	University	**Strathclyde**
	Department	**Mechanical Engineering**
	Module	**Engineering Mechanics**
	Overview	Engineering Mechanics is a core first year class delivered to approximately 250 students. Traditionally Engineering Mechanics was a 20 credit (10 ECTS) class, delivered in two hour sessions twice a week over two semesters (a total of 96 hours). As well as this students were expected to spend 32 hours on assignments and 72 hours engaged in private study. Students were assessed with 8 homework exercises and 2 class tests. The homework exercises had a weighting of 30% (calculated from the six best homeworks submitted), while the two class tests were both weighted as being 35% each. In the second semester students who missed homework submissions or preformed poorly in the first semester were allowed to submit additional 'catch-up' homework for each topic. The pass mark for this class depended on the degree programme being studied. Students on the professional accredited MEng degree programmes, the majority of students, had to attain 50% or above. All other students only needed 40% or above to be awarded a pass.
	Drivers for change	10 years ago the Department of Mechanical Engineering embarked began to radically change its teaching methods for first year students. The New Approaches to Teaching and Learning in Engineering (NATALIE) project introduced active and collaborative learning into the large lecture room through the use of Peer Instruction developed by Professor Eric Mazur at Harvard University. The physical teaching space was also redesigned to allow students to work collaboratively in this new style of teaching. Rooms were refurbished to allow group seating and an electronic voting systems (EVS) was installed. Over this period, while the teaching methods radically changed, the assessment methods remained fairly static with a reliance on workload intensive written formative and summative assessment. The primary drivers for change were therefore to implement a suitable assessment strategy which emphasises the process of learning rather than the product while reducing the amount of time spent marking homework and class tests.
	Intervention	During ***phase 1*** of the pilot (2005-6) a new online intelligent homework system (MasteringPhysics, developed by MIT and marketed by Pearson Education) was implemented as a replacement to the traditional paper based homework. In parallel to this certainty-based marking (CBM) with EVS was also piloted in a bid to promote meta-cognitive thinking and deep reflection on students' level of certainty they have about their own knowledge and understanding. Initial responses from students indicated that students adapted well to the online homework system but students had some problems were: the Americanisation of terms; and using the equation editor to enter mathematical notation. The implementation of CBM produced unexpected results whereby the distribution of expected grade and actual grade were misaligned. The initial analysis indicated that because CBMs use radically different grading regime, students have not had enough time to develop their own personal response strategies. For ***Phase 2*** (2006-7) an alternative homework system (WebAssign) was fully implemented in both semesters and both class tests were reduced from 2 hours to 1 hour, while the use of CBM was postponed .
PROCESS		
EMPOWERMENT		
NICOL'S 7 PRINCIPLES OF GOOD ASSESSMENT DESIGN		
	Principle 1 (clarify criteria)	(1) Students had an opportunity to work through a graded step by step format in the homework system were provided with a series of hints and tips. (2) Students were enabled to link proximal to distal goals through being encouraged to look at the outcomes of problems as engineers rather than simply students (3) Since the best of 10 exercises are selected for assessment, so students can compare standards across their own work.
	Principle 2 (self-assess, reflect)	(1) Students had an opportunity to work towards a solution using graded steps, rather than the product, the completed homework exercise (2) WebAssign indicated to students how close they were to the correct answer to encourage reflection and self-assessment
	Principle 3 (tutor feedback)	1) The traditional lecture was replaced with 'active-learning' sessions which are a mix of mini-lectures, videos, demonstrations and problem-solving which are all linked together by classroom questioning and discussion, designed to aid learning through cognitive conflict and scaffolding. 2) Increased opportunities for peer formative feedback have been built in to the course by the provisions of social seating arrangements in a custom built lecture theatre 3) Use of EVS in lectures to promote discussion 4) Increased opportunity for peer electronic dialogue through WebCT discussion boards

ENGAGEMENT	GIBBS & SIMPSON'S 4 CONDITIONS OF TIME & EFFORT ON TASK	**Principle 4** (peer feedback)	1) Increased opportunity for peer feedback through EVS and social seating structure in lectures 2) Increased opportunity for written peer feedback through discussion forum 3) Increased opportunities for group work while doing individual assignments
		Principle 5 (motivation)	1) Increased social cohesion through WebCT discussion forum to help students to build contacts and increased social interaction in lectures 2) Increased opportunities for professional development facilitated by peer working groups in preparation for work settings
		Principle 6 (close feedback loop)	1) Repeated learning cycle of on-line homework submissions and immediate feedback
		Principle 7 (shape teachng)	1) Through the implementation of the online homework system tutors have been provided with an extra level of easily accessible diagnostic information pertaining to student performance. 2) EVS use in lectures also served as an additional diagnostic tool
		Condition 1 (in and out of class)	1) Increased opportunity for flexible learning through provisions of access to homework system and discussions board on and off campus
		Condition 2 (spread evenly)	1) Multiple deadlines enabled students to build progressive skills in a stepped progression throughout the year.
		Condition 3 (deep not surface)	1) Increased quality of learning was higher as students were engaged in Socratic processes which encourage deeper thinking.
		Condition 4 (high expectations	1) The combination of the conceptually based lectures and problem solving format in the homework exercises facilitates a high standard of application of theory to practice in the course of assessments
OUTCOME		**Efficiencies**	1) Because the online homework system automatically grades students work, staff marking time was reduced from 4-5 hours per written homework to almost zero. 2) The primary benefit of implementing the online homework system, and potentially the CBM marking, has been the freeing up of tutor time. Even though the online homework system was only implemented in the second semester this freed up a total of 40 hours of all four tutors. 3) Further reductions were made in the assessment burden because of the increased time-on-task afforded by the online homework system, reducing the final class test from 2 hours to 1 hour. This equated to a total of 30 hours saved in tutor marking

	Informal Learning Gains	***Phase 1*** 1) Initial evidence showed that the students were spending considerably more time and effort on the new homework exercises. ***Phase 2*** Findings from student focus groups indicated that compared to the traditional format there had been 1) Increased clarity of assessment criteria through the synthesis of the homework assignments, written questions in class and end of chapter questions 2) Increased reflection, efficiency and learning value through the continual and immediate on-line feedback 3) Increased targeted individual verbal tutor feedback through reduced tutorial attendance because of the shift to on-line support which culminated in very small tutorial groups, thus increasing student engagement with tutors 4) Increased peer support through discussions board which has enhanced learning opportunities 5) Increased course satisfaction compared to other courses 6) Increased understanding due to enhanced learning opportunities involving application to theory through combination of conceptual lecture material and problem solving tasks 7) Increased time on task 8) More even distribution of learning activities and increased consolidation of lecture material 9) Impression that staff do respond more to student learning needs as a result of the use of the technologies as diagnostic tools 10) Increased flexibility and greater opportunities for time management through global accessibility of homework system 11) Increased attention and engagement during lectures because of interactive activities 12) Increased enjoyment of class compared to other classes due to interactive nature and synergy of learning activities
	Formal Learning Gains	Over the past ten years, this class has introduced group work, re-designed learning spaces, teaching-by-questioning using EVS and structured problem solving strategies. Overall the impact on the students has been profound, with high levels of attendance (even at early morning 2hr sessions on Mondays and Fridays), improved grades and an impact on retention. The on-line homework system has now student focus on exam preparation. While there has been no change in exam grades this year since students were already performing extremely highly, the main goals of reduced staff marking and student focus on the learning process have been achieved.