behaviour, motivation) affect what they get out of lectures [3]
- That expressive enthusiastic teaching behaviours relate to higher levels of student achievement [4]
- That the lecturer communicating enthusiasm for the topic is effective in lectures [5],[6],[7],[8]
- That meaningful context, and applying information in the lecture, are effective [9],[5], [10]
- That large classes may cause some barriers [11]

And what do reports reveal about the reasons why students attend lectures?
A range of responses:

- That enjoyment is the main factor for attendance, followed by concerns about difficult material [12]
- That some attend to acquire current information [8], and assessment information [6]

What about disciplinary differences?

- That indeed there are some, at least for lecture attendance levels and motivation [12]
- That science use lectures as a way into their reading, whereas arts students use them to help interpret what they have read [13]
- That science students value logical and structured lectures more highly than arts students [14]

Observations of discipline differences are not surprising to those who teach Mathematics, and these pointers highlight the need for caution when interpreting and generalizing findings from other disciplines.

2 Is there growing learner pragmatism in our undergraduate classes?

Are changes in our student body resulting in a creeping learner pragmatism that affects learning attitudes and preferences? Are students prioritizing fast and flexible access of core information over deeper learning goals? Certainly access to technology, pursuit of studies for professional rather than academic reasons, and learners accommodating work and family commitments, may be powerful agents for change. Do we still need lectures, or should flexible online delivery and ICT's take their place? In a recent study of reasons why undergraduates attend lectures, Dolnicar [1] collected data from 612 students in Australia. Students were invited to say if each of 12 listed reasons applied to them or not. I summarise and group the data that emerged below:

Highest frequencies of agreement were associated with "information" gathering:

- to find out what they are supposed to learn (78 % agreement)
- not to miss important information (72%)
- to find out about assessment tasks (59%)

Moderate frequencies were related to learning:

- make sure I learn fundamentals (45% agreement)
- easier than learning it myself (43%)
- make knowledge meaningful (39%)

Expectation:

- expected to be there (30% agreement)

Lowest frequencies for a mixed range of factors:

- work on problems (22% agreement)
- find out real world application (21%)
- enjoy them (21%)
- find out latest thinking (20%)
- enthuses me (17%)

Dolnicar notes the relatively high frequency of responses on gaining essential information, compares this data with studies from the 1970's, and claims there is a shift towards lectures being viewed more as a means of, rather than learning and enjoyment, and claims that the findings reveal a "shift towards pragmatism" that now "defines the reality of the tertiary learning environment".

In particular, students labeled "pragmatics" were those who reported attending lectures to get the information they needed to succeed in the subject. Pragmatics (17% of those surveyed) were found to be among the younger students, more typically Australian than Asian, and "over-represented" in the Commerce and Informatics faculties. They reported the "lowest lecture attendance while achieving the highest grade point average of the students in the study". In contrast, students labeled "idealists" (7% of those surveyed) were wholly and genuinely enthusiastic about attending lectures. Typically, idealists were found to be "mature aged students with work experience and more frequently in the arts subjects surveyed". Between these two extreme groups, other clusters identified were 11% were averagely motivated across the range of reasons offered, 15% who reported that lecture attendance also gave them the course fundamentals, 14% who only attended lectures not to miss relevant information, and 11% who attended for every reason but pleasure. However, Dolnicar's claims were established from data gathered from a sample of predominantly Commerce, Arts and IT students.

Indeed, the reliability and generalisability of these provocative findings may be affected by a number of factors:

- Discipline bias in the sample: 294 Commerce students, 156 Arts, 71 Informatics, 53 Health and Behavioural Science, 33 Engineering, and 5 Science.
- Courses sampled largely opportunist, and completion of the questionnaire voluntary.
- No indication of course level. Numbers suggest that Science and Engineering courses sampled may have been at a higher level than the Commerce and Arts courses.
- Timing of the questionnaire is not offered. Students may have different priorities at different stages of a course.

Particularly provocative is the finding for mainly Commerce students that links "lowest" levels of attendance with "highest" levels of performance for a group of Commerce and IT students. This finding may be discipline-specific, even institution-specific. Some of the effect may be explainable by the fact that top performers may be bored in ill-pitched lectures. But a growing trend of that kind would challenge well-established strong relationships between quality face-to-face teaching and performance: as evidenced by Hattie broad meta-analysis [2], for example. Discipline bias alone makes the findings in [1] well worth testing for Mathematics, Science and Engineering students, who were strongly under-represented.

3. This Study: Why do mathematics students want explicit face-to-face teaching, and do they benefit?

The underlying questions were: Are mathematics students pragmatic in their views about the usefulness of lectures? Do they want explicit face-to-face teaching? If so why? And do they benefit from large-group lectures? I tested the following questions in on-campus cohorts of mainly Science and Engineering students. Lectures were voluntary. All course materials and resources were fully and readily available outside of lectures. All students had the texts, Study Guide, course rules, and the assignments, and files containing all lecture slides and weekly exercises were posted on the course website some days before class. Hence there was no pressure of any kind at all to attend lectures.

1. Why do mathematics students attend lectures?
2. Did those who attended lectures perform better in the course than those who did not?
3. What were the performance levels of those students whose learning attitudes and approaches are well aligned with those that define Dolnicar's so-called "pragmatics"?

4. Method:

Qn 1: I invited all 30 students present in an Algebra & Calculus II class roughly two-thirds into the course, to write a few sentences (anonymously) on why they come to mathematics lectures when they have full access to all the materials and lecture slides. This data was investigated for primary and common themes.

Qn 2: I used data captured in Semester 1, 2005, for research into learning approaches and behaviour in an Australian undergraduate Algebra & Calculus I course. To identify those students who attend a substantial number of the course lectures ("attendees"), I identified those present in class (85) roughly two thirds of the way through the course. While opportunist, this sample was clearly representative of the population committed to attending lectures. An independent samples T-test was used to compare the mean performances of that sample with those not present, for each of the 5 assessment items in the course.

Qn 3: No equivalent data was available to identify so-called "pragmatics", that is, those students who attended lectures to "*find out what they are supposed to learn, not to miss important information,* and *to find out about assessment tasks*". However, these three characteristics are well aligned with those that define Strategic learners, viz *organized studying, time-management,* and *alertness to assessment demands*. And data on *strategic* approaches, alongside *deep* and *surface* approaches, had been captured late in the course using the ASSIST scales (see Tait, Entwistle & McCune, [15]). Thus correlations and scatterplots were examined to establish whether the mathematics group contained a substantial number of *strategic* learners who were also high mathematics performers.

5. Findings

Qn 1: Students reported and listed a range of reasons for attending lectures. The primary reasons were:

- to gain understanding of concepts and processes via explanations and examples;
- learning style: hearing and seeing, rather than reading;
- to ask questions and hear what others ask;
- motivation, and the stimulus to keep up;
- enjoyment;
- a sense of belonging and purpose;
- to establish and keep in contact with the lecturer.

Qn 2: Attendees at a lecture two-thirds of the way through the course performed substantially better on all course assessment items than non-attendees. T-tests revealed significant differences between the group means on all assessment items but Assignment1. Table 1 gives the mean scores on all assessment items for the two groups. Variations in group size is due to some students not completing all assessments. Note that * indicates the difference was significant at the 0.05 level (2-tailed); ** indicates that the difference was significant at the 0.01 level (2-tailed).

Table 1 (SPSS): Group Means for the Five Course Assessment Items

	0 = non-attendees 1 = attendees	N	Mean	Std. Deviation	Std. Error Mean
Assignment 1	0	30	70.6833	14.79369	2.70095
	1	50	75.5900	16.10827	2.27805
Midsemester Mark **	0	35	18.0714	10.48258	1.77188
	1	46	24.8804	11.80216	1.74013
Assignment 2 *	0	34	74.2206	25.97119	4.45402
	1	48	84.6667	17.83683	2.57452
Examination *	0	35	87.1714	40.28811	6.80993
	1	50	105.6600	39.73425	5.61927
Final mark *	0	34	54.3020	20.45663	3.50828
	1	50	63.5970	19.87536	2.81080

See Figure 2 for the distributions of overall performance levels attendees and non-attendees. Very few non-attendees scored in the top performance bracket, only 3 achieved over 80% compared to 10 attendees.

Qn 3: There was no evidence at all that students with highly strategic approaches to learning performed better on any of the course assessment items. Correlation coefficients were close to 0 and not significant. For

example, Figure 3 show scatter plots for 46 attendees later in the course (not the same students as those analysed above.) These plots offer no evidence that high performance on the examination was related to highly *strategic* approaches; or to the subscale *alertness to assessment demands*, in particular.

Figure 2: Course performance levels for Non-Attendees (0) and Attendees (1)

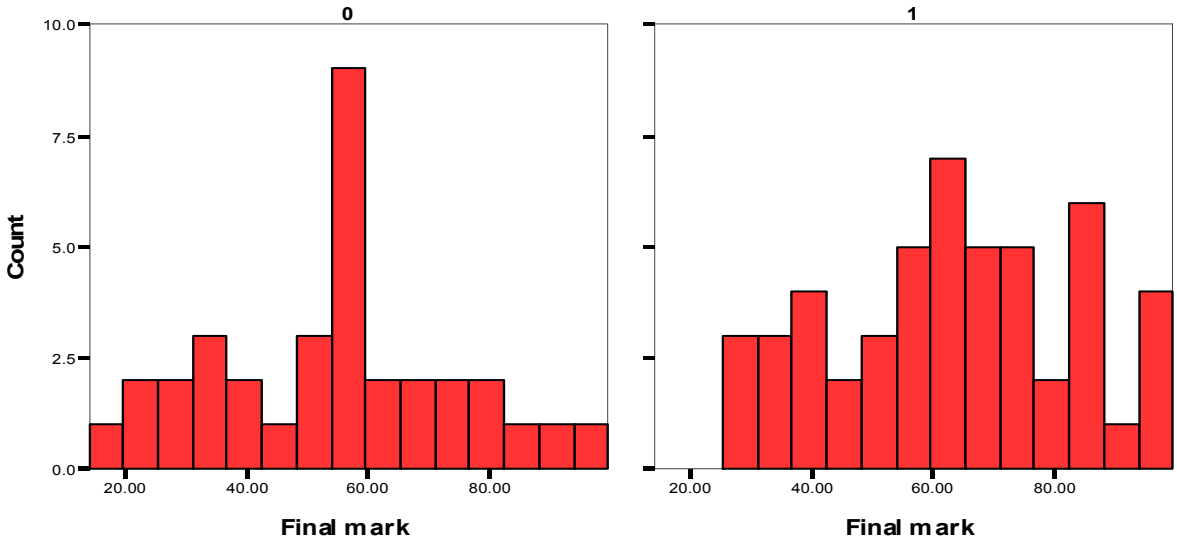
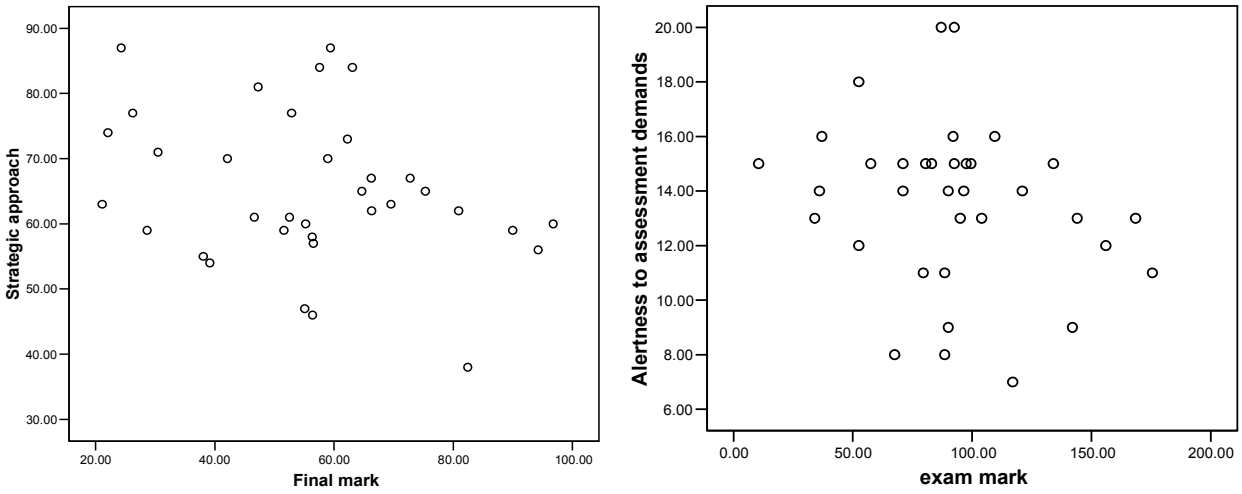


Figure 3: SPSS Scatter Plots of Exam Performance and Approaches to Learning for 46 student present at a lecture at the end of the course



5 Discussion and Conclusions

The views and behaviour of lecture attendees investigated in these mathematics courses presented little evidence of the kind of "pragmatism" reported by Dolnicar, who found students (predominantly in Commerce and IT) attended lectures with low levels of enjoyment, to gain essential information. I argue that levels of

pragmatism of that kind vary with discipline, content and study-goals, and are strongly affected by the effectiveness, commitment, and approachability of the lecturer.

The attendees studied here regarded lectures as an efficient, companionable, and convenient way to meet new mathematical material, build understanding of the concepts, and develop the confidence to perform challenging tasks. Lectures were reported to be motivating, keep many students on track, gave many a sense of community and common purpose, and clearly suited the learning preferences of those who said they learned by hearing, seeing and asking, rather than reading. Gaining information per se was not found to be a primary reason why students attended lectures. However, that purpose is implicit in the ascribed learning role.

Students' belief in the value of attending lectures may also have paid dividends. A strong positive relationship was evident between performance and lecture attendance. This is in line with a wealth of studies (see Hattie [2]) that indicate that face-to-face teaching and strong individualized feedback are generally highly effective for performance. Only a few students performed well without attending lectures, and relationships between mathematics performance and strategic approaches to learning were very low. *Strategic* approaches to learning, as defined in [15], are associated with *organized studying, time-management,* and *alertness to assessment demands*, three characteristics that seem closely associated with the attitudes ascribed to "pragmatics". Thus this data suggests that the finding in [1], that pragmatics are high achievers but low attendees, may not be robust.

Certainly, lecture attendance has diminished only a little in the Mathematics courses described. It remains in the region of 60 – 65 % despite easy full access to all course information and materials, online and in hardcopy, and generous support for independent learning in the course by both email and phone. Particularly interesting is that a substantial number of students are second-years with a strong background of enforced collaborative work and online problem-solving. Yet they attend voluntary large group lectures willingly and good-naturedly, and voluntary online discussion has declined in the wake of enforced participation. Does that convey a preference for face-to-face communication, or simply falling back on old habits?

To conclude, findings on the strong relationship between lecture attendance and performance of mathematics students in Science and Engineering, are in contrast with the findings reported in [1]. Rather, they add weight to the value of lectures and the wealth of studies and meta-analyses like [2] that demonstrate the high effects of face-to-face teaching and individual feedback. The fact that students with online and collaborative learning experience, and access to all essential course information elsewhere, still enjoy, support and attend lectures, and that many prefer face-to-face teaching, confirms the value and place of explicit teaching within the high-tech educational arena. While we welcome ICT's and the internet as a powerful force for change, it is clear that online mathematics courses are not a quick cheap alternative. Generous high quality guidance or face-to-face or online teaching, and remedial feedback to students on their individual mathematical understanding and progress are vital factors underpinning educational success, and electronic courseware and feedback must be resourced strongly and appropriately.

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