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Resource Pack on Curriculum Design and Assessment to Promote Effective Learning.

Christine O'Connor
Technological University Dublin, christine.oconnor@dit.ie

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Dr Christine O'Connor, School of Chemical and Pharmaceutical Sciences

Aim of Resource Pack

This resource pack is an overview of current considerations for academics designing programmes for third level education. The changing demographic of third level students along with employers' demands has resulted in programme development with a focus on skills basis (Hyslop-Margison, 2001) to support a knowledge based society. The rationale behind the changes in curriculum design is introduced and further focus is emphasised in the areas of curriculum design models, assessment models and evaluation models. Examples of innovative curricula and assessment models in third level chemistry education will be incorporated during the pack which may be applied across other disciplines.

Executive Summary of Topic

'Constructive Alignment'

Current chemistry education is in a dynamic state as third level institutes are under pressure to fulfill the economic demands from industry as well as attracting prospective students to their programmes from the ever decreasing pool of chemistry second level graduates. (Childs, 2002) Current chemistry programmes in Ireland are becoming more career focused than before and the transferable skills acquired during the programmes are now used as marketing tools for prospective students. The change in career focused curricula design may be a way forward, however, is the content knowledge being lost by our current students? A 'need to know' attitude is being experienced by academics as students frequently ask *'What do I need to know?'* in order to strategically prepare for assessments. This question should be answered by the learning outcomes of the curricula and modules to which the delivery mechanisms and assessment strategies (Biggs, 1999) in place should reinforce.

'What the Academic needs to know'

A structural guide to standards of knowledge, skill or competence to be acquired by learners has been published by the National Qualifications Authority of Ireland (**NQAI**). The European Credit Transfer System (**ECTS**) has been implemented as part of the Bologna process. The ECTS is a student-centred system based on the student workload required to achieve the learning outcomes and competences to be acquired. 60 ECTS credits are equivalent to 1200 learning hours per year, which is a combination of lecture, tutorial, practical laboratories and self directed learning. In general undergraduate programmes in the DIT, 180 ECTS credits is awarded a level 7 degree and 240 ECTS credits is awarded a level 8 degree. With all this guidance and transparency why are we still being asked *'What do I need to know?'.* In order to approach the challenges of the diversifying educational demands in third level institutes the role of curriculum design and assessment strategies will be discussed and some evaluation techniques suggested.

Scholarship on Topic (background literature)

'Education in the 21st century'

Designing curriculum and assessment strategies for third level education in the 21st century has drastically changed from that of the past. Since 1975 education researchers have witnessed a shift in focus from the curriculum to the student. (Bucat, 2004)

> *"OECD economies are placing an increasing emphasis on the production, distribution and use of knowledge. The knowledge economy is dependent on peoples ability to adapt to situations, update their knowledge and know where to find knowledge. These so called knowledge workers are being paid for knowledge skills rather than manual work"* (Maier and Warren, 2000)

The past 100 years saw the dominant influence in the curricula structure has been that of the academics in their separate knowledge fields. Barnett, (2000) states that '*in the contemporary world, academic hegemony is dissolving as curricula become subject to two contending patterns of change*'. The two patterns of changed suggested by Barnett are; (i) widening of participation at third level colleges and (ii) that a universal shift in the direction of performativity is emerging: what counts is '*less what individuals know and more what individuals can do (as in their demonstrable skills)*'. He goes on to say that '*curricula are taking on ad hoc patterns that are unwitting outfall of this complex of forces at work, diversifying and universalling. He feels that as a consequence, curricula will be unlikely to yield the 'human qualities of being that the current age of supercomplexity requires*'.

Bodner (1992) stated that *"changing the curriculum – the topics being taught – is not enough to bring about meaningful change in science education, we also need to rethink the way the curriculum is delivered".* Bucat, (2004) proposes that *"Before our teaching can advance, we need to be knowledgeable not only about the learning outcomes of our teaching, but of the conditions, including subject specific factors, that have given rise to those outcomes. Then perhaps we can design our teaching accordingly".* The dramatic changes which have been taking place in higher education in recent years and the consequential disruption to the 'traditional identities of place, of time and of scholarly and student communities' is changing the structure and functions of third level education institutes. The changes are producing for the 21st century a higher education system which operates under a greater variety of conditions than ever before (part-time/ full-time, work-based/ institution-based, face to face/ delivered at a distance etc.) and which brings with it a student experience and an informal curriculum, which are both changed and increasingly diverse.

Curriculum Design

Chemistry is regarded as a difficult subject and many of the concepts are inexplicable without the use of analogies or models. Reviews of misconceptions over the past 16 years will affirm this. (Andersson, 1990; Gabel and Bunce, 1994 and Nakhleh, 1992) Recent modifications in chemistry education have seen the introduction of modularisation. The introduction of the modular system has been a quick transformation and maybe with little time for forward planning and minimum prior knowledge of the importance of programme learning outcomes.

> *"Planning for learning means that designing the forms of instruction which support learning becomes as important as preparing the content of programmes".* (Dearing, 1997)

Many of the programmes currently modularised are a dissected version of the 'un-modularised' course with all the content and less delivery time and formative assessment due to semesterisation. Programmes that were previously run over the entire academic year with summative exams at the end of year are now delivered in two semesters with summative exams at the end of each semester, which are combined for the over all grade at the end of year. If the current curricula of our programmes are closely looked at, are they "*the planned and guided learning experiences and intended learning outcomes, formulated through the systematic reconstruction of knowledge and experiences, for the learners' continuous and wilful growth in personal social competence"?* as curricula is defined by Tanner (1980).

Curriculum Design in the disciplines (case study)

Teaching and learning should take place through a system from the classroom, to department, to institution levels. A coherent system should have integrated curriculum, teaching and assessment tasks to support learning and promote students into a higher order learning process. (Zoller, 1999)

One example of a Curriculum Alignment Project (CAP) developed by Pinkerton (2001) incorporated the CAP to coordinate one semester of activities. CAP's are long-term, multiple approach design and construction projects that provide students a concrete task to accomplish, rather than an abstract theme to appreciate. Pickerton found that "*after one cycle of CAPs, student motivation began to change from extrinsic to intrinsic; achievement on objective measures was holding steady; students' abilities to craft and carry out long-term plans for complex projects were improving; and the teacher was learning how to design curriculum that fostered students' need to know*".

Inquiry based learning through technology (Edelson et al, 1999) or student driven practicals (Mc Donnell et al) are other examples of strategies to promote learning through curriculum design. Jones (1999) has discussed introductory chemistry learning environments that promote the use of design activities which can provide students with opportunities to develop authentic scientific inquiry skills. '*Many of the activities students complete in their coursework are "school activities", activities conducted only in classroom settings. Seldom are opportunities to carry out more authentic science activities available. However, when asked to design their own experiments and control variables, students must think like scientists. Such authentic experiences are difficult to provide and to monitor in large general chemistry classes. However, multimedia computer based simulated laboratory experiments can give students the opportunity to design and carry out many experiments in chemistry in a short period of time.*'

Problem based learning (PBL) which has been pioneered in the School of Physics at DIT is a very good example of aligned teaching. In PBL, the aim is to produce graduates who can solve professional problems, the main teaching method is to get the students to solve professional problems, the assessment is judging how well they have solved them. Most teaching methods could be more effectively aligned than they currently are. (Biggs, 2002) How we assess should promote learning and drive the learning outcomes.

Assessment models

The role of assessment in accordance to constructive alignment is to achieve the learning outcomes to the best of ones ability. Figure 1 gives just some examples of assessment strategies. These do not include group projects, PBL, and all the other assessment activities used to assess a diverse range of learner types and skills basis. Module descriptors require the assessment weighting and methods to be outlined by the module authors. The competencies envisaged in the learning outcomes should be assessed in the appropriate manner. Clear assessment criteria should be at hand for students to refer to and it should be evident from the assessment criteria 'What they need to know'!

Coppola et al, (1997) have restructured their classroom practice and have devised five principles which guide their instructional design to help students develop higher order learning skills. The five principles they have outlined are;

i. Give out explicit rules/ criteria
ii. Use Socratic Instruction
iii. Create alternative metaphors for learning
iv. Use authentic problems to elicit authentic skills
v. Make examinations reflect your goals (constructive alignment)

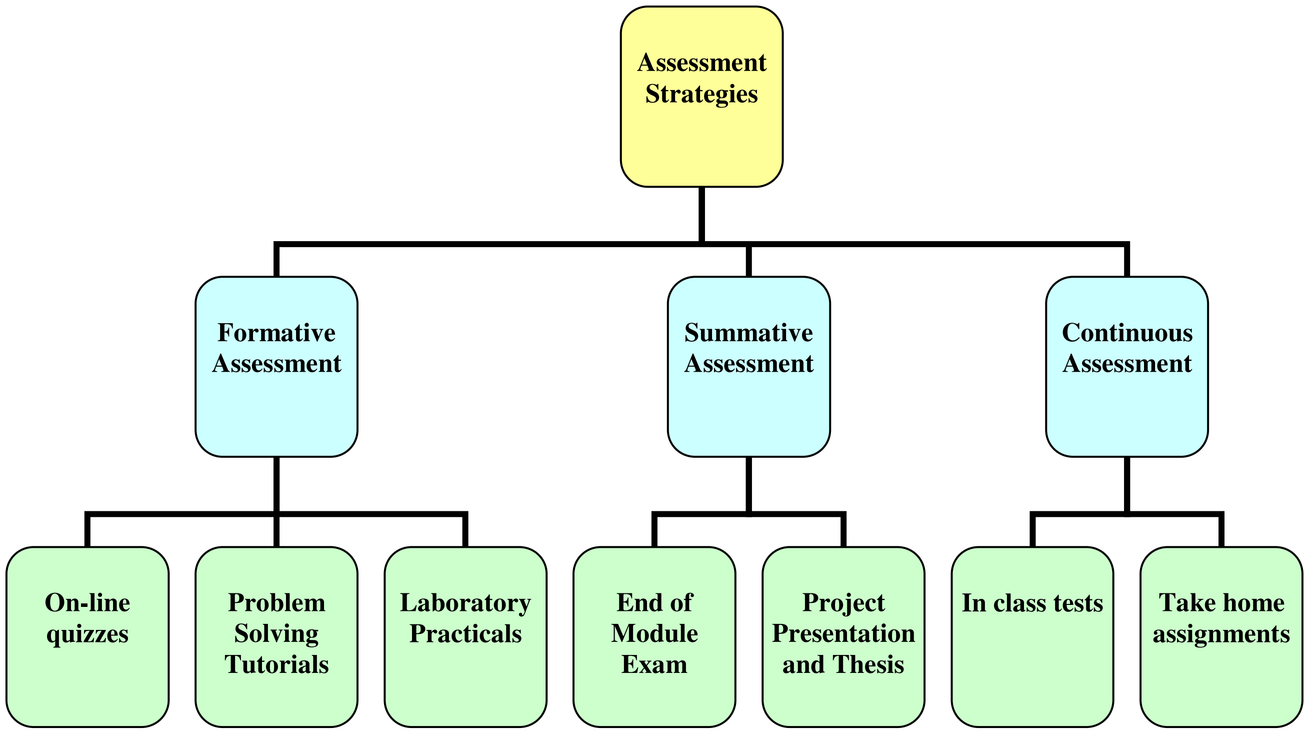

Figure 1: Examples of Assessment Strategies

Formative assessment in students learning is usually acknowledged, but it is not well understood across higher education. It is argued that there is a need to take account of the epistemology, theories of intellectual and moral development, students stages of intellectual development, and the psychology of giving and receiving feedback. It is noted that formative assessment may be either constructive or inhibitory towards learning. (Yorke, 2003)

"Assessment should be given serious consideration and reflection and the choice of assessment methods should clearly relate to the learning outcomes. There will rarely be one method of assessment which satisfies all learning outcomes for a module and we would recommend that in devising your assessment strategy, a variety of methods is included."

(Donnelly and Fitzmaurice, 2005)

Practice suggestions for departments

An example of a curriculum design model is given in Figure 2 which gives a simplistic overview of where to start. The level of award in which the programme is to achieve can be selected in accordance to the NQAI. Level 7 is a BSc (Ord) (formerly known as the Diploma), level 8 is a BSc (Hons) and level 9 is MSc etc. The next step is to decide on the programme aims and objectives in the form of learning outcomes specific (i) to the programme and (ii) to the individual modules.

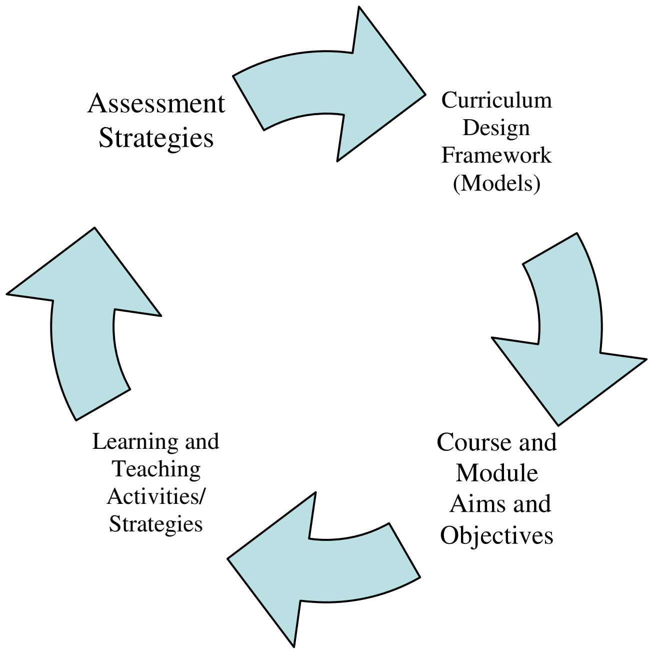

Figure 2: Example of a Curriculum Design Model

The learning outcomes should reflect the skills and competences required of the graduate from this programme. Learning and teaching activities should be selected that are suitable to the delivery of the module. (Bucat, 2004) Activities is the 'key' word as *"Learning takes place through the active behaviour of the student: it is what he/ she does that he/she learns, not what the teacher does"* (Tyler, 1949) In an integrated system where assessment is constructively aligned (Biggs, 2002) to drive the learning, this approach to curriculum design optimises the conditions for quality learning.

When designing a new programme a curriculum planning model may be used to overview the programme design as shown in Figure 3. This gives the programme manager and committee a prospective view of the programme as a whole and the criteria that must be fulfilled in order to implement it successfully. Fink (1999) has outlined five principles to ensure good course design which include criteria such as;

(i) challenges students to higher level learning,
(ii) uses active forms of learning,
(iii) gives frequent and immediate feedback to students on the quality of their learning,
(iv) uses a structured sequence of different learning activities, and
(v) has a fair system for assessing and grading students.

The last criterion is an important one, as the increased diversity of learners has changed from the traditional students of the past and this diversity must be catered for within the programme design.

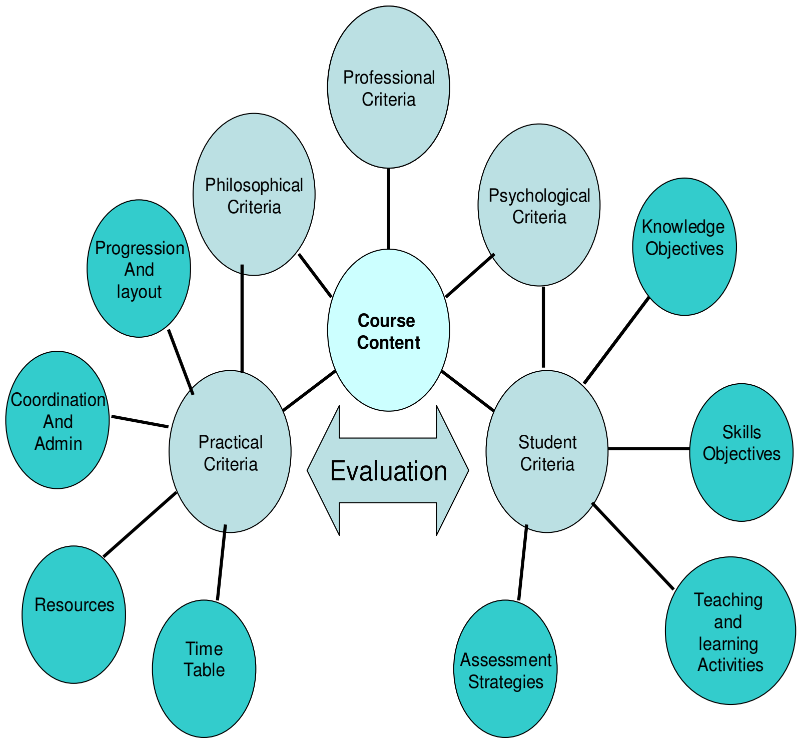

Figure 3: Example of a Curriculum Planning Model

What to do next

As part of a programme committee deicide on modules that may be incorporated into programmes. As a module author view a selection of module templates currently used with/ within your school but also outside your institute on a national and international level. Create/ update your module by making (i) making the aims of the module more transparent, (ii) ensure that the assessment is driving the learning outcomes for the module and that the learning outcomes are valid for the key skills to be achieved and at the appropriate level, (iii) list the content of the module including recommended reading/ study material, (iv) clearly outline the learning activities and assessment criteria necessary to fulfill the requirements of the module. Examples of the teaching and learning strategies adopted in the School of Chemical and Pharmaceutical Sciences at DIT are the use of contextualization (O'Connor and Hayden, 2008), annual industry visits, visual images (use of posters, animation on computer packages, scientific DVD's), molecular models, creating a virtual learning environment (VLE) via webcourses (WebCT), demystifying the marking process (sample papers for exams, marking criteria for lab practicals), weekly problem solving workshops (tutorials students must engage and are given a mark for participating), and team and theme teaching (one topic may have a variety of applications across disciplines). The limitations to what you can do will be based mainly on Time, Resources and Timetabling.

'***Some suggestions'***

Do some research before you start and see what is already developed. There are a wide range of resources readily available such as text books, CD's and DVD's, Subject specific education journals, Professional bodies and discipline specific education conferences. The Learning and Teaching Centre and the Learning Technology Team have small grants for academics interested in developing new initiatives for there practice. To find out more about what can be done attend the DIT Teaching and Learning Showcases and the DIT e-learning summer schools.

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