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Possible approaches to personalisation at Cass Business School

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Introduction

This report discusses the result of an investigation into the personalisation of learning and how it could be applied in a university with primarily face-to-face instruction, and, a diverse student body.

Underlying motivation and framework

The starting point for the report is an evolving set of principles for the incorporation of personalisation into learning materials at Cass Business School. It is a response to the availability of innovative learning environments that broaden the scope for educational materials, delivered electronically, to be tailored to a particular student's requirements. As teaching is directed at the median ability level of the class, what helps most students understand concepts and integrate them with their knowledge does not work for everyone. Different students learn study and domain skills at different rates and in different ways.

In the case of Cass Business School, an important driver is the move to Moodle 2, which offers a range of features based around the idea of conditional release of content. However, the principles and taxonomy discussed here are not specific to institutions using Moodle, or indeed, to those using any sort of conventional virtual learning environment. There is a lively debate in the higher education community as to whether personalised learning is in fact best supported by tools, such as Moodle, created specifically for pedagogic purposes or whether they should be combined with more generic social media and content management systems (Dabbagh and Kitsantas, 2012; Downes, 2005)

Historically an element of personalisation has been provided within Cass, at both undergraduate and postgraduate levels, by the provision of a range of elective subjects. In terms of curriculum design, this is not a risky method, but it does mean that the ability to include certain subjects can be precarious if they are not chosen by enough students to justify offering them. The expectations that students currently have in terms of products and services being personalised are closer to those associated with the *long tail* (Hintz et al, 2011) with the implication that the combination of a large number of tailored products can satisfy a large proportion of a market, even when each individual variant of the product is only supplied in very small numbers. Istance (2011) regards provision of 'deep personalisation' as a key characteristic of future learning environments.

Conklin (2013) provides one useful area of context for discussion of personalisation. His approach is pertinent because he is interested both in personalisation of learning and of the responses of the 'millennial' generation - a term which is also favoured at Cass but which is largely synonymous with the group also sometimes known as 'generation Y', born between 1982 and 2000. While there are divergent views on how pronounced the differences are between millennial students and their predecessors, and inevitably, any study of millennial students is open to challenge because the students involved may or may not be

representative of a larger group, Conklin does observe that the characteristics of what he calls an ‘autonomy-supportive learning environment’ aligns well with the demands typically associated with the millennial generation.

Conklin’s proposal for the autonomy-supportive classroom is based around the concept of andragogy, itself defined by Knowles (1984) as a perspective that would be relevant to adult learning.

A key objective of this personalisation project, is to create a set of design principles, based around instances where personalisation can enhance existing courses. This is informed by Laurillard’s (2012) concept of teaching as a design science.

Instances of personalisation

Two types of innovation were initially considered:

1. Predominantly for undergraduates, to take account of the problems arising from sharply increasing diversity in incoming student prior capabilities and styles, relative to key core modules. How can the delivery methods for large groups take account more realistically of such diversity? The first year, of the undergraduate courses with which the authors are concerned, is already structured to provide an element of different content to students with different levels of prior knowledge, notably by offering a much more comprehensive introduction to mathematics and statistics for those who have not studied these at A level or the equivalent. Feedback from undergraduate students has indicated that there would be interest in providing material, in a range of subjects, more closely tailored to individual students’ prior abilities and the use of new technology offers promise in achieving this. This could be summarised as “tailoring for a whole cohort”. It is an example of using personalisation to reduce the diversity of the cohort, by taking in a group of students with varied attitudes, expectations, knowledge and skills, and ensuring that all members of the cohort achieve a baseline level of understanding.

For example, some students taking an introductory module on economics will have studied economics at school. For other students, this is their first exposure to the concepts and techniques used by economics. To what extent can we personalise these students' learning journeys? How do we help students bridge their personal knowledge gaps? And how can students identify where those gaps are: how can they know what they do not know?

2. Predominantly for postgraduates, the particular aim by contrast relates to “narrow and small” personalisation. This will enable experienced practitioners to "round off" the necessarily generalised education provided by core and even by elective modules. This includes in particular possibilities for innovation in the area of Digital Enterprise, in part due to the growth of interest from the Digital Shoreditch/Tech City initiatives relating to the creation of a cluster of high-technology businesses in one part of London. One illustrative radical idea which was first proposed as early as 2003 for postgraduate personalisation was the "one hour, one student" module. MBA and executive education students embark on their studies with significant and valuable business experience and there is potentially a connection between personalisation, and co-creation of content with students with experience in niche areas. This is an example of using personalisation to increase the level of diversity of the cohort, by encouraging niche skills and areas of knowledge.

While the initial assumption was that the first category would be most appropriate for undergraduates and the second most appropriate for postgraduates, it rapidly became apparent from discussions with course directors in particular that opportunities existed to put both categories into practice across the range of undergraduate and postgraduate courses.

Furthermore it became apparent that there were economic and logistic ramifications around the implementation of personalisation. The experience of personalising mathematics and statistics provision in the first year reinforced this. Personalisation had proved successful in this case partly because the subject was taught in the same way across a range of business, management, and finance degree courses. Therefore, there were enough participants for it to be feasible to run face-to-face tutorial sessions with a large number of small groups, which were allocated, so that students shared their tutorials with others who had a comparable background. But this could only be achieved by setting aside a significant amount of time each week for the subject, and to replicate this same tutorial pattern in a different subject would have created insurmountable problems in timetabling.

A further factor is that on occasion subjects which start as areas of specialist interest, attract more students and develop into popular elective choices. Within Cass this has been observed notably with an elective option on arts markets, which was first identified by a small number of students as a possible area of interest but has become a popular choice for final year students.

A palette for personalisation

Personalisation of learning materials can take several different forms. For this project a range of different levels of personalisation were identified:

Specialised personalisation refers to the provision of very specific, tailored, specialist content that is appropriate for a particular learner's requirements.

Stylistic personalisation refers to keeping the same content, but delivering it in ways which suits the individual learner's preferred learning style, or other aspects of their preference. So stylistic personalisation would offer the option to deliver content in more or less visual forms, for example, according to whether the content was being read by somebody with a preference for visual learning. Stylistic personalisation would extend to the ability to translate content into different languages, and to deliver it through different electronic channels – for instance either through a web browser or an app on a mobile device.

Outward adaptation refers to relatively minor changes, such as choosing the colour scheme or detailed layout for course material available electronically. This can be important in fostering a sense of ownership of the learning process among learners, but does not alter either the content or the way in which it is delivered.

Uncustomised refers to completely standardised course materials.

The two categories of personalisation identified in the previous section are mapped onto two different learning journeys as follows:

The standard learning journey depends on students achieving a certain common level of understanding. The instance where students start with a variety of backgrounds and acquire a common level of knowledge is where personalisation can contribute to a this type of learning journey

The personalised learning journey depends on students working towards a range of different goals and learning about issues that might suit their own interests. The instance of "narrow and small" electives in particular subjects is an example of this type of learning journey.
Combining the two categories produced a palette of possible approaches from which educators could draw ideas. This is represented below, with examples of what could be achieved with some of the possible approaches:

Standard learning journey	**Personalised learning journey**	**Design of teaching approach**
Personalised navigation: facilitation for students to find the supporting resources that suit them best	Deep personalisation: individual or tiny group study of self-defined areas on interest	Specialised
Choice of interactive, text, or visual approaches to learning basic economics concepts	Diverse choice of dissertation research approaches within an inter-disciplinary masters	Stylistic
Tailoring students' presence on a virtual learning environment with photos etc	Choice of a pathway of modules or subjects to follow	Outward adaptation
Baseline: conventional teaching and learning to a whole cohort	Small group teaching of specialised elective material	Uncustomised

Table 1 Personalisation palette – range of approaches to the learning journey

This palette could be expanded into a second dimension by considering different ways of determining students' requirements. One way of doing this is to identify two broad categories:

- students' conscious choices, made either by selecting from a range of options, or through students' responses to questionnaires
- choices determined through students' actions and through an automated process in which these actions are observed, and the material can then be tailored to students' preferences

Next steps

The palette is useful as a tool for identifying possibilities where personalisation could be implemented, by supplementing the baseline of teaching and learning at the bottom left of the diagram with other approaches. It can also be used to identify opportunities for change. For instance, in cases where the traditional combination of uncustomised learning and a personalised learning journey, through the availability of specialised electives, has proved unfeasible because of limited numbers, there could be scope to introduce a combination of a personalised learning journey and specialised material, where students would be invited to choose areas of interest and work with staff to develop learning resources in these areas. In cases where there are deficiencies in the ability of students to follow the standard learning journey, there is scope for supplementing the baseline materials. For a subject such as economics, where one of the challenges for students is to become confident with the terminology used, there are particular attractions in offering stylistic personalisation which would steer students towards material which presents ideas in ways that they can relate to.

The palette also offers the basis of a set of design principles which could be adopted in producing new personalised material.

Pedagogy and possible approaches to personalisation

The starting point of this is a consideration of how students learn. Learners start to try to understand a problem or a learning task, drawing from their experience and limited by their current understanding.

Wells & Ball (2008: 55) call the process of trying out the implications of new information, knowledge building. They say: “The aim is to participate in a common, or shared knowledge building process to which all contribute, whether overtly or through responding internally to the contributions of others in the dialogue of inner speech”. What learners often do during this phase is analyse and synthesise solutions to the problem, and justify and choose between alternatives. They have moved from exploration into creating and testing, like a group of navigators who stop sailing while they draw up a new chart.

This new chart, model or document represents new knowledge they have built, through externalisation and synthesis. It is a step on the way to understanding, but then they need to reflect on this model, refine it and integrate it into their own understanding and experience.

Once the learners have gone once around the cycle, they have not finished learning. It is in the nature of most problem-solving that it is incremental. Solving one problem creates another one to be solved. Or in formal learning, once one task is completed, there is another task to be tackled, gradually building up a deeper and broader understanding of the subject. So they need to go round the next cycle in the spiral.

What can go wrong in this process? If students do not know what they know (a gap in metacognition), then they are likely to make mistakes in defining the problem to be investigated, leading to a search for the wrong information. So being aware of gaps in understanding is the first problem to be overcome in this process.

When it comes to knowledge building, and integrating that with current understanding, some students can develop misconceptions. So the second problem to overcome is a failure of knowledge building.

It is these two steps that are the most important ones to address in personalisation. Dynamic adaptive learning will deliver relevant content in the problem exploration stage. Social clues from peers in personal learning environments can do the same. But neither help the student who thinks he or she already understands something, or the student having difficulty building a conceptual overview of recent learning when trying to fit it into past misunderstandings. There are approaches in intelligent tutoring systems and adaptive learning environments that help learners discover what they do not know. These include adaptive testing, and tracking what resources they read.

Those with difficulties in knowledge building can be helped by tools which help them organise ideas (e.g. concept maps), and social interaction with peers, when they find that their understanding of something differs from other people's models. A few personal learning environments do support knowledge building, as would the emergent learning habitat of Newman and Holtham (2008).

It is worth trying both approaches to personalisation at Cass Business School. An intelligent tutoring system, with adaptive learning, would be suited to a module where many of the students misunderstood basic concepts, or analytical techniques, used in the subject domain. It would take time to develop the course content and adaptation rules or algorithms. But there are possible savings, as the number of contact hours can be reduced without affecting grades, as shown in a large-scale controlled trial of a statistics learning tool (Bowen, Chingos, Lack, &Nygren, 2012).

Literature review

There are several different literatures on personalisation, from different disciplines and with different understandings of personalisation. Not all are relevant. The authors have not attempted to produce a complete review of all these, but have picked out the more useful approaches to personalisation that could be applied in university management degree courses. The relevant domains are enumerated below.

1) Personalising services

In government and social policy articles, personalisation refers to customising service delivery to meet the needs of each client. An example is the personal budgets given to some disabled people to purchase the social services that meet their own individual needs.

This is the understanding of personalisation that Smith, Schmoller, & Ferguson (2004) noted in their review of personalisation software for JISC. They mention 3 meanings of personalisation in public service, as used in e-government and public administration literature:

1. Providing people with a more customer-friendly interface with existing services,
2. Giving users more say in navigating their way through services once they have got access to them,
3. Seeing users as not just consumers but co-designers and co-producers of a service.

They go on to review research literature available then on personalisation, such as portals to help in 1 and 2.

2) Student support literature

There is a stream of literature on supporting individual student study. A lot of this is about support services, such as personal tutors, study skills training, advice and support for those at risk of failing (Crosling& Webb, 2002).

However, there are some articles which describe how a human tutor works, as do some articles in the intelligent tutoring literature (Lane & Johnson, 2008). Lane discusses the performance enhancements due to different tutoring techniques, and the possible reasons for the effectiveness of tutoring.

Tutoring system	Learning gains (scores) cf. conventional classroom
one-on-one with expert human tutors	+2.0 standard deviations
best intelligent tutoring system	+1.0 standard deviations
best non-AI computer-aided instruction	+0.4 standard deviations

Table 2: Performance gains from personalised tutoring.

Most hypotheses tend to focus either on the behaviours of the tutor – that learning occurs because of expert execution of tutoring tactics – or of the student – that learning occurs when the student makes deep contributions during a tutoring session.

Lane concludes that both help learning, and goes on to describe the ways intelligent tutorial systems used in virtual worlds and simulations both apply tutor tactics and modify the learning environment to deepen the student's learning experience.

3) Usability literature

This is concerned with how to make web site and applications more usable for individual users by personally customising the interface - instances where the user customises, rather than changes produced automatically by software and this has value in VLEs like Moodle, it just makes it easier to find information, rather than delivering information needed to meet a specific student's needs. While there are systems which keep track of a student profile in terms of accessibility for disabled learners (IMS, 2013), these are still static profiles, not adapting to cognitive changes as students grasp new concepts.

One of the reasons that web sites might be judged as unusable is that the design assumes users are familiar with the terms, concepts and ways of working in a discipline. For example, most online legal databases are unusable by people without legal training (Newman & Doherty, 2008). That lack of understanding of basic terms is a common problem in introductory courses, and one of the reasons teaching staff consider personalisation.

4) Information science/retrieval literature

Some of the information science literature looks as ways of providing more relevant results for user questions. What is algorithmically relevant is not necessarily what the user is looking for, let alone what they need. Situational relevance is where the results are relevant to the problem situation of the user. That is relevant for us - although it is a subset of the information retrieval literature, around question answering and some kinds of recommender systems.

Borlund (2003) explains the difference between algorithmic relevance: how closely the target document matches in world frequency the search terms. Learners need situationally relevant answers. But few adaptive learning environments deliver that.

5) Artificial intelligence (AI) literature

AI approaches have been used to support personalisation in several different contexts:

The first context is of intelligent tutoring systems. One of the earliest applications of computers to teaching was that of the programmed learning script. This let learners move at their own pace. But most systems took all students through the same fixed path.

Applying Artificial Intelligence techniques to this kind of instructivist learning led to the field of Intelligent Tutoring Systems. Early work used rules to model all the different kinds of misunderstandings of questions, then send students through a set of explanations to clarify their own misunderstanding. More recent ones use algorithms to model the student, based on performance in tests (psychometric or subject-specific), what tasks they have completed, and sometimes their own profile entries or their current search terms. That approach is adaptive learning.

The second context is metacognition, and the idea of the self-regulated learner. The successful use of cognitive and metacognitive learning processes involves setting meaningful goals for one's learning, planning a course of action for attaining these goals, deploying a diverse set of effective learning strategies in pursuit of the goals, continuously monitoring one's own understanding of the material and the appropriateness of the current information, and making adaptations to one's goals, strategies, and navigational patterns based on the results of such monitoring processes and resulting judgments. (Azevedo, Landis, Feyzi-Behnagh, Duffy, &Trevors, 2012, p. 213) But few learners do all of that. So Azevedo et al. set out to support students' metacognitive processes by using pedagogical agents in MetaTutor to provide adaptive scaffolding.

Context-dependent help is automatically generated when students are building causal models in DynaLearn (Beek&Bredeweg, 2012) - an approach which has some relevance to the module in systems dynamic modelling which is offered as a 'niche' elective to BSc management students at Cass.

Concise messages are generated on the fly, pulling out texts from a semantic web repository, as required by the logic of the current diagram state. Now although this appears to be help for use of the diagramming tool, since the tool is used to build conceptual models, students also learn the concepts in conceptual modelling, and the ways of representing objects and relationships in diagrams.

Not all intelligent tutoring systems are designed to be used by the student. When tutoring is provided by peers, the students taking on the role of tutors need support. Walker, Rummel, Walker, &Koedinger (2012) designed an intelligent tutoring system to improve the help peer tutors give learners. One student tried to solve an algebra problem, while another marked the work and give feedback. This approach, with or without the intelligent tutoring system, could be used to get students to think about and critique each other's work.

The third and most currently relevant context is adaptive learning. Newnam (2013a) distinguishes adaptivity from personalization in that it takes a more sophisticated, data-driven, and, in some cases, non-linear approach to remediation. At a simple level, an adaptive learning system behaves differently based on how the learner interacts with it – the system goes beyond providing binary responses (i.e., right / wrong) to student interactions, and can do more than simply point the learner back to appropriate materials at an earlier stage in the linear learning sequence. An adaptive learning system will adjust to what the learner's interactions with the material suggest about his or her mastery of the materials over time and, based on the learner profile it develops, will begin to anticipate things about the learner and serve up content based on knowledge of that profile.

This can take several forms. The idea is to adapt the learning environment to better meet the learning needs of the student. The first attempts at supporting adaptive learning were in hypermedia and on web sites (Odlyzko, 2002). The field quickly grew, as the technology became more capable.

Thompson (2013) classifies adaptive learning environments in a decision tree. A key distinction is between a static adaptation, presenting materials according to a student profile and dynamic adaptation, where learning resources are assembled on the fly to meet the current model of the student.

They can use rule-based models, linking particular misunderstandings to explanations, based on learner preferences, or use algorithms (based on test data) to pick the difficulty level of the next unit to study.

Algorithms may be based on rates of forgetting, such as some mobile vocabulary learning tools like Supermemo that deliver flash cards just before you are about to forget the word. Or they may just do tests, namely adaptive tests, where each question is harder or easier than the previous, as the system calculates the average expertise of the learner (Triantafillou, Georgiadou, & Economides, 2008). Integrated adaptive learning networks use both kinds of algorithm to schedule learning objects.

Secondly, we can separate systems according to what is adapted, once the rules or algorithms have updated their domain, learner, group and adaptation models (Paramythis&Loidl-Reisinger, 2003).

- Adaptive Interaction, refers to adaptations that take place at the system's interface and are intended to facilitate or support the user's interaction with the system, without, however, modifying in any way the learning "content" itself.
- Adaptive Course Delivery, is used to refer to adaptations that are intended to tailor a course to the individual learner.
- Content Discovery and Assembly, refers to the application of adaptive techniques in the discovery and assembly of learning material / "content" from potentially distributed sources / repositories.
- Adaptive Collaboration Support, is intended to capture adaptive support in learning processes that involve communication between multiple persons (and, therefore, social interaction), and, potentially, collaboration towards common objectives.

What in 2004 was just a research idea developed through research projects such as PROLEARN (Aroyo, Dolog, Naeve, Nilsson, & Wild, 2006), is now an active marketplace. A number of commercial providers now sell adaptive learning environments. Adam Newman has evaluated the products from 8 companies and, produced a framework for institutional decision-making (Newman, 2013b).

Although many Adaptive Learning Environments are designed to support instructivist teaching, it is possible to support constructivist learning with simple adaptation approaches. For example, in adaptive role playing games (Sancho, Moreno-Ger, Fuentes-Fernández, &Fernández-Manjón, 2009). They classify students according to Vermunt's learning styles questionnaire, then assign them to teams to explore a virtual environment. This provides the initial team and player profiles. They are adapted at the end of every mission, sometimes leading to reassignment of students' roles and teams.

A fourth context is user behaviour monitoring. There are systems which apply machine learning or statistical analysis techniques to the data collected when users interact with a web site or application. In education, researchers have taken the interactions over a whole module and applied data mining techniques to identify patterns of learning (Hung & Zhang, 2008)□. These have then been used in the design of the following year's module.

In the literature around intelligent agent systems, personalisation comes down to algorithms and heuristics that drive the behaviour of the system to better match the context set by the user and outside constraints: and even more narrowly, to user profiles. For example, an AI "butler" on a mobile phone that learns user preferences and uses them to interact with other AI services.

The latter can be done in simple tools, likehttp://m.modelling4all.org/ and NetLogo. How could one model the ways students find out where to learn the things that they personally need to understand? One way is to get the students to create a model of all the social interactions they use to find out information and learn to understand knowledge. They could build an agent-based model, as was done by villagers in Cameroun to build models of plant growth and predation around their villages, to help them optimise their planting strategies.

6) Personal Learning Environment literature

This is an approach where the learner customises the VLE or a collection of separate tools to meet personal learning needs. Early examples include the use of widgets on web pages. But improved usability does not guarantee usefulness, as it is harder to provide guidance in such environments.

The general idea is that the learner shapes the learning environment to a greater or lesser extent. But the term personal learning environment (PLE) is used in a variety of ways. Mark van Harmelen (2006) drew distinctions between these meanings.

> *Personal learning environment can be used to refer to any online environment for use by an individual. This is so vague it is useless. To see how wide this definition is, take a look at ("Posts about personalized learning on the Institute@CESA#1," 2013).*
>
> *A personalised learning environment can mean any environment that has been tailored for an individual prior to use.*
>
> *A personalisable learning environment is one that can be personalised at the time of its use, either by the user or by the system on behalf of the user.*

PLEs can be collaborative or non-collaborative, open or closed, peer-to-peer or server based, and involve single or multiple institutions. Most of them move the local of control closer to the learner, and provide some degree of personalisation. Less vague is the Mash-up PLEs of Wild, Mödritscher, &Sigurdarson (2008). They take a learning design, rather than instructional design approach. The learning environment is an outcome of the learning process, not a precondition designed by instructors.

Nowadays, PLE designers have started to catch up with social media. Dabbagh&Kitsantas (2012) have developed a pedagogic framework for using social media to create PLEs that support self-regulated learning, defined as a set of skills where students must know how to set goals, what is needed to achieve those goals, and how to actually attain these goals. The pedagogic framework has 3 levels.

Level		Zimmerman phase	Social media use
1	Personal information management	Forethought	Create a personal learning space using blogs and wikis.
2	Social interaction and collaboration	Performance	Engage in basic sharing and collaboration activities (e.g. blog comments, wiki editing).
3	Information aggregation and management	Self-reflection	Synthesise and aggregate information from phases 1 and 2.

Table 3: Pedagogic framework for using social media in a PLE (based on Dabbagh&Kitsantas, 2012).

The final stage, aggregating information, and integrating it into models and the students' personal understanding can be hard when using disparate tools. The Open University has built collaborative tools such as collaborative mind maps into its Responsive Open Learning Environments (ROLE) (Rizzardini, Linares, Mikroyannidis, & Schmitz, 2012).

It is possible to support adaptive learning in a PLE. Altimari, Plastina, & Cronin (2012) have built an adaptive recommender system into a collaborative PLE. The recommender system picked learning objects that fitted the student model, and dynamically assembled them into personal learning paths.

As an alternative to the instrumentalist view of personalisation (individual tests leading to directed individual study), how could one model the ways students find out where to learn the things that they personally need to understand? One way is to get the students to create a model of all the social interactions they use to find out information and learn to understand knowledge. In the students' case, it is a matter of building a model of how quickly they can identify personal learning needs through their interaction with peers and tutors, and how quickly they can locate the relevant learning resources. The routes may not just be the formal ones set up by the institution.

7) New approaches to learning literature

The term ‘learning style’ has been used by a number of authors to represent different people’s preferences in their approach to learning. Notably Grasha (2002) in the context of higher education made a powerful argument for including consideration of learning styles within the instructional design process. Interestingly, Grasha’s analysis does extend to discussion of teaching style as well as learning style, and he sees the two as being closely linked. Honey and Mumford (Honey; no date) devised a learning styles questionnaire which was suitable for use within management learning - particularly with a view to its being applied for in-service training by employers.

In practice there is some controversy over the use of learning styles, some centring on whether learning preferences are an innate characteristic of particular individuals, with other criticism, notably from Coffield et al (2004) suggesting that the evidence supporting them is flimsy. Fleming and Baume (2006) discuss the application of Fleming's VARK questionnaire (also used by undergraduate students in their 1st year at Cass). While the phrase 'learning styles' appears in the title of the article, the VARK questionnaire is positioned as a practical tool which has the potential to be useful to educators, and the term 'modalities' is used in preference to 'learning styles' as a neutral way to account for these preferences. Fleming's (2012) own response to Coffield's criticism suggests that the lack of clear evidence should not be used as an argument against practical application of a questionnaire which has been observed to raise some useful issues.

8 Moodle/VLE innovation literature

Kallkvist, Gomez, Andersson, & Lush (2009) published two prominent cases studies to discuss the uses of a virtual learning environment to support undergraduates in producing research reports – the first case used an 'e-profile' as a support tool. The authors noted the similarity to the Moodle 2 version currently used at Cass, as e-profiles could be adapted with ease. The key point raised was that participants felt face-to-face meetings were the only option better than the 'e-profile',' the former which would be unfeasible at Cass, and with the study focus group in the case, due to funding issues and the sheer workload of academics.

The second case utilised Instant Messaging conversations to support study structures, with reasonable success. Since the paper was published however, Skype has tended to become a more prominent tool amongst students, which, through video interface, eases the communication gap and opens new possibilities through seamless video interface, rather than text messages. A Moodle developer from Cass noted "From personal experience, when students study for a test, they will attempt the practice test and post their answers on Facebook where they are corroborated by others, or even refuted at which point, discussion around said question/answer emerges. The creation of a study room type forum within Moodle, or even a Moodle Chat (between students or with a lecturer) would replicate this interaction quite well."

The authors note that Moodle 2 would allow an open window to the study habits of students - which might later lead to data to further refine the course.

From Kwasnicka, et al (2008) comes a formal introduction to the 'Learning Assistant,' which learns about the user to create a personalised learning path for them. Whilst not a disruptive innovation in Virtual Learning Environments, it nevertheless highlights the use of grading test that links to further resources dependant on skill level at Cass.

A version of this is implemented in Case Study 1 below. The grading test also draws parallels to the paper by Limongelli, Sampietro, &Temperini (2007) which involves the importing of SCORM ideals into Moodle. The most notable parallel is the grading test at Cass shows students the material needed to learn to pass up to the next grade boundary, resulting in constant learning., and the SCORM paper forces the student onto that path through comparison of the result of a grading test and a 'target knowledge' file set by a teacher.

Case study 1 - foundations of economics revision booster

The teaching of 'Foundations of Economics' to 1st year undergraduate students in business and management presented itself as a case study, for the application of personalisation to an instance where students needed to attain a baseline level of knowledge and understanding, through a process which could be categorised as serendipity. At the time that the proposal for the project was prepared, it was recognised that students had some concerns at their ability to follow tutorials associated with the first year module, and one move to address these concerns was to institute a measure of streaming, so that students who had experience with economics before starting on their degree programme were in different tutorial groups from those who were learning economics for the first time. This set out to replicate a streaming approach which had been used with some success for the mathematics and statistics module taken by 1st year undergraduates at Cass.

Feedback, particularly at the staff-student liaison committee, suggested that the move towards streamed tutorials was welcome, and the students appreciated evidence that their concerns were listened to, but that streaming of tutorials did little to solve the underlying problem. The complexities of students' past economics background, and the difficulties that the students had with the unfamiliar language used in studying economics, were such that it proved unhelpful to generalise about which of two simple categories - those with A level economics or the equivalent and those without - students fell into. A telling observation from one of the economics lecturers was that some of the students who struggled most were ones who had learned a little economics before but who had been accustomed to a different approach to that used at Cass.

As the exam period in spring 2013 approached, students expressed concern that they would struggle when it became time to take the exam. At the same time, the lecturer and one of the supporting tutors in particular, expressed a regret that within constraints of the time available and skills that the staff delivering the module possessed, it would be difficult to add as much material on Moodle as would have been desirable.

Moodle permits a 'meta' module to be created, which is an additional module which takes the attributes, and has the same participants, as an existing module. This was used in the case of economics to create a second module, accessible to 1st year students taking the economics module, known as the 'foundations of economics revision booster', The revision booster was originally created in Moodle 1.9. This provided an opportunity to:

- Make additional revision material available (as requested by the students)
- Allow supplementary material to be published for the students to read (something which the lecturer and tutors wanted)

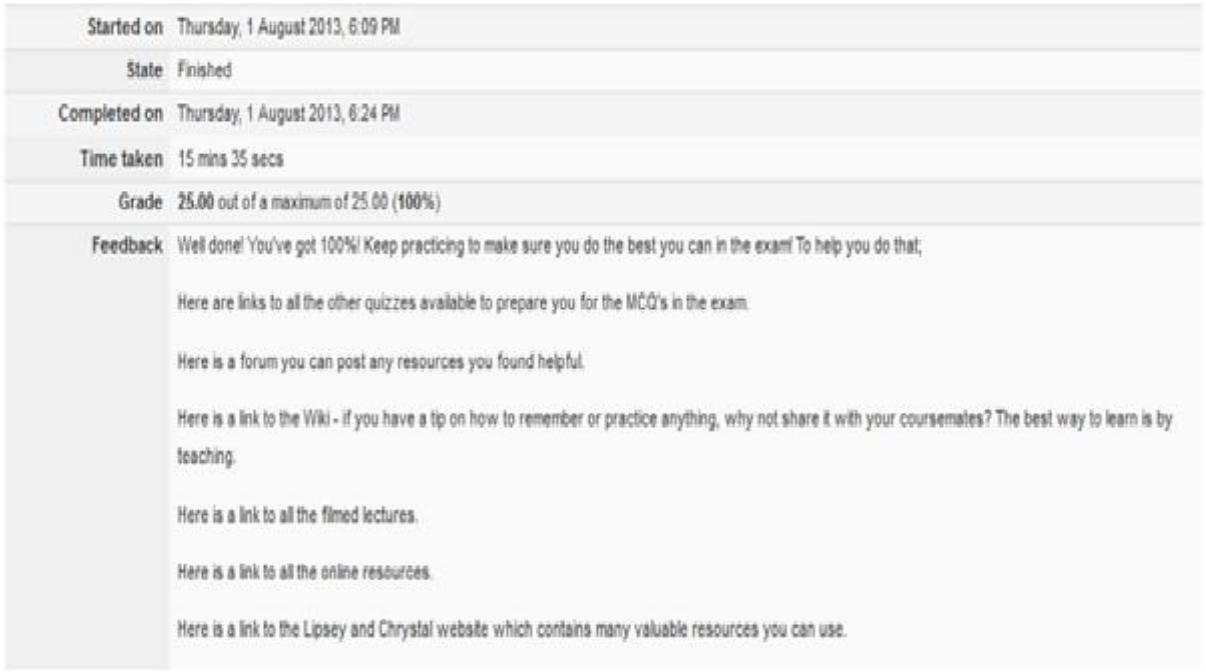
These are intrinsically linked to the third fundamental opportunity: Provide a test-bed for the personalisation concepts in a context where students were working towards a baseline desirable for the participants in the personalisation project. This is detailed below:

There are two grading quizzes, one for the microeconomics segment and one for macroeconomics, covering both basic and complex ideas, so that students taking them are able to accurately ascertain their placement in the course as a whole. The grade received results in feedback targeted at their particular baseline:

0-25%
26-50%
51-75%
76-100%

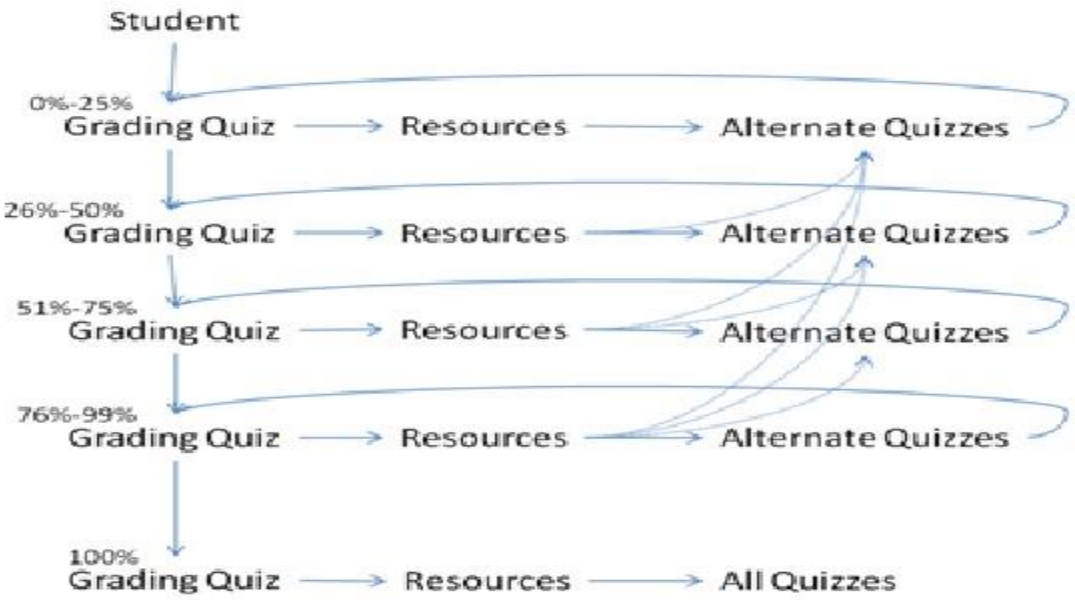
These are purposefully different to the degree classification grades, to encourage the typical student to aim for a degree classified Distinction - over 70% - if they fall into the broad 51-75% category in the quiz.

Within the 25 question quiz, each question can be flagged; this data highlights difficult questions and particular issues that the lecturer would be able to specifically target. Personalisation through feedback is another important feature:



Started on	Thursday, 1 August 2013, 6:09 PM
State	Finished
Completed on	Thursday, 1 August 2013, 6:24 PM
Time taken	15 mins 35 secs
Grade	**25.00** out of a maximum of 25.00 (**100%**)
Feedback	Well done! You've got 100%! Keep practicing to make sure you do the best you can in the exam! To help you do that; Here are links to all the other quizzes available to prepare you for the MCQ's in the exam. Here is a forum you can post any resources you found helpful. Here is a link to the Wiki - if you have a tip on how to remember or practice anything, why not share it with your coursemates? The best way to learn is by teaching. Here is a link to all the filmed lectures. Here is a link to all the online resources. Here is a link to the Lipsey and Chrystal website which contains many valuable resources you can use.

Moreover, the ability to take alternate tests, through knowledge progression, links to the first two opportunities of additional revision material and supplementary material. Below is a flowchart to explain the methodology.



Whilst this did not permit the sort of branching and alternative paths through Moodle made possible in Moodle 2, a limited amount of conditional navigation through the page could be implemented by using the Moodle 'lesson' feature.

The revision booster was launched, and students enrolled, with no publicity. However students would have been aware of its existence because it was listed in their 'my Moodle' page, which appeared when they first logged in, and a significant number of students explored it, out of curiosity, before they were given any explanation of its purpose.

Immediate future developments include forums added for students to pose questions, to submit their own resources; and a Wiki resource relying on student moderation, particularly useful for discussing complex economics models. These will add another layer of personalised learning to the existing features such as student-chosen revision slides and interactive flash-cards.

Thoughts/commentary on the economics quizzes

Currently the feedback for every boundary includes the same things; this will change to be more targeted in the future (see below)

The quiz is set to 25 questions in 30 minutes, upon which point any open questions are forcibly submitted and a grade given. This was structured to encourage time management skills relevant because students were typically unfamiliar with multiple choice questions.

The quiz will shuffle each time so the questions never follow the same pattern, and further to this, the answers within each question will also shuffle so that they are never laid the same way. Hopefully this will minimise cheating (though, hopefully the students will understand that cheating in this quiz is not in their best interests).

Students will be able to take the main quiz once a week only, but will be able to take the secondary quizzes as often as they would like. This is to ensure they spend sufficient time studying at the level of knowledge they have demonstrated instead of memorising answers and trying to skip ahead.

The quiz will be done with confidence-based marking turned on; a subject like economics is very suitable to this type of marking. If a student is confidently making incorrect choices then they will be forced to consider they don't know the subject as well as they think they do; conversely, an unconfident student making the correct answers will learn to be more confident in themselves. It also removes the ability of people to make guesses without fear of penalisation and also shows them that if they are not able to answer each one confidently, then they need to study more.

Each question can be flagged by the students; the data from these flags will highlight what students find what questions difficult and if there is a particular issue that seems to be a problem with a majority of students, the lecturer would be able to specifically target that in a lecture or tutorial and hopefully fix it.

A few things left to implement in subsequent enhancements of the revision are as follows;

- The overall feedback for a given grade boundary will contain links to more resources for the students to learn. These will also include secondary tests for them to do, targeted at cementing their current knowledge level, whilst also stretching them to learn for the next boundary.

- Discern a way to easily add the grade boundaries to the feedback. At the moment it is set up for specific grade, e.g. 75%, but no for groups, e.g. 76%-99% - to add individual grades manually would probably cause issues with Moodle as well as being hugely time consuming. It also rounds to the nearest grade boundary; in testing a deliberate attempt to score 48% triggered the appropriate feedback for the 50% grade - this is an issue as it unlocks the tier of quizzes from the next boundary up, which require a minimum of 50% to do.

- When a student gets a particular question wrong, the feedback for that question will contain links to content specific resources; the pages of the textbook/notebook that covers that topic, a recording of the lecturer discussing it, the appropriate part of the textbook website etc.

- The creation of the new quizzes for the specific grade boundaries; hopefully to be done with input from the lecturers so as to ensure content is aimed at the appropriate knowledge level. This will also include calculation based questions if the lecturers think it's necessary. These questions, if included, will have two primary uses – first within quizzes to test deeper knowledge of the subject whilst a student is pressured by time, and also as a separate quiz of pure calculation questions with no time limit. The feedback for this quiz would also point towards sections of the textbook with other questions they can do.

The project offered an opportunity to explore other benefits of Moodle 2, which, by offering a range of channels for access to material, could be construed as opportunities for stylistic personalisation. In the era of tablet and mobile computing, where the majority of students have some form of mobile device – be it a mobile, a tablet, or even both – it is important that Moodle be accessible on these devices. The previous generation of Moodle was optimised for personal computers and, when viewed on a mobile device, was perceived as tired and ugly.

Within Moodle 2 tests can contain feedback personalised to a student's grade. This feedback will link students to other tests they can do in order to achieve a higher grade; these tests will form part of a series of 'Conditional Activities'. That is to say, you will only be able to take Test 2 upon completion of Test 1.to a satisfactory degree (e.g. Above 75%).

Confidence Based Marking is the application of a simple idea; force students to honestly reflect on how well they know the question. If they decide they are not sure at all (<67%) but get a question correct, they only receive 0.33 marks instead of the full 1. If they decide they are super confident (>80%) but get the answer wrong, they get -2 marks, instead of 0.

There are multiple benefits to this, ranging from curtailing cockiness to building confidence in the students.

Case study 2 - systems dynamics modelling

Systems dynamics modelling was chosen as a case study of personalisation where there was a need to increase diversity within the cohort. It is a specialist analysis tool and was the subject of an elective offered to students in the final year of their undergraduate management degree.

In 2013 fewer than 10 students chose this option. The usual policy would not be to run a module for such a small cohort, but because this was a new module, and because the material was very highly valued by the students who did choose it, a dispensation was made to run it but on the understanding that possible ways to attract more students to the module would be explored. Significantly, though, the discourse at this stage was purely in terms of increasing numbers to what would be perceived as a viable cohort, and no thought was given as to how to make the module viable with a small number of students.

Systems dynamics has been recognised as a valuable but specialised sub-discipline in other institutions than Cass. Beek and Bredeweg (2012) in their discussion of Dynalearn address the application of an intelligent tutoring system influenced by system dynamics approaches.

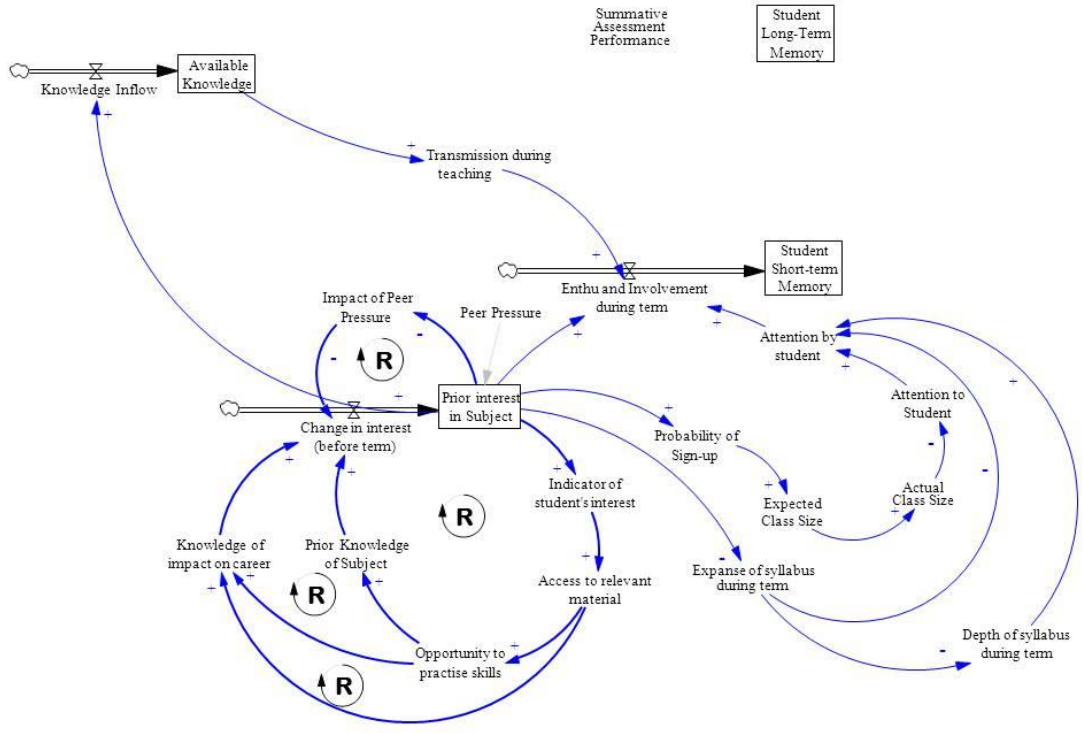
Because systems dynamics provides a set of useful tools which can enhance the understanding of problems which might otherwise appear intractable, a systems dynamics model with a set of propositions was developed to help to unravel the problem. The propositions fit closely with the notion of creating a set of design principles.

For the 2013-2014 academic year one simple pragmatic change in relation to feedback from the previous year was to move the systems dynamics module from the spring to the autumn term. This meant that there was a direct logical step for students who wished to use the modelling techniques learned in the module as part of their final year projects, due to be submitted at the end of the spring term. This change was made as a result of inquiry with students about how this niche module fitted in with their broader study plan.

Description of the tentative model

To understand the factors affecting the desirability of niche modules, a model was created representing demand for the system dynamics module. This set out to understand the degree of enthusiasm and involvement which students might bring to a 'niche' subject. This could be a function of three factors: (a) the students' prior interest in the subject, (b) the quality of transmission by the teacher during the lesson and (c) the attention paid by the student during the lesson. Arguably, these are not independent of one another, and a high quality module based around effective transmission of knowledge would become known about to students, and would generate an increased demand for the module.

The intention would be to give students access to relevant and suitable material that piques interest and provides information on how it can be useful from the career point of view. If possible, students should have the opportunity to practise some of the skills covered in the elective and to build up a level of basic knowledge before the module starts.



Abhijit Mandal has generated a systems dynamic model for the module as shown. Most notably it shows how prior interest in a subject can be encouraged at an early stage, and how this can create a reinforcing loop – represented by a letter R in a circle with an arrow – which in turn fosters deep knowledge of the subject. It also emphasises the need to relate such niche subjects to practical skills which students could put into practice in their studies.

Extending the cases - applications to post-experience students

As discussed earlier, the motivation for studying personalisation at Cass covered areas of interest in a range of courses. However the case studies related here are specific to the Cass undergraduate programme, and were adopted because they offered opportunities to put personalisation into practice in a manner which would address an immediate need within the institution.

However it is worth reflecting on the scope for generalising the principles so that they are relevant to postgraduate students, and especially in the context of a business school to students who have prior experience before they embark on a course of study. The revision booster was created as a direct response to the range of different types of past experience found among undergraduate students - not only in terms of whether they had studied the subject before or not, but in terms of variation in the sort of language and approach which they had used in their prior learning. These variations are even greater in postgraduate courses, where students are also under pressure to study within a compressed amount of time, and to adjust rapidly to a particular way of dealing with a subject.

For post-experience students there are also opportunities for niche modules analogous to the system dynamics case. These students often arrive on a postgraduate course with a particular set of expectations and interests, and these can often map onto distinct subject areas which students might wish to pursue. So a logical next stage would be to experiment with applying the same principles to post-experience, postgraduate degrees at Cass.

Conclusions and design principles

Evaluation of the case studies was fairly informal, but set alongside the literature discussed, some quite clear principles emerged for the application of personalisation:

- There is scope for both many goals/many paths and one goal/many paths, approaches. While it can be tempting to view core modules within large-scale degree courses as standardised because they are based around a single goal, in fact there is significant value in providing a range of options through offering many paths
- Students value personalisation both in terms of pedagogic approaches and in terms of presentation. The ability to reach the same resources through multiple channels (for instance from a computer, a tablet, or a mobile device, and navigating to it in a more or less interactive fashion) can be regarded as essential
- Barriers to offering a more personalised learning experience can have more to do with organisational barriers, and the preconceptions of both academic and administrative staff, than to do with technical constraints. One challenge is to recognise that a niche subject may be effectively covered without necessarily attracting a cohort of at least ten students to participate
- Students value the ability to navigate learning materials with the help of diagnostic

quizzes, and other questions, which can provide a measure of scaffolding and direct them to resources which are pitched at the appropriate level. This works best when positioned as a positive approach which facilitates students in their navigation through a very large amount of information that is available, and not a negative approach which blocks students' access to information that might not be at a suitable level
- Moodle provides a very valuable range of tools to build a platform for personalisation, depending on students' own preferences. However future trends could well embrace a move towards adaptive learning which would depend on more specialised personalisation tools, possibly automatically linked to analytic data available through environments such as Moodle

These can be extended to produce some underlying ideas for pedagogic design. Some general principles which have emerged from this include:

- The importance of providing a wide range of targeted learning resources, and recognising within a course aimed at a large number of learners the importance of offering material which might be directed at just a few of them. Sometimes, notably with elective modules covering 'niche' topics, it is important to reflect on how these fit into the totality of students' studies
- The benefits of providing tactical support for students in response to a particular need - as in the revision booster for economics where it became apparent that the student group was less homogenous than might at first have appeared
- The scope for allowing students to retain control of their own learning journey, while at the same time offering them guidance so that they can locate resources which are best matched to their own needs
- The need to offer personalisation in terms of channels and presentation as well as in terms of pedagogic material: students have little patience with electronic learning resources which are only optimised for a personal computer when their principal tool for access to the Internet is a mobile device
- The potential for making vastly increased use of the analytic data available when learning resources are provided electronically, and for moving in the future towards an environment where this data is used to determine automatically how learning materials could be adapted to a particular student's needs
- The suitability of a learning environment which offers comprehensive analytic data, a range of tools for conditional release of material, and which works well through a mobile device. Although these principles are about pedagogic design more than about any particular platform, it is worth observing that Moodle 2 is a much better match to these requirements, in the context of City University, than were earlier versions.

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