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ENGINEERING CURRICULUM PLANNING
Learning development for social engagement in the 21st century

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Some guiding principles

- Many of our graduates will work in careers outside of their discipline of study

- Universities do not graduate engineers, doctors, lawyers, etc. Rather, we graduate people who are ready to learn these professions

- We accept that, 10-15 years after graduating, our students will probably be in jobs that may not have a name yet

- Academic Freedom and Institutional Autonomy are important and must be defended at all times
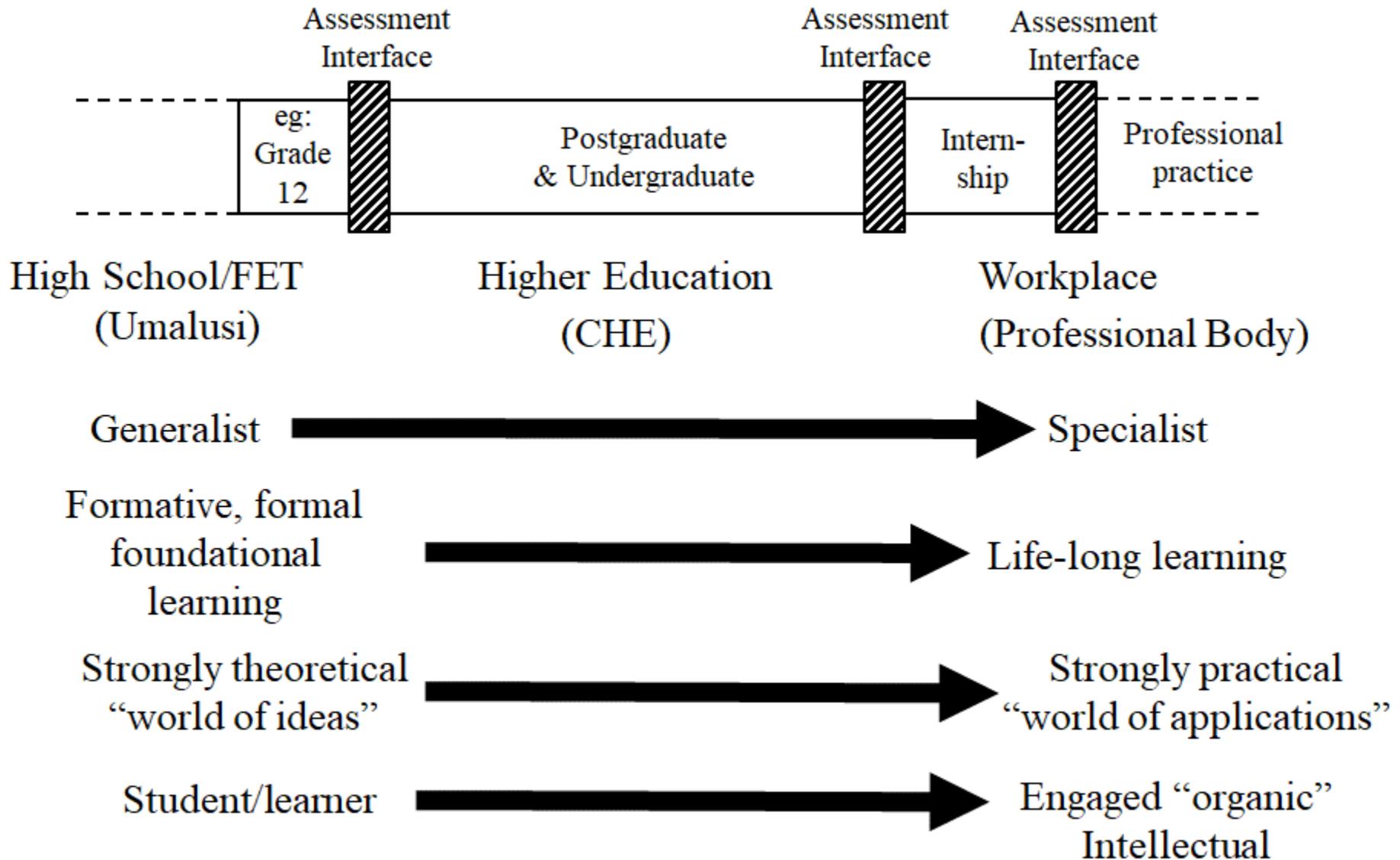
The Academic Planning Continuum

Admissions Policy

Curriculum Structure & Coherence

Pedagogy to Support Curriculum

Exit "Standards"

"Interfaces" in the Learning Continuum

Assessment Interface | Assessment Interface | Assessment Interface

eg: Grade 12 — Postgraduate & Undergraduate — Intern-ship — Professional practice

High School/FET (Umalusi) — Higher Education (CHE) — Workplace (Professional Body)

Generalist → Specialist

Formative, formal foundational learning → Life-long learning

Strongly theoretical "world of ideas" → Strongly practical "world of applications"

Student/learner → Engaged "organic" Intellectual

Shifting approach to curriculum development

FROM:

- What content do I have to deliver for this course?

- How much content is needed to fill the lecture time?

- How should I deliver this content

- What exam questions will assess student mastery of the content?

TO:

- What competencies do I intend students to develop in this course?

- How will we assess these competencies?

- How will students practice these competencies?

- What pedagogical approach will access different learning styles?

- What content material will support development of these competencies?

For the cynical:

"The teaching process involves transferring information from the notes of the lecturer to the notes of the student – without passing through the brain of either one of them"

The value of content knowledge and professional technique is shifting:

- Ready availability of content knowledge – free courseware, "MOOCS"; online textbooks, etc

- Ubiquitous presence of devices for access

- E-learning management systems: Moodle, Sakai, Blackboard, etc

The value of content knowledge and professional technique is shifting:

- Challenges to the idea of "*the student as a sponge waiting to absorb knowledge – but only from the all-knowing professor*"

- Foundational knowledge in a discipline changes very slowly. "Flavour of the Month" knowledge changes quickly and is only useful as anecdote or example.

Two Important Teaching Questions

- If content knowledge is so ubiquitously available, what case do we make for asking our students to attend our classes?

- How do we respond to the very real possibility that one of the reasons for our students' poor academic performance is that we did not teach them properly?

Drivers of Curriculum Contestation with outside bodies

- Massification of higher Education

- Race and gender transformation

- Globalisation and the demands of the "knowledge economy"

- "Birth of Athena" conception of the University as social institution – in conversations about the "relevance" of universities

Relationships at the interfaces require:

- Recognition of SEPARATE BUT COMPLIMENTARY roles

- Respectful understanding of each other's intentions, objectives and values

- Strict adherence to the principle of   EYES ON – HANDS OFF

- Consideration of a "negotiated self-regulation" relationship

Some questions for shared engagement with outside bodies

- What are the attributes that make graduates ready for entry into the world of work?

- Does more directive approaches to accreditation make for better quality graduates?

- How do we jointly defend international comparability, critically engaged graduates; socially equitable profiles of professionals; academic freedom and the highest ethical conduct of professionals?

- See: **Ballim, Y, Mabizela, S and Mubangizi, JC**. *Professional bodies and quality assurance of higher education programmes in South Africa: Towards an appropriate framework.* SA Journal of Higher Education Vol 28; No 4; 2014; pp 1140–1155.

Example: ECSA Outcome Competencies

1. Engineering problem solving
2. Application of fundamental and specialist knowledge
3. Engineering design and synthesis
4. Investigations, experiments and data analysis
5. Engineering methods, tools, skills and IT
6. Professional and general communication
7. Impact of engineering activity on society and the environment
8. Team and multi-disciplinary working
9. Lifelong learning
10. Professional ethics and practice

These competencies are to be **introduced**, **developed**, **practiced** and **<u>assessed</u>** in the curriculum

ECSA: Content Knowledge Areas

- Mathematics (10%)
- Basic Sciences (10%)
- Engineering Sciences (30%)
- Design and Synthesis (12%)
- Computing and IT (3%)
- Complementary Studies (10%)

Note: Σ = 75%

Example of an approach to curriculum structure: The Coherence Matrix

Course Code	Course Name	Problem Solving			Fundam-ental & Specialist Knowledge			Design and Synthesis			Investiga-tions, Experiments & Data Analysis		
		B	I	E	B	I	E	B	I	E	B	I	E
CHEM180	Chemistry I	✓			✓						✓		
CIVN101	Civil Eng & Development	✓											
CIVN102	Engineering Computing												
CIVN104	Engineering Skills	✓						✓					
MATH180	Mathematics I	✓			✓								
CIVN219	Materials & Structures		✓			✓		✓			✓		
CIVN222	Eng. Planning & Design		✓					✓			✓		
CIVN223	Numrcal Methods & Stats	✓				✓		✓			✓		
MATH280	Mathematics II		✓				✓						
MINN250	Surveying for Engineers		✓				✓					✓	
CIVN303	Structural Design		✓				✓			✓	✓		
CIVN304	Construction Materials I		✓			✓						✓	
CIVN327	Infrastructure Mngmnt		✓										
CIVN328	Infrastructure Planning		✓						✓				
CIVN408	Construction Materials II			✓			✓			✓			✓
CIVN409	Hydraulic Engineering II			✓			✓			✓		✓	
CIVN420	Investigational Project			✓			✓			✓			✓
CIVN421	Integrtd Resource Mngmnt			✓			✓			✓		✓	

The complete Coherence Matrix

Course Code	Course Name	Problem Solving			Fundamental & Specialist Knowledge			Design and Synthesis			Investigations, Experiments & Data Analysis			Eng. Methods, Skills, Tools &IT			Prof. & General Communication			Impact on Society & Environment			Team & Multi-disciplinary Working			Lifelong Learning			Professional Ethics & Practice		
		B	I	E	B	I	E	B	I	E	B	I	E	B	I	E	B	I	E	B	I	E	B	I	E	B	I	E	B	I	E
CHEM180	Chemistry I	✓			✓						✓															✓						
CIVN101	Civil Eng & Development	✓															✓			✓			✓			✓			✓		
CIVN102	Engineering Computing													✓			✓									✓					
CIVN104	Engineering Skills	✓						✓						✓			✓			✓			✓			✓			✓		
MATH180	Mathematics I	✓			✓																										
PHYS180	Physics I	✓			✓						✓			✓												✓					
PHYS181	Mechanics	✓			✓						✓			✓												✓					
APPM280	Applied Mathematics IIA		✓			✓						✓			✓																
CIVN204	Earth Materials & Process					✓			✓						✓						✓						✓				
CIVN208	Intro to Env. Engineering	✓			✓										✓			✓			✓										✓
CIVN219	Materials & Structures		✓			✓		✓			✓			✓				✓		✓			✓			✓			✓		
CIVN222	Eng. Planning & Design		✓					✓			✓				✓			✓					✓						✓		
CIVN223	Numrcal Methods & Stats	✓				✓		✓			✓				✓											✓					
MATH280	Mathematics II		✓				✓																								
MINN250	Surveying for Engineers		✓				✓					✓				✓								✓							
CIVN303	Structural Design		✓				✓			✓	✓					✓		✓						✓				✓			
CIVN304	Construction Materials I		✓			✓									✓			✓						✓			✓				
CIVN305	Hydraulic Engineering I		✓			✓									✓			✓									✓				
CIVN308	Structural Engineering I		✓			✓		✓			✓			✓																	
CIVN318	Geotechnical Eng. I		✓			✓		✓			✓			✓			✓			✓			✓			✓				✓	
CIVN327	Infrastructure Mngmnt		✓											✓			✓			✓			✓			✓			✓		
CIVN328	Infrastructure Planning		✓					✓						✓			✓			✓			✓			✓			✓		
CIVN408	Construction Materials II			✓			✓			✓			✓		✓				✓						✓			✓			
CIVN409	Hydraulic Engineering II			✓			✓			✓	✓					✓			✓					✓				✓			✓
CIVN412	Structural Engineering II			✓			✓	✓					✓					✓										✓			
CIVN414	Civil Eng Design III			✓			✓			✓			✓			✓			✓			✓			✓			✓			✓
CIVN418	Geotechnical Eng. II			✓			✓			✓			✓			✓			✓			✓			✓			✓			✓
CIVN420	Investigational Project			✓			✓			✓			✓			✓			✓									✓			✓
CIVN421	Integrtd Resource Mngmnt			✓			✓			✓		✓				✓			✓			✓		✓				✓			✓

Some benefits of this approach

- Learning development of students is mapped across the whole curriculum – rather than one course at a time

- Individual academics become accountable to the "community of teachers" who contribute to the programme

- Expectations of each course are clear and one can better predict the implication of curriculum changes

Some thoughts on the "Second Curriculum"

- This is the learning that takes place at university but outside of formal course-based learning – seminars, debates, cultural events, etc.

- Influenced by the "institutional culture" of the university

- Can be directed to enhance learning

- Does require teaching staff to be aware of activities and to encourage students to participate

- Issues can sometimes blend with the first curriculum

To remind you:

- Curriculum is one component of the academic plan and must be integrated

- Focusing on competence means a review of the primacy of content knowledge and skills

- Consider variations of the "curriculum coherence map" in programme planning and management

- Consider opportunities in the second curriculum

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