Implementing Academic Criteria for Bachelor and Master Curricula

Kees van Overveld
TU Eindhoven

Contents

- Context and motivation
- Purposes
- Conceptual framework
- Approach and Measurements
- Results
- Conclusions

Contents

- Context and motivation
- Purposes
- Conceptual framework
- Approach and Measurements
- Results
- Conclusions

Context and Motivation

In the past:

- Academic curricula developed according to the autonomous dynamics of an academic discipline
- ‘academic’= defining predicate for university education

Context and Motivation

Now:

- Demand side: blurring disciplinary boundaries
- Supply side: questions for benchmarking, standardization and accreditation, (international) market mechanisms
- Novel kinds of disciplinary-independent professional skills

Contents

- Context and motivation
- Purposes
- Conceptual framework
- Approach and Measurements
- Results
- Conclusions

Purposes

- Vocabulary for academic contents
- Qualitative description of programs
- Quantitative description of programs
  - (used for accreditation etc.)
- Awareness in educating staff
- (Academic) quality improvement

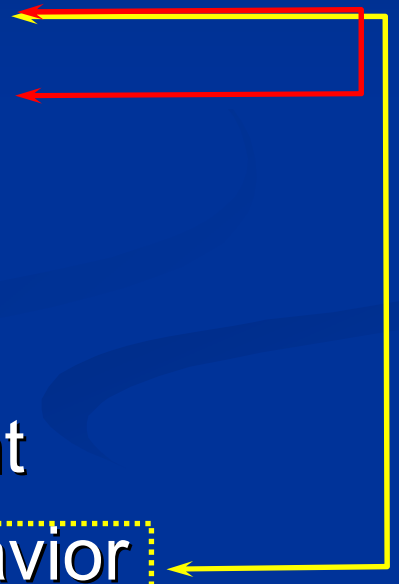
Contents

- Context and motivation
- Purposes
- Conceptual framework
- Approach and Measurements
- Results
- Conclusions

Conceptual Framework

stages in education:

- program manager's intentions
- teachers' intentions
- teachers' actions
- students actions
- students' competence development
- students' visible (assessable) behavior



Conceptual Framework

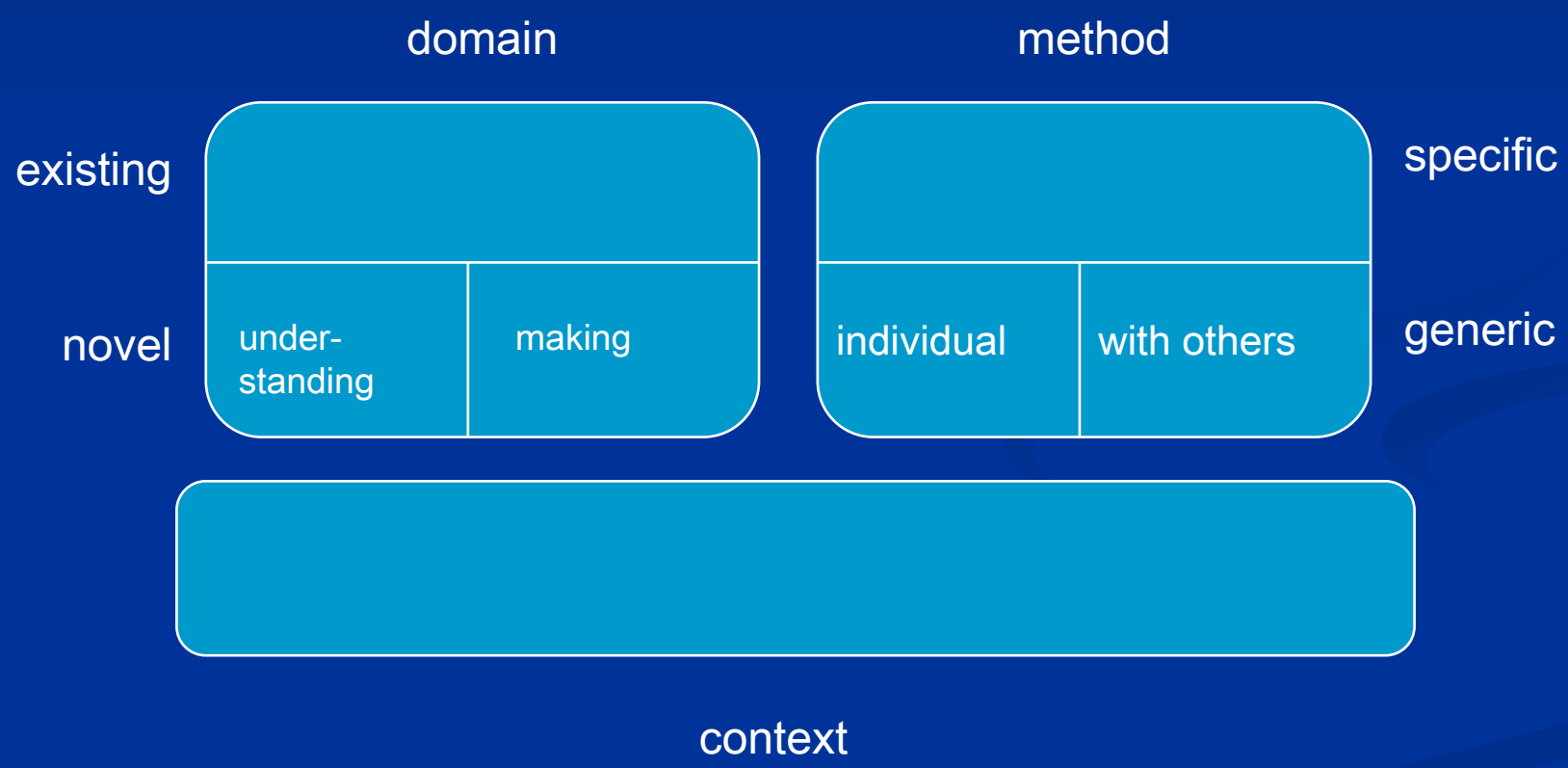
Consists of:

- Competences
  → qualitative: academic profile
- Academic Dimensions
  → quantitative: profoundness

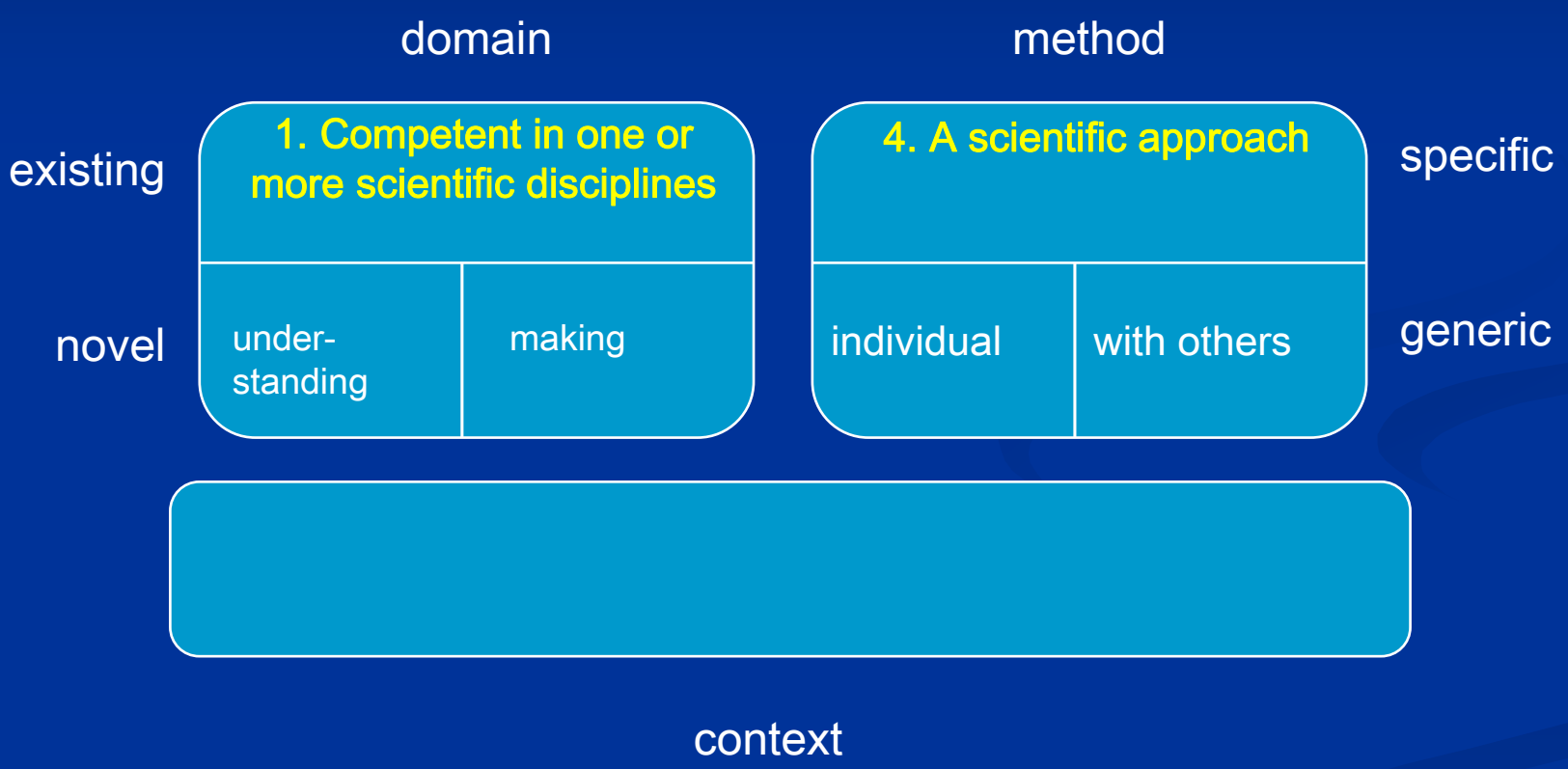
Conceptual Framework (competences)

- Covering (complete)
- Independent
- Operational (manageable and comprehensive)
- Matching with intuition of ‘academic’
- Easy to memorise

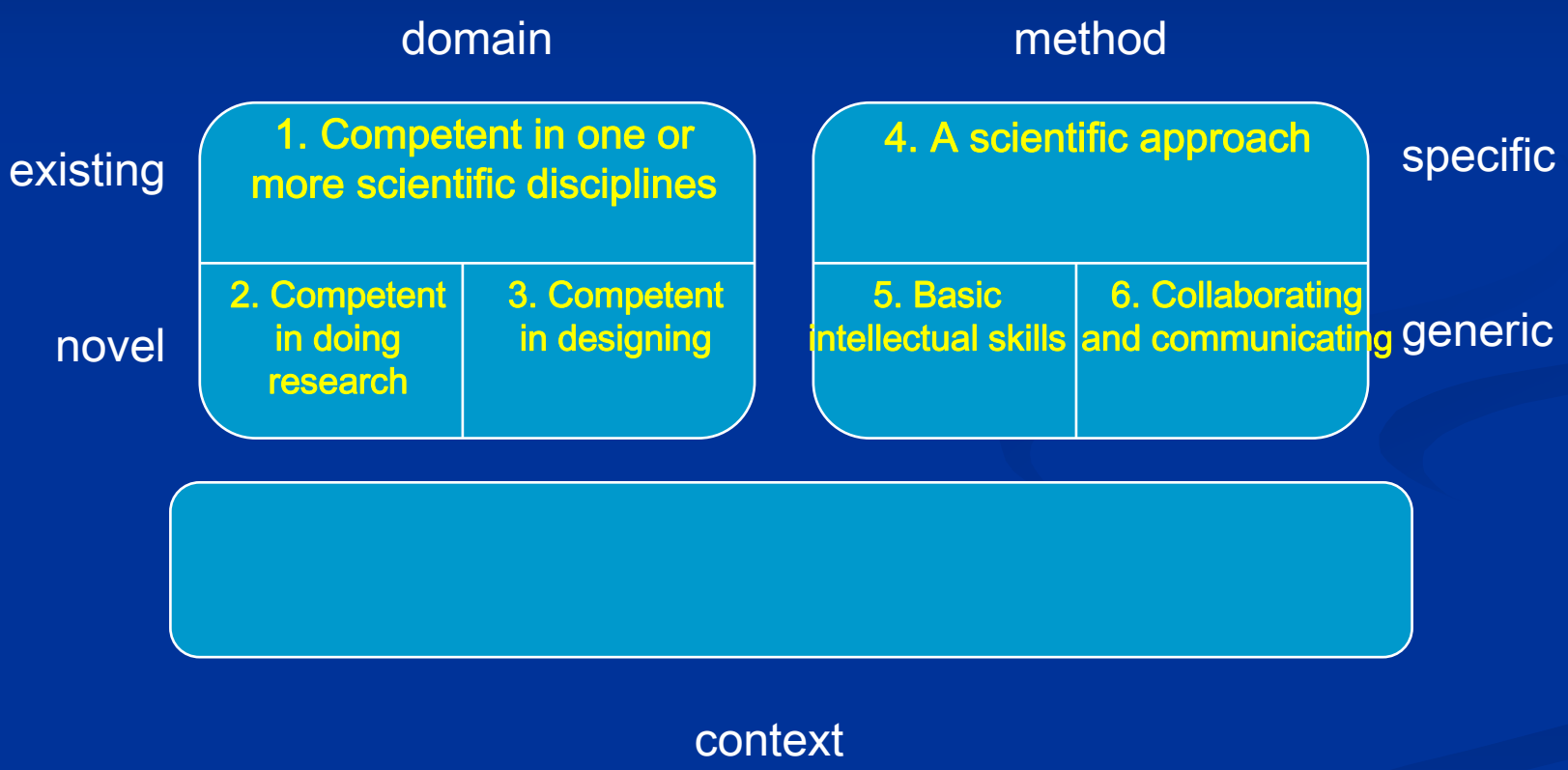
Conceptual Framework (competences)



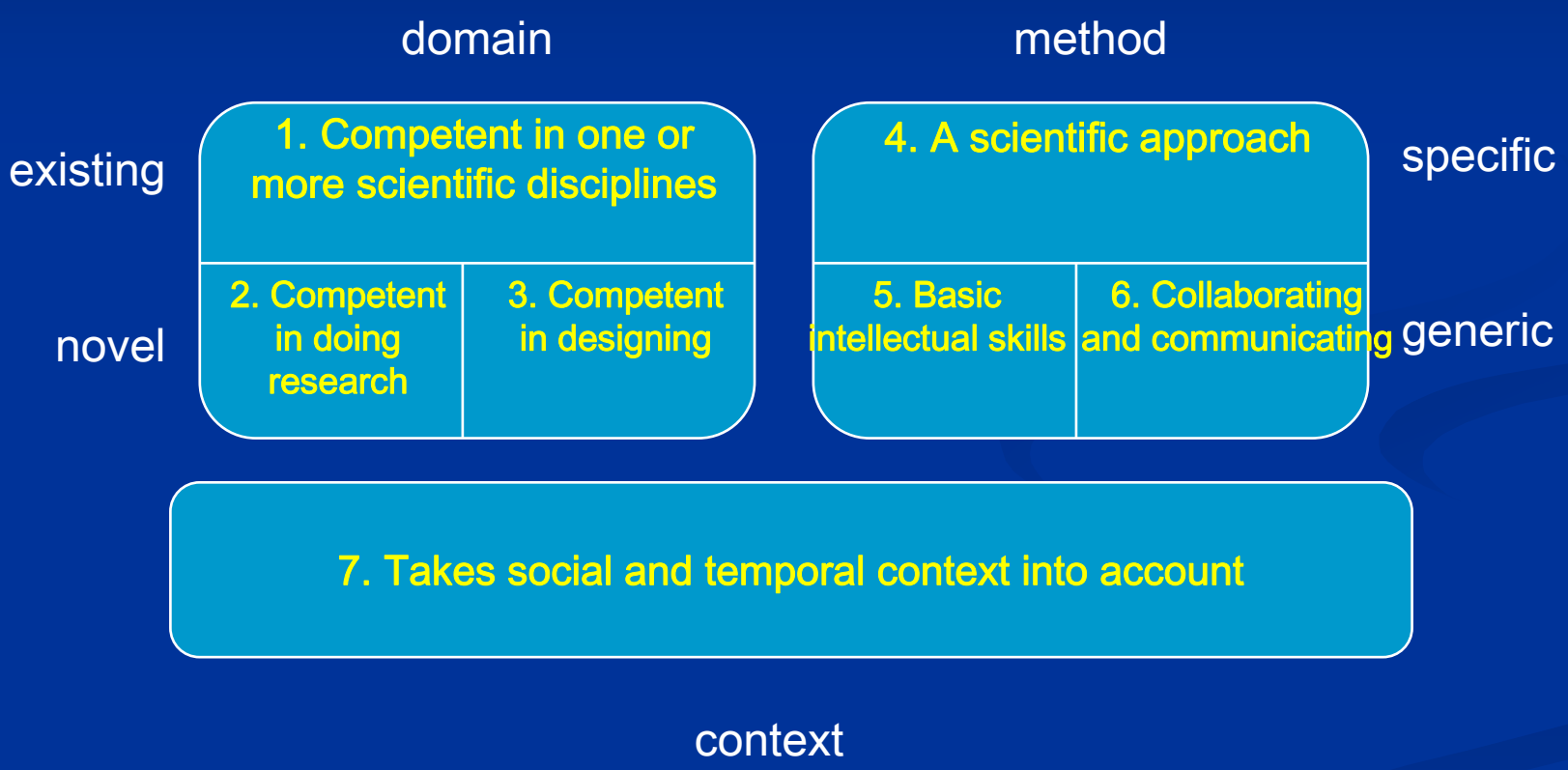
Conceptual Framework (competences)

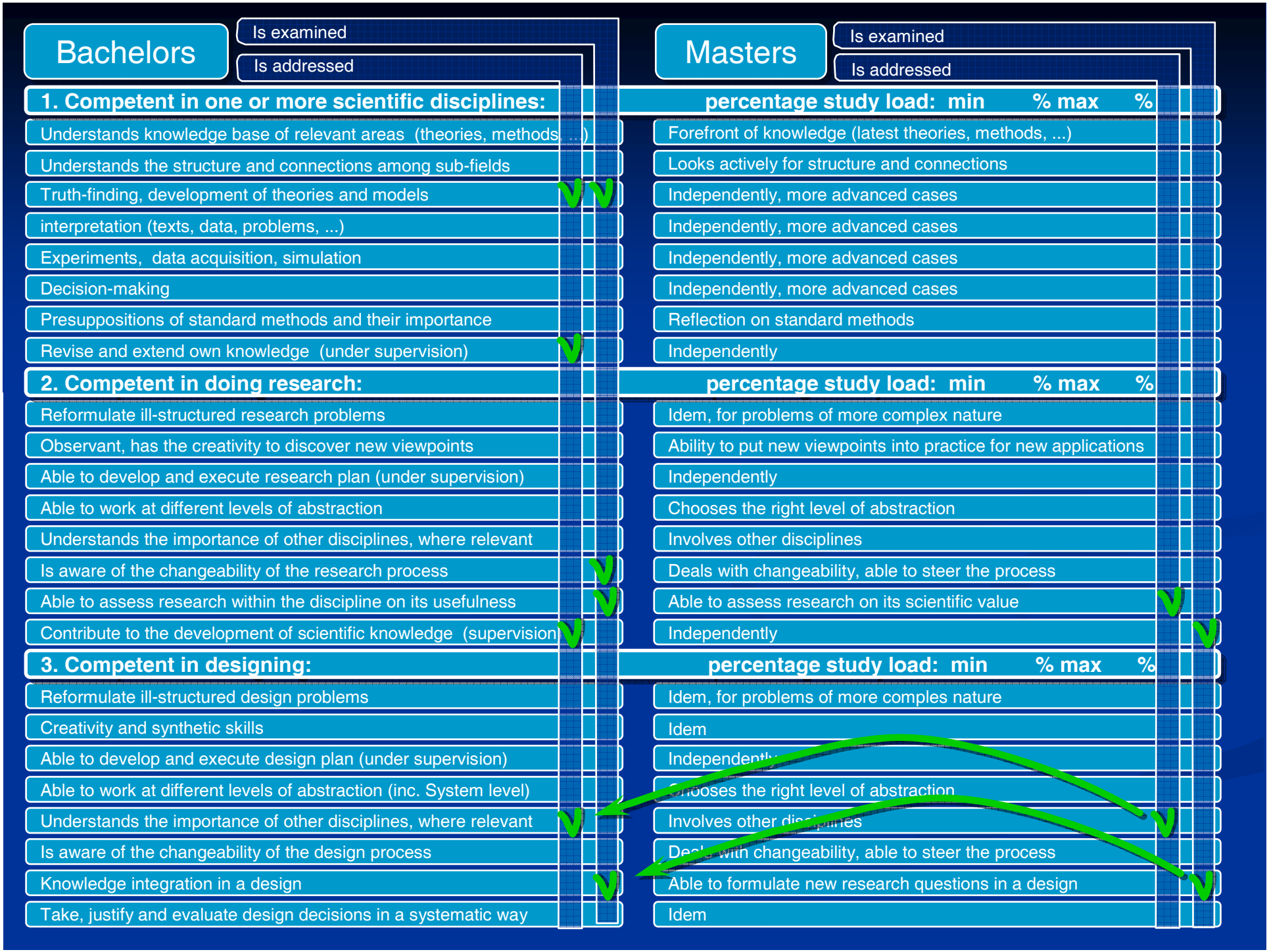


Conceptual Framework (competences)



Conceptual Framework (competences)




Bachelors
Is examined
Is addressed
Masters
Is examined
Is addressed
1. Competent in one or more scientific disciplines:
percentage study load: min % max %
Understands knowledge base of relevant areas (theories, methods, ...)
Forefront of knowledge (latest theories, methods, ...)
Understands the structure and connections among sub-fields
Looks actively for structure and connections
Truth-finding, development of theories and models
Independently, more advanced cases
interpretation (texts, data, problems, ...)
Independently, more advanced cases
Experiments, data acquisition, simulation
Independently, more advanced cases
Decision-making
Independently, more advanced cases
Presuppositions of standard methods and their importance
Reflection on standard methods
Revise and extend own knowledge (under supervision)
Independently
2. Competent in doing research:
percentage study load: min % max %
Reformulate ill-structured research problems
Idem, for problems of more complex nature
Observant, has the creativity to discover new viewpoints
Ability to put new viewpoints into practice for new applications
Able to develop and execute research plan (under supervision)
Independently
Able to work at different levels of abstraction
Chooses the right level of abstraction
Understands the importance of other disciplines, where relevant
Involves other disciplines
Is aware of the changeability of the research process
Deals with changeability, able to steer the process
Able to assess research within the discipline on its usefulness
Able to assess research on its scientific value
Contribute to the development of scientific knowledge (supervision)
Independently
3. Competent in designing:
percentage study load: min % max %
Reformulate ill-structured design problems
Idem, for problems of more comples nature
Creativity and synthetic skills
Idem
Able to develop and execute design plan (under supervision)
Independently
Able to work at different levels of abstraction (inc. System level)
Chooses the right level of abstraction
Understands the importance of other disciplines, where relevant
Involves other disciplines
Is aware of the changeability of the design process
Deals with changeability, able to steer the process
Knowledge integration in a design
Able to formulate new research questions in a design
Take, justify and evaluate design decisions in a systematic way
Idem

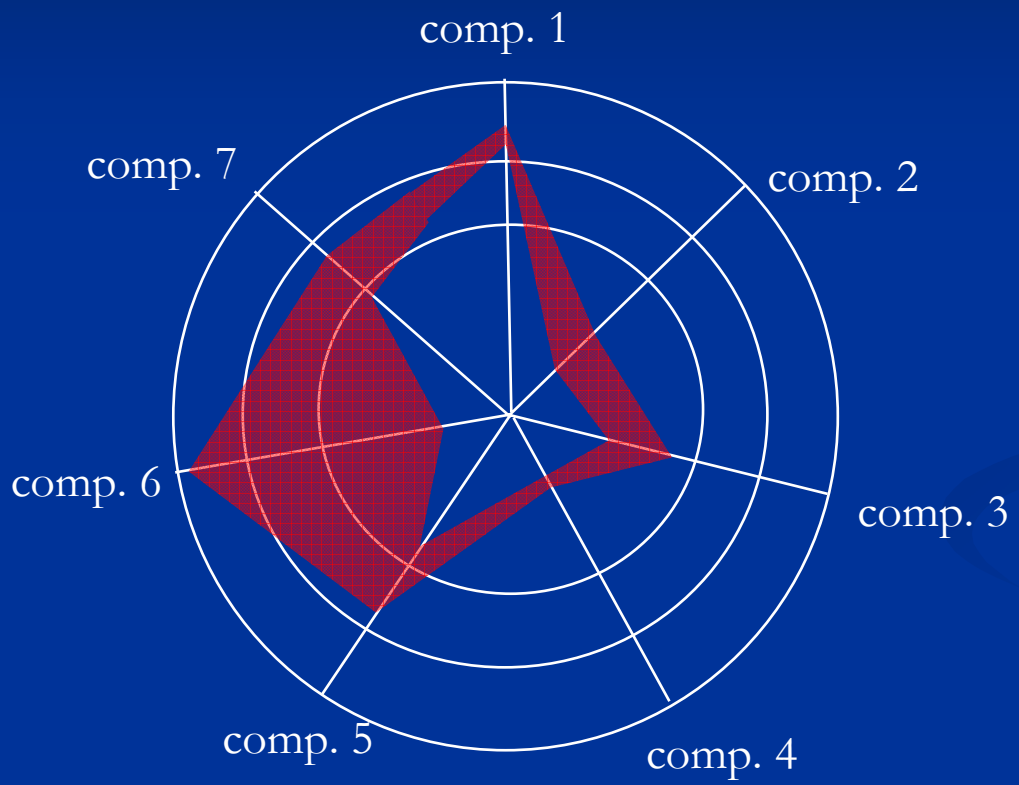
Bachelors	Is examined / Is addressed	Masters	Is examined / Is addressed
4. A scientific approach:	**percentage study load: min % max %**		
Inquisitive, an attitude of life long learning		Identify and take in relevant developments	
Systematic approach (develop and use theories, models. …)		Critically examines existing theories in the area of graduation	
Use, justify and assess models for research and design		Develop and validate models; chose modelling technique	
Insight in the nature of science and technology		Idem; current debates	
Insight in scientific practice (research system, ...)		Idem; current debates	
Adequate documentation		Idem; publication	
5. Basic intellectual skills:	**percentage study load: min % max %**		
Critical reflection (own thinking, deciding, acting,…)		Idem, independently	
Logical reasoning (within the field and beyond)		Able to recognise fallacies	
Recognise modes of reasoning (deduction, induction, …)		Able to apply modes of reasoning	
Able to ask questions, critical / constructive attitude		Idem for more complex (real-life) problems	
Deal with incomplete or irrelevant data		Idem, taking acount of the origin of the data	
Take a standpoint with regard to scientific argument		Idem, able to assess this critically	
Basic numeric skills, understands orders of magnitudes		Idem	
6. Competent in collaboration and communication:	**percentage study load: min % max %**		
Able to communicate in writing on results of learning, thinking, …		Able to communicate in writing on research and solutions	
Able to communicate verbally on results of learning, thinking, …		Able to communicate verbally on research and solutions	
Mastering of a second language		Idem; attitude aspect	
Able to follow debates about the field and its societal place		Idem; attitude aspect	
Characterised by professional behaviour		Idem	
Able to perform project-based work		Idem; for more complex projects	
Able to work within interdisciplinary team		Idem; larger disciplinary variety	
Deal with team roles and social dynamics		Able to assume the role of team leader	
7. Takes account of temporal and social context:	**percentage study load: min % max %**		
Understands relevant developments in the history of the field		Integrates developments in scientific work	
Analyses societal consequences		Integrates consequences in scientific work	
Analyses environmental and sustainability issues		Integrates consequences in scientific work	
Analyses normative and ethic aspects		Integrates these aspects in scientific work	
Has an eye for the different roles of professionals		Chooses a place as a professional in society	

Conceptual Framework (competences)

- intended distribution of time spent at competence level (percentage interval)

- Yes/No indication at sub-competence level :
  - Is it addressed in the educational activities?
  - Is it examined?

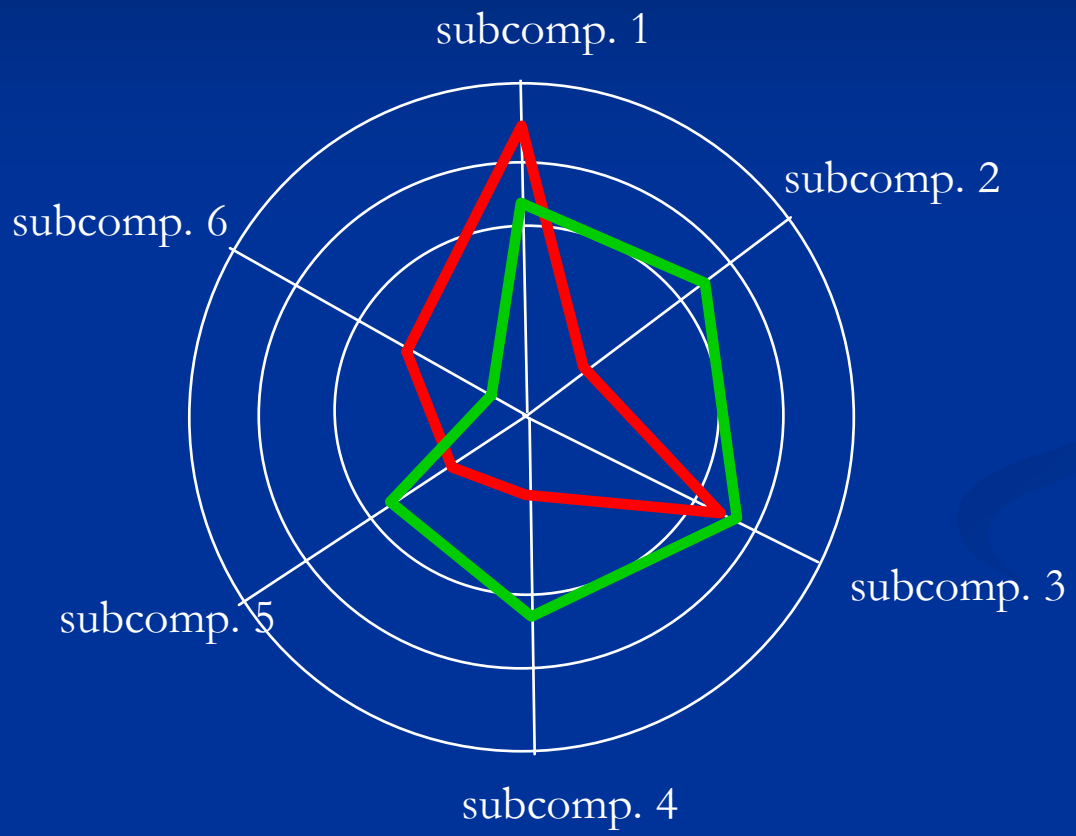
Conceptual Framework (competences)



Radar plot Competences

- Radial coordinate: time budget over total curriculum (uncertainty band)
- Info over 'missing' competences
- academic 'profile'
- *No* statements about 'right' or 'wrong' distribution

Conceptual Framework (competences)



Radar plot Sub-Competences

- Made for each competence
- Radial coordinate: time spent in topics where this sub- competence is addressed or is examined (no uncertainty band)
- Informs about 'missing' sub-competences
- Provides additional detail on academic profile
- *No* statements about 'right' or 'wrong' distribution

Conceptual Framework (competences)

Conceptual Framework (dimensions)

Dimensions are associated with *activities*

analytic → analysing

synthetic → synthesising ('composing, assembling')

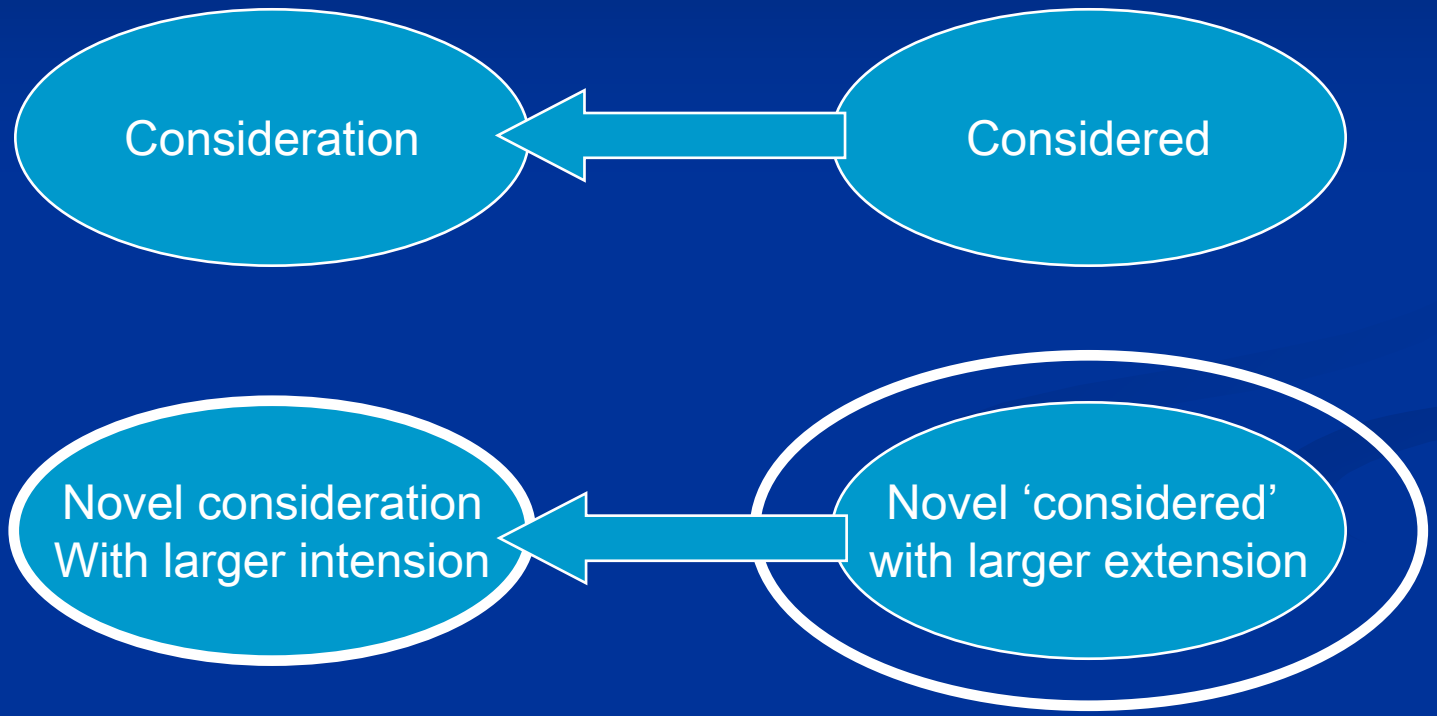
in general → *establishing* a relation between 'considered' and 'consideration'

abstract → abstracting

concrete → concretising

in general → *refining* a relation between […]

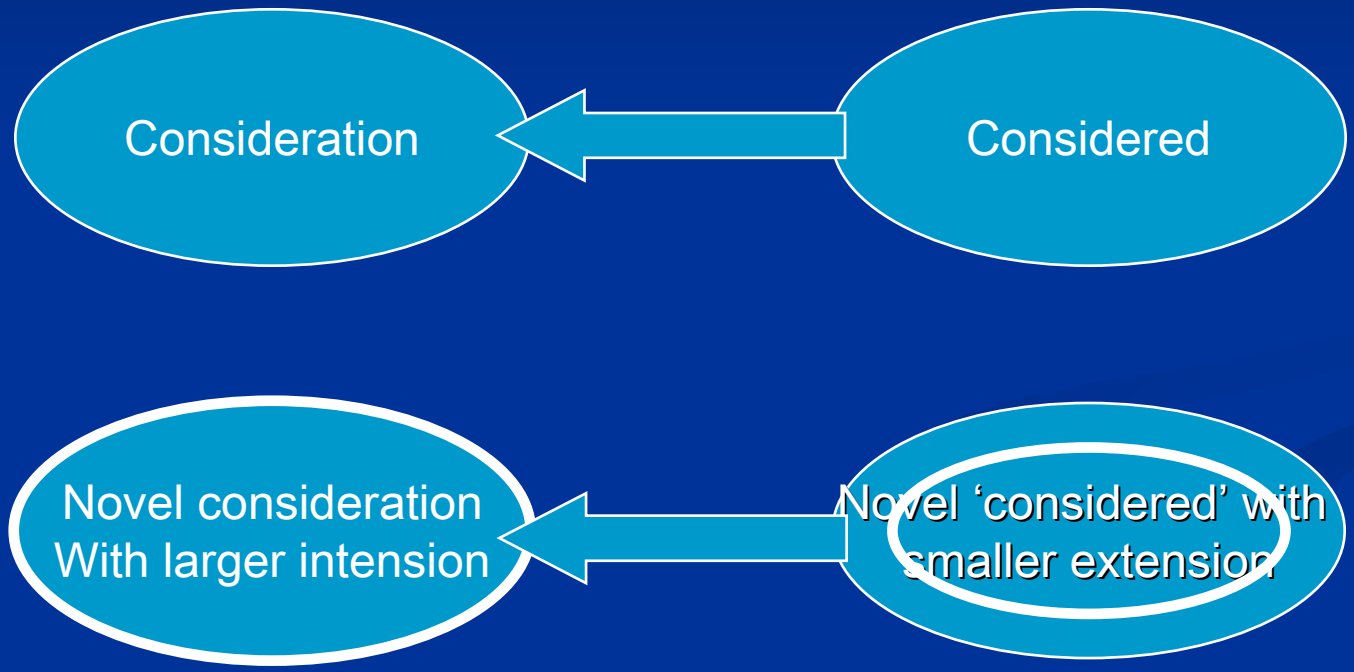
Conceptual Framework (dimensions)



abstracting

example: 1-D transport equation for gases, seen as a collection of point masses, predicts congestion behaviour in motorway traffic

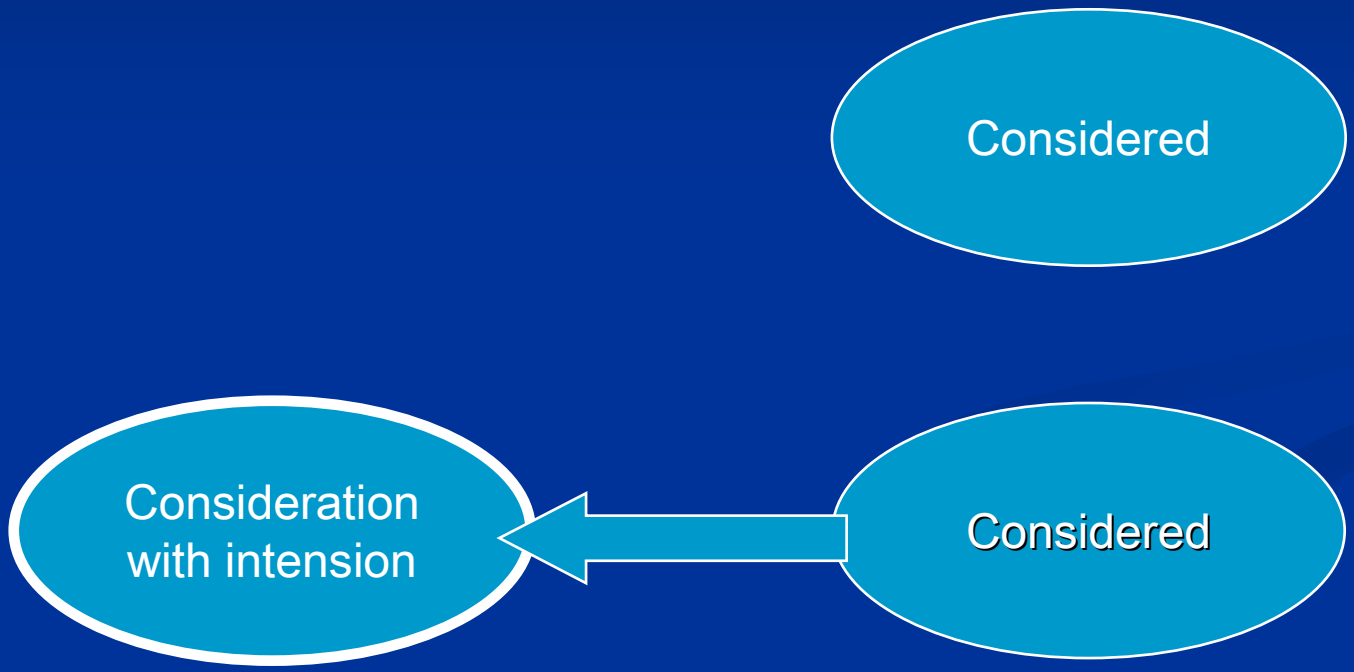
Conceptual Framework (dimensions)



concretising

Example: general transport equation for gases, applied to a gas with given density and viscosity, gives quantitative predictions of transport behaviour of a *concrete* gas

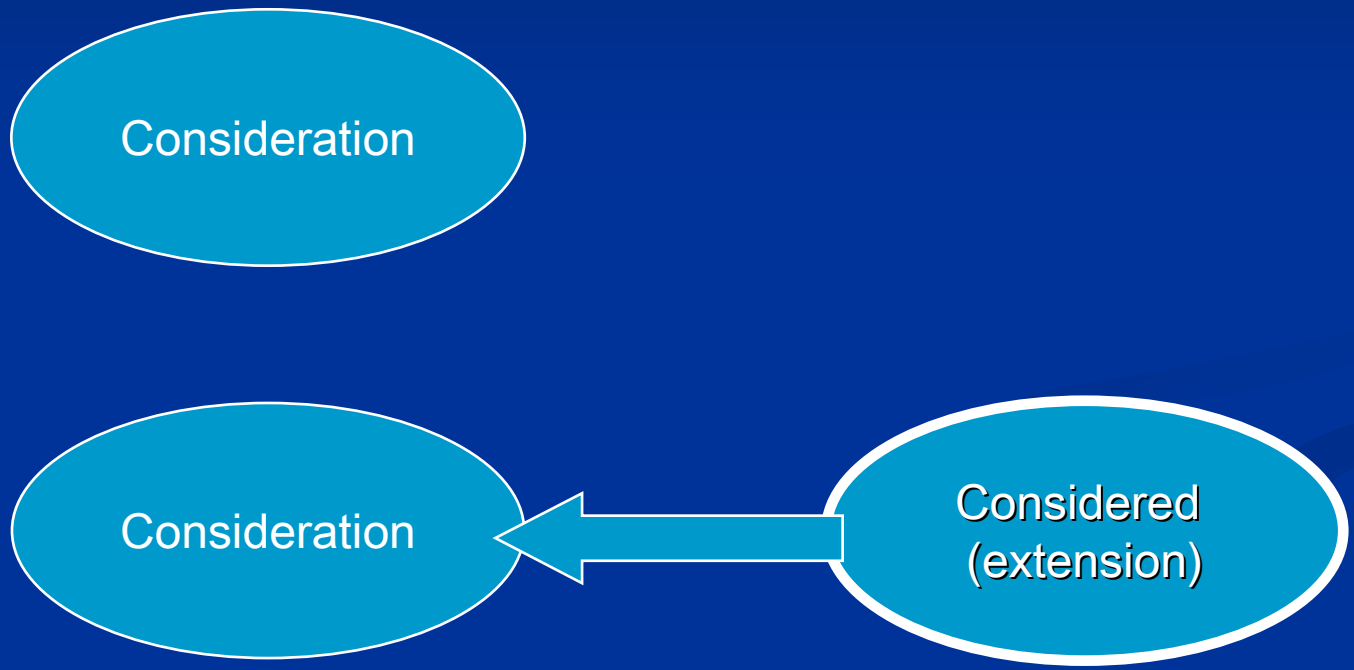
Conceptual Framework (dimensions)



analysing

Example: a series of measurements of transport behaviour of a gas, leading to empiric transport equations

Conceptual Framework (dimensions)

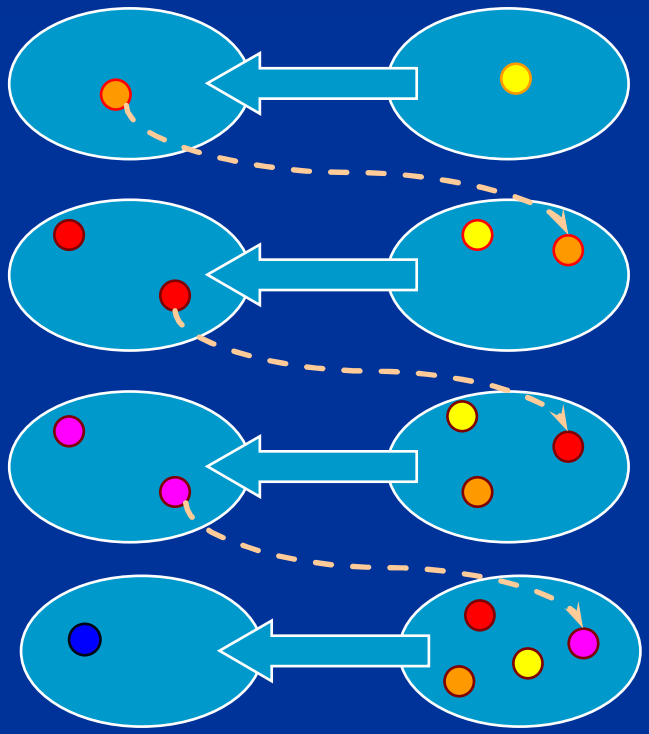


synthesising

Example: specification of desired transport behaviour of a gas leads to decisions (design) regarding density, pressure, etc., in a chemical process device

Conceptual Framework (dimensions)

Levels in consideration-relations: *hinge-concepts*
(example: the dimension 'abstract')

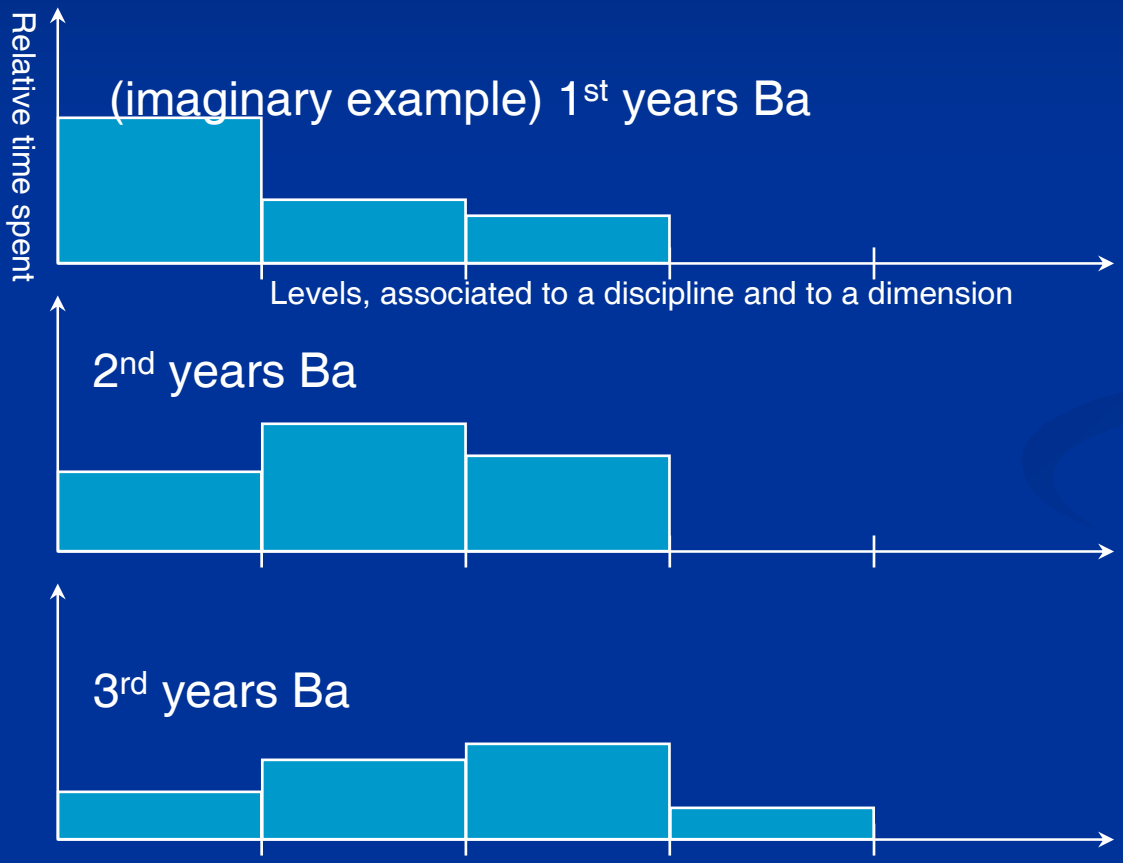


- concrete substance (e.g., the amount of argon in a specific gas-discharge lamp)
- material (e.g., argon – which is an element of the Periodic System)
- idealised material (e.g., inert gas, with all properties characteristic of an inert gas)
- idealised transport phenomena of a continuum (e.g., momentum transport)
- conservation law associated with transport quantity (e.g., conservation of momentum)

Conceptual Framework (dimensions)

- Similar construction for other dimensions
- Number of levels may differ per dimension
- Number of levels may differ per discipline
- Highest and lowest level demarcate the scope of a discipline (e.g., where theoretical physics ends and mathematics begins)
- Disciplines cannot be compared
- Programs in the same discipline can be compared
- Programs in the same discipline in university *vs.* professional school can be compared
- Which levels in a discipline are covered by any given program?
- Time distribution (in a program) over levels → histogram

Conceptual Framework (dimensions)



Histograms for dimension levels inform about:

- Is the program complete with respect to the discipline?
- Is the program well-balanced over the discipline?
- Is the program well-balanced in its profoundness over the subsequent phases / years?

Contents

- Context and motivation
- Purposes
- Conceptual framework
- Approach and Measurements
- Results
- Conclusions

Approach and Measurements

- 2004: Pilot with 2 programs TU/e (Business Engineering and Technology Managenent)
- Next: revision of some details of the instrument
- Interviews with all teachers in a relevant part of the program (e.g., Ba+ some Ma-tracks)
- Data processing and visualisation
- Discussion with the Director of Education: ‘explanation’ of some conspicuous aspects with respect to the education plan + external conditions
- Confrontation of the results of the profile measurement with results of the University Paper

Contents

- Context and motivation
- Purposes
- Conceptual framework
- Approach and Measurements
- Results
- Conclusions

Results

- Vocabulary begins to be embedded within ‘Academic Jargon’
- Teachers report that the instrument (the interview) helps to put one’s teaching activities in a broader perspective
- Revision is completed; 4 next programs are ready to be examined (Mathematics, Industrial Design, Computer Science, Electrical Engineering)
- Vocabulary + methodology is adopted by all Dutch Technical Universities; faculties in other universities are following

Contents

- Context en motivatie
- Doelstellingen
- Conceptueel framework
- Onderzoeksopzet en Metingen
- Resultaten
- Conclusions

Conclusions

- A methodology has been developed to give an operational meaning to the predicate ‘academic’

- This methodology has been implemented; a pilot has been executed, and after some revision it is now being executed on a large scale