



Investigation of the Outcomes of a New Informatics Curriculum

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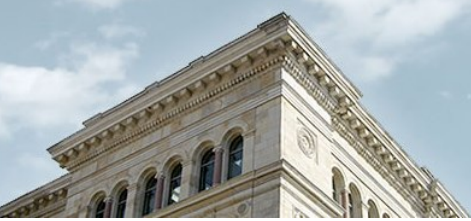
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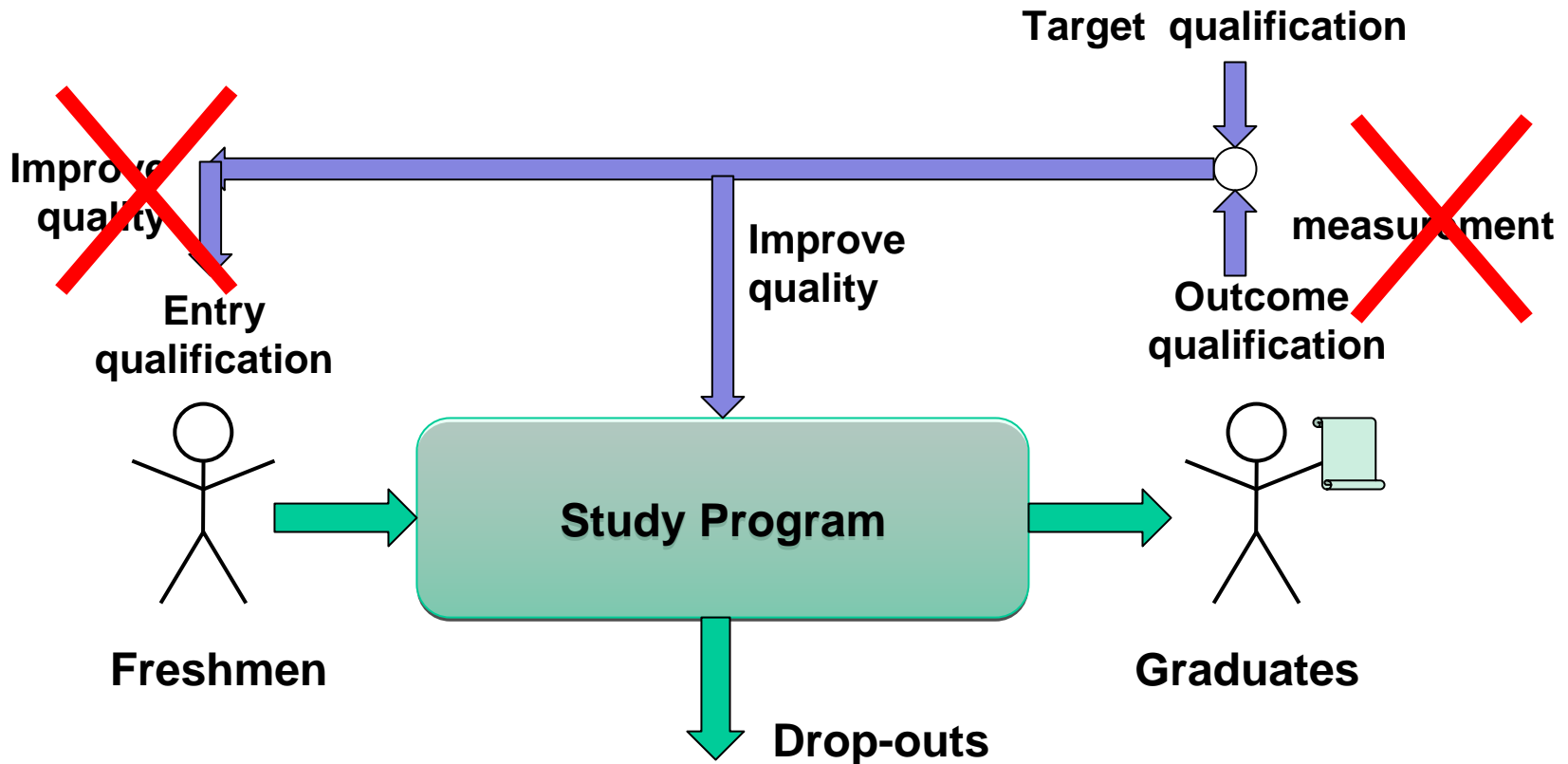


Goals

1. Analysis of a study program's competence profile
2. Evidence, that study programs produces graduates with the intended competence profile
3. (Enforced reflection about competence goals)

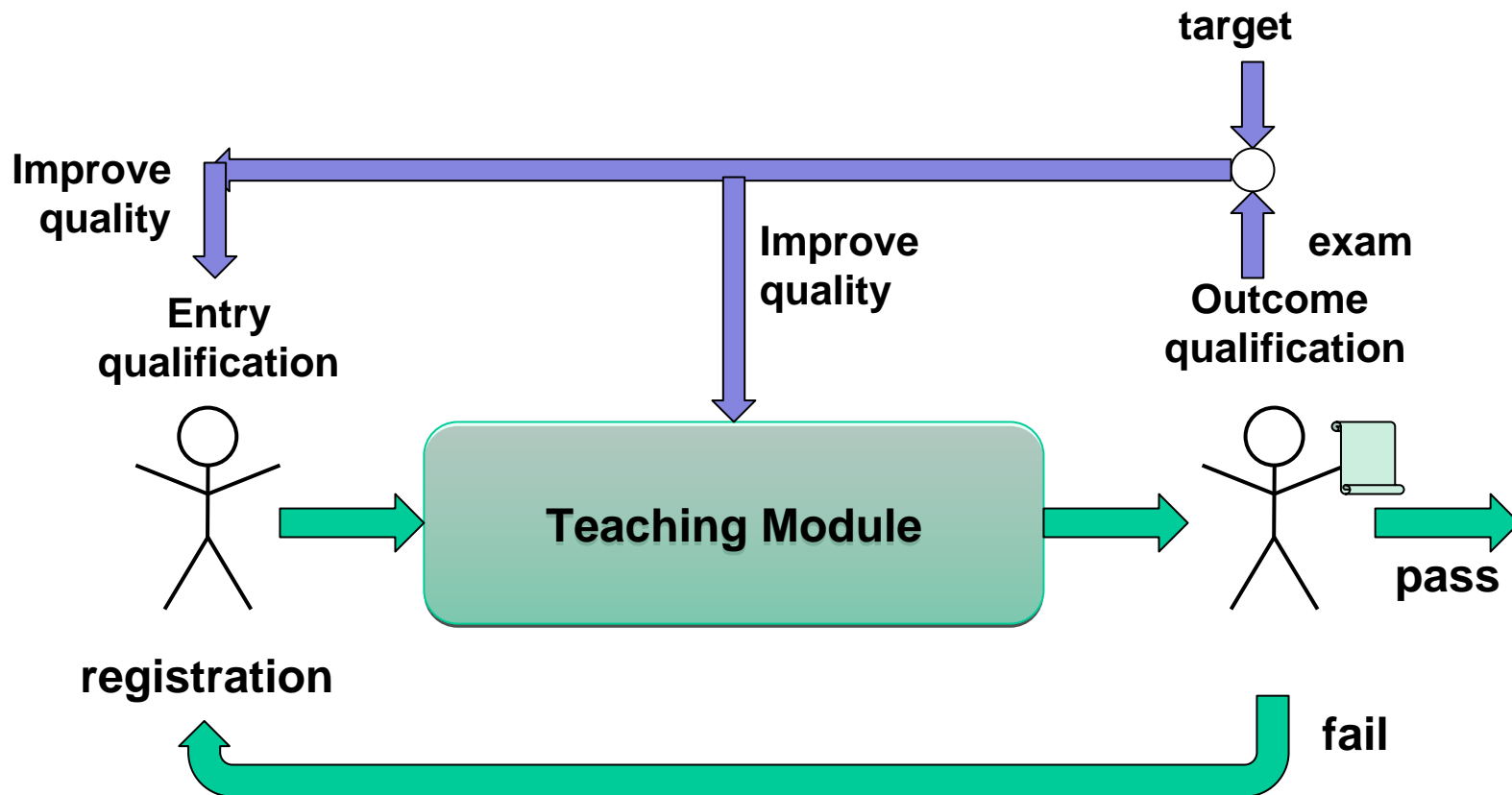


Education Process





Education Process at Course Level



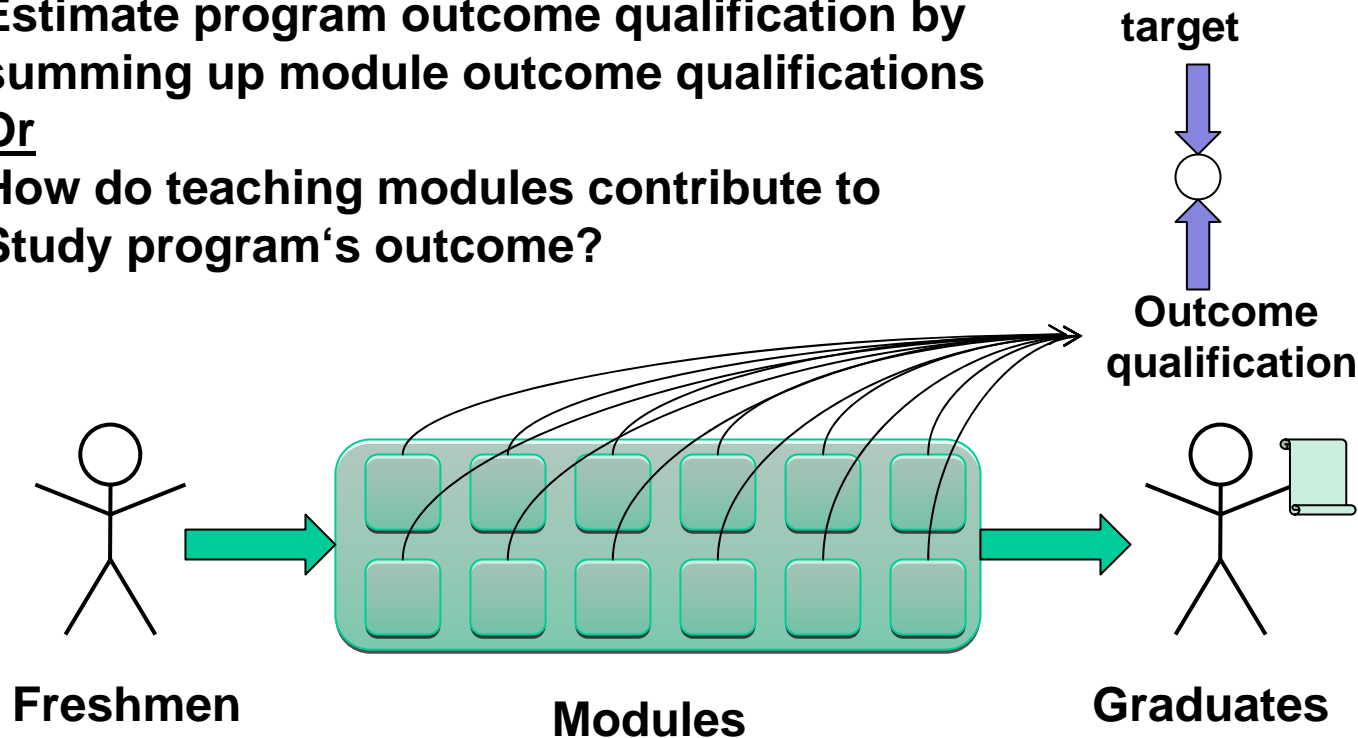


Approach

Estimate program outcome qualification by summing up module outcome qualifications

Or

How do teaching modules contribute to Study program's outcome?





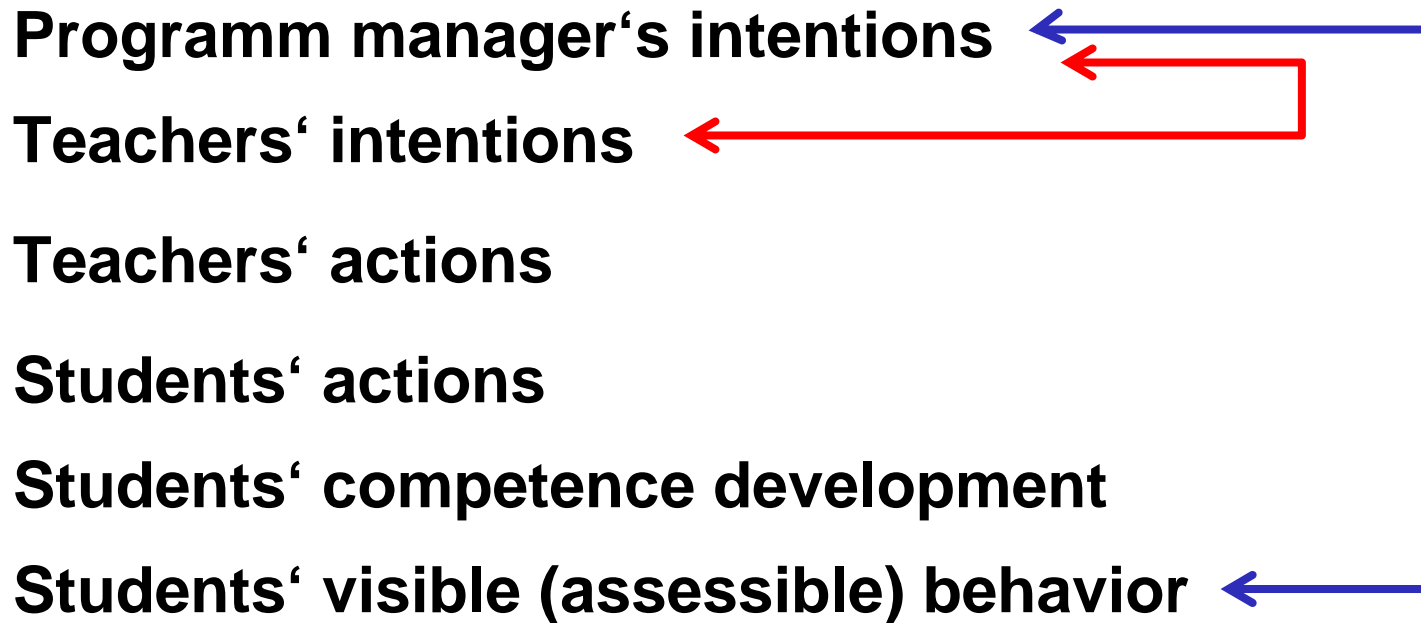
Method

- Developed by TU Eindhoven
- Adopted by TU9 (German Institutes of Technology) and applied to several study programs at TU9 universities



Conceptual Framework(competences)

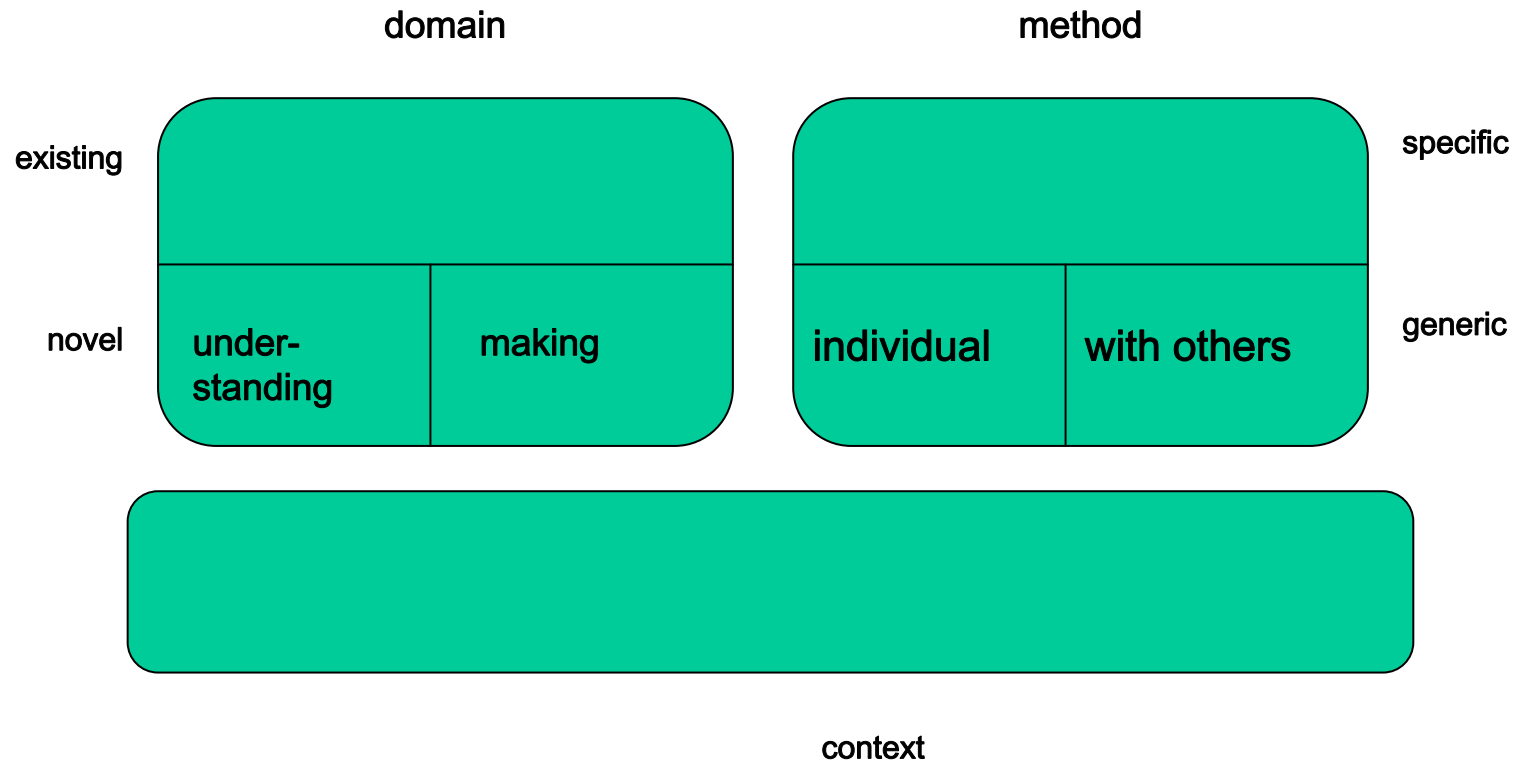
Stages



Source: K. v. Overveld

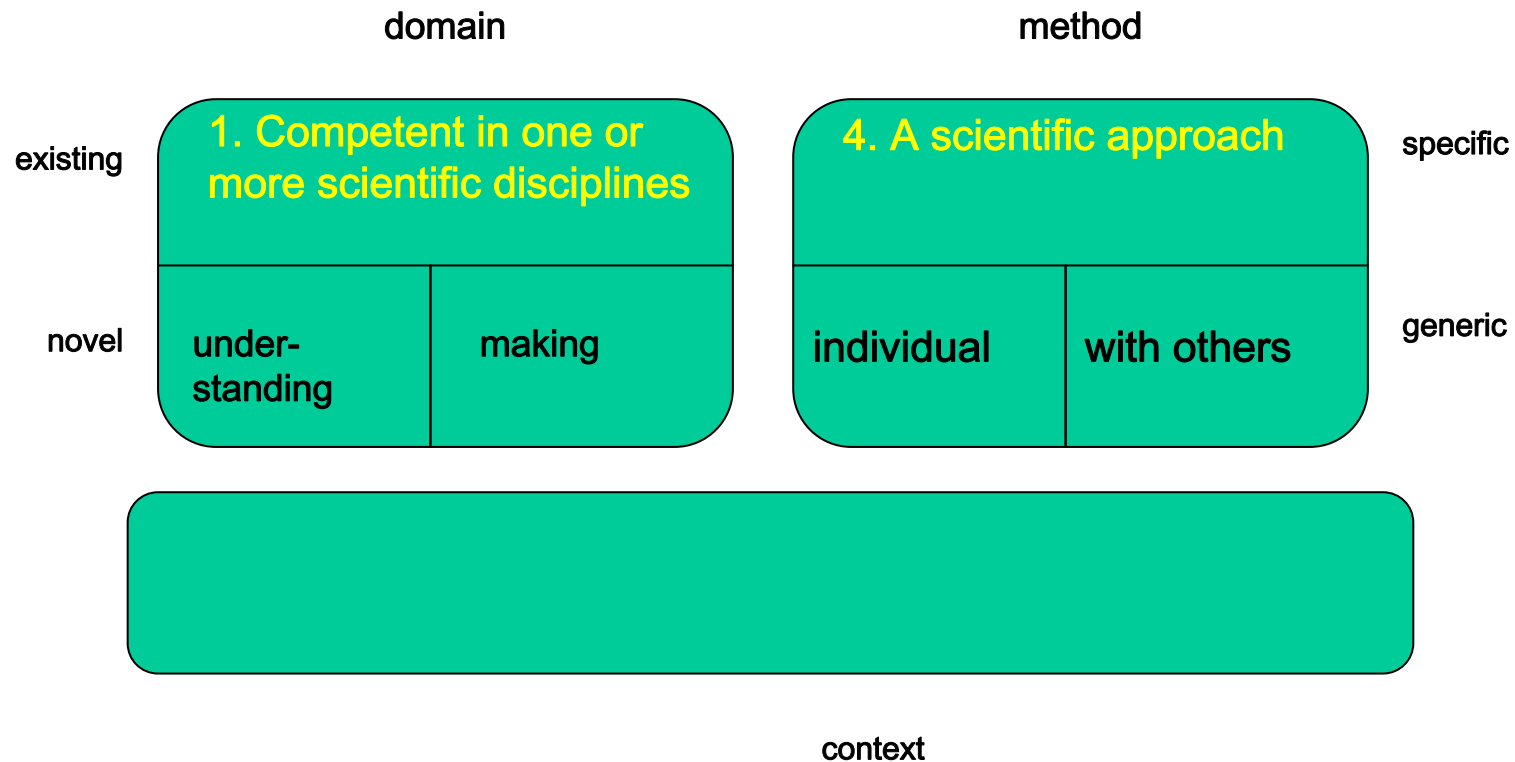


Conceptual Framework(competences)

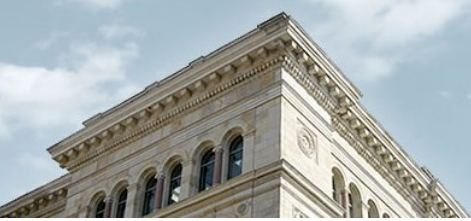




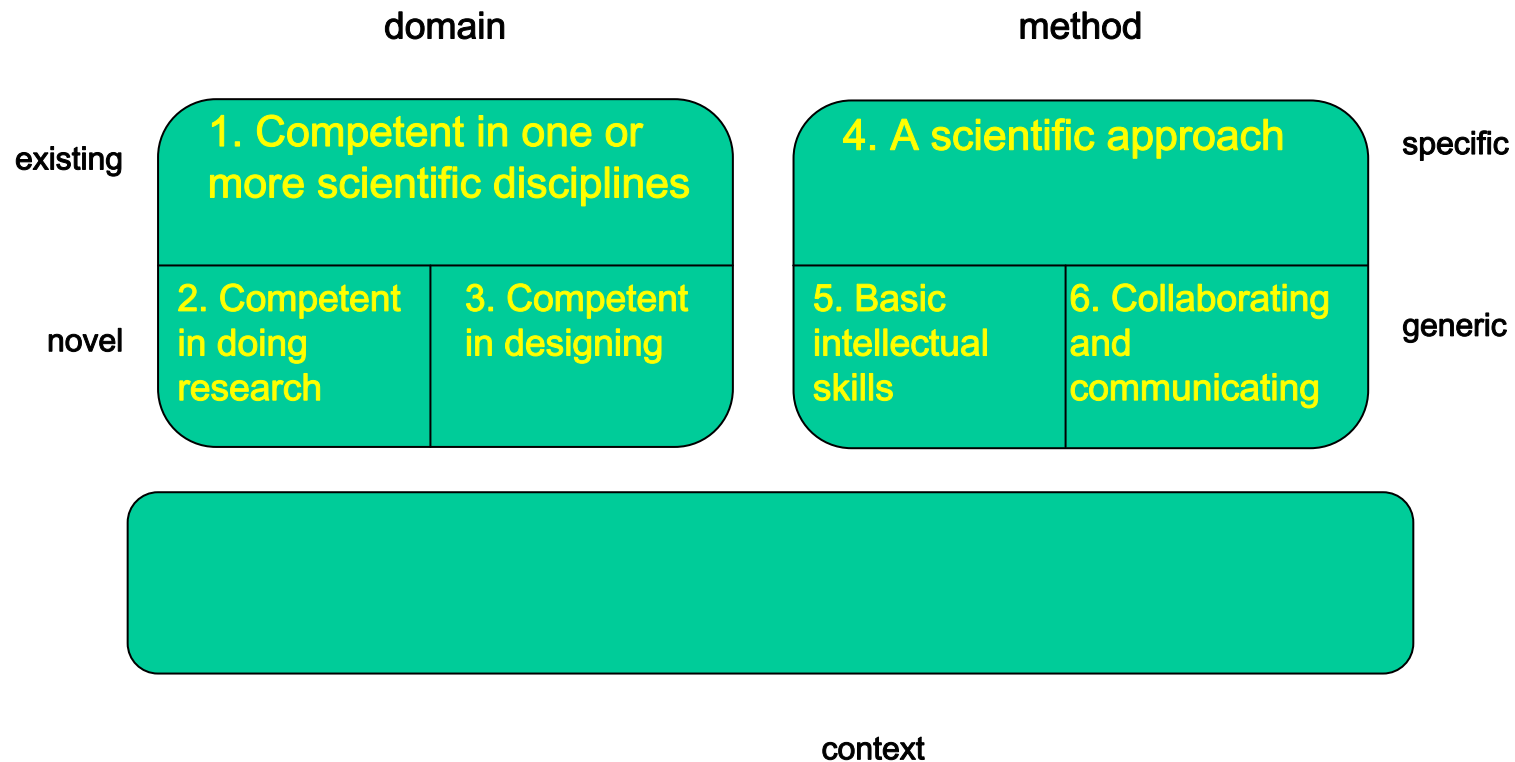
Conceptual Framework(competences)



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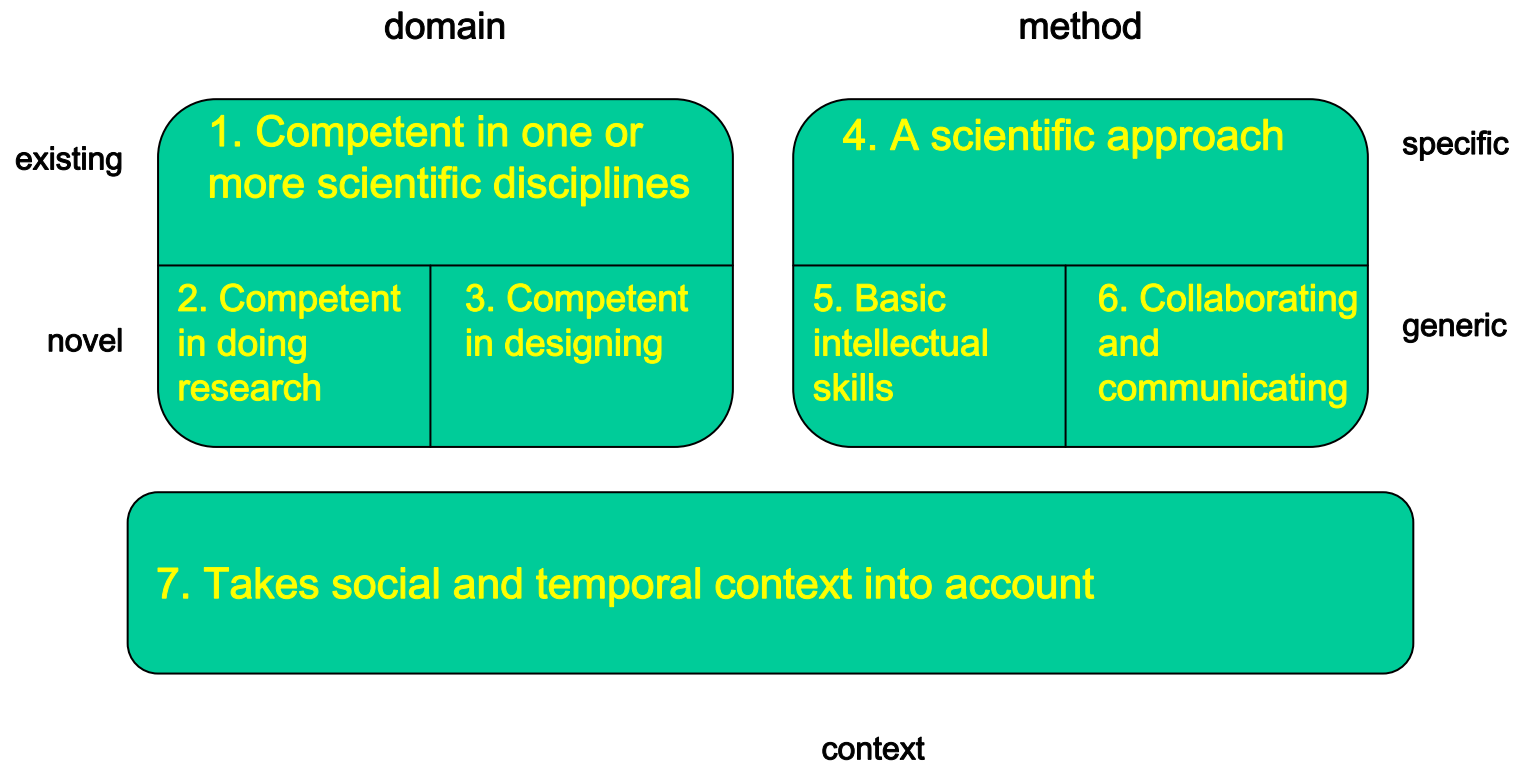


Conceptual Framework(competences)





Conceptual Framework(competences)



Source: K. v. Overveld

Bachelors	Is examined			
	Is addressed			
1. Competent in one or more scientific disciplines:				
Understands knowledge base of relevant areas (theories, methods, ...)				
Understands the structure and connections among sub-fields				
Truth-finding, development of theories and models	✓	✓		
interpretation (texts, data, problems, ...)				
Experiments, data acquisition, simulation				
Decision-making				
Presuppositions of standard methods and their importance				
Revise and extend own knowledge (under supervision)	✓			
2. Competent in doing research:				
Reformulate ill-structured research problems				
Observant, has the creativity to discover new viewpoints				
Able to develop and execute research plan (under supervision)				
Able to work at different levels of abstraction				
Understands the importance of other disciplines, where relevant				
Is aware of the changeability of the research process	✓			
Able to assess research within the discipline on its usefulness	✓			
Contribute to the development of scientific knowledge (supervision)	✓			
3. Competent in designing:				
Reformulate ill-structured design problems				
Creativity and synthetic skills				
Able to develop and execute design plan (under supervision)				
Able to work at different levels of abstraction (inc. System level)				
Understands the importance of other disciplines, where relevant				
Is aware of the changeability of the design process				
Knowledge integration in a design				
Take, justify and evaluate design decisions in a systematic way				

Masters	Is examined			
	Is addressed			
percentage study load: min % max %				
Forefront of knowledge (latest theories, methods, ...)				
Looks actively for structure and connections				
Independently, more advanced cases				
Independently, more advanced cases				
Independently, more advanced cases				
Independently, more advanced cases				
Reflection on standard methods				
Independently				
percentage study load: min % max %				
Idem, for problems of more complex nature				
Ability to put new viewpoints into practice for new applications				
Independently				
Chooses the right level of abstraction				
Involves other disciplines				
Deals with changeability, able to steer the process				
Able to assess research on its scientific value			✓	
Independently				✓
percentage study load: min % max %				
Idem, for problems of more complex nature				
Idem				
Independently				
Chooses the right level of abstraction				
Involves other disciplines				
Deals with changeability, able to steer the process				
Able to formulate new research questions in a design				
Idem				

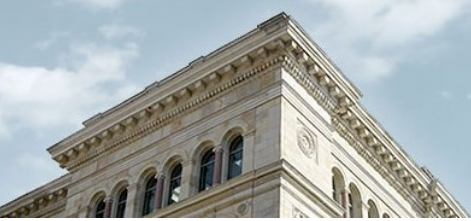
Bachelors		Masters	
Is examined		Is examined	
Is addressed		Is addressed	
4. A scientific approach:		percentage study load: min % max %	
Inquisitive, an attitude of life long learning		Identify and take in relevant developments	
Systematic approach (develop and use theories, models. ...)		Critically 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 account 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	



Application of Method to Computer Science Curriculum at TU Berlin



CP	Bachelor's Program in Computer Science				
1st Sem. 29 CP	Digital Systems (6 CP)	Algorithmic and Functional Solution of Discrete Problems (9 CP)		Found. and Algebraic Structures (8 CP)	Linear Algebra (6 CP)
2nd Sem. 29 CP	Computer Organization (6 CP)	Data Structures and Algorithms in Imperative Style (9 CP)		Automata and Complexity (6 CP)	Calculus I (8 CP)
3rd Sem. 32 CP	System Programming (6 CP)	Software Engineering (12 CP) Including Project	Practical Program Development (6 CP)	Logic and Calculi (6 CP)	Calculus II (8 CP)
4th Sem. 30 CP	Networks and Distributed Systems (6 CP)		Database Systems (6 CP)	Specification and Semantics (6 CP)	Stochastics (6 CP)
5th Sem. 30 CP	Computer Science Electives (21-24 CP)		Minor Studies (12-15 CP)		Management (6 CP)
6th Sem. 30 CP	Software Technology or Communication Technology		Bachelor's Thesis (12 CP)		Social Aspects of CS (6 CP)



CP	Master's Program in Computer Science (Basic Structure)		
1 st 30 CP	Major Studies (54 - 60 CP) including at least 30 CP in the specialization area: <ul style="list-style-type: none"> • System Engineering • Dependable Systems • Intelligent Systems • Communication Systems 	Minor Studies (18 - 24 CP)	General Studies (12-18 CP)
2 nd 30 CP			
3 rd 30 CP			
4 th 30 CP	Master's Thesis(30 CP)		

- **System Engineering:** Software Engineering, Programming Language Design, Computer Organization, Operating Systems, Performance Evaluation, Information Systems, System Analysis, Enterprise Arch.
- **Dependable Systems:** Component-Based Modeling, Specification Tools, Semantics and Calculi, Security&Trust, Realtime Systems, Correctness, Testing, Fault-tolerance,...
- **Intelligent Systems:** Neural Information Processing, Bio-Informatics, Intelligent Data Analysis, Computer Graphics, Computer Vision, Robotics, Artificial Intelligence, Agent Oriented Systems,...
- **Communication-based Systems:** Communication Networks, Protocol Design, Mobile Communication, Ambient Intelligence, Next Generation Networks, (Open) Distributed Systems, SOA,...



Procedure:

1. Interview with lecturers
2. Guided answering of a questionnaire
3. Independent answering of additional module questionnaires via web interface

Extent of survey:

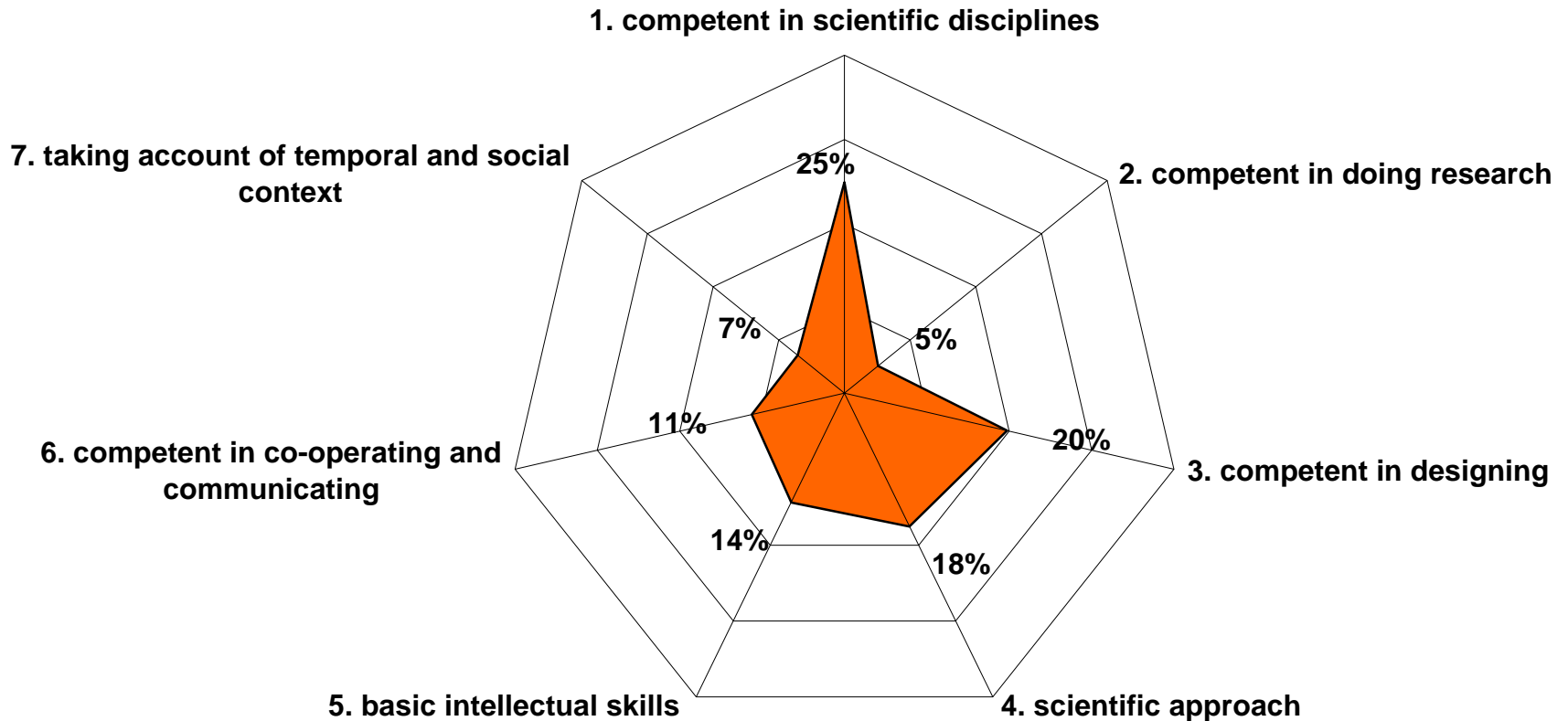
70 Modules, including:

- all mandatory modules
- Selected representative modules from specialization areas (electives)
- Bachelor and Master thesis



Competence Profile: Bachelor Programme Computer Science

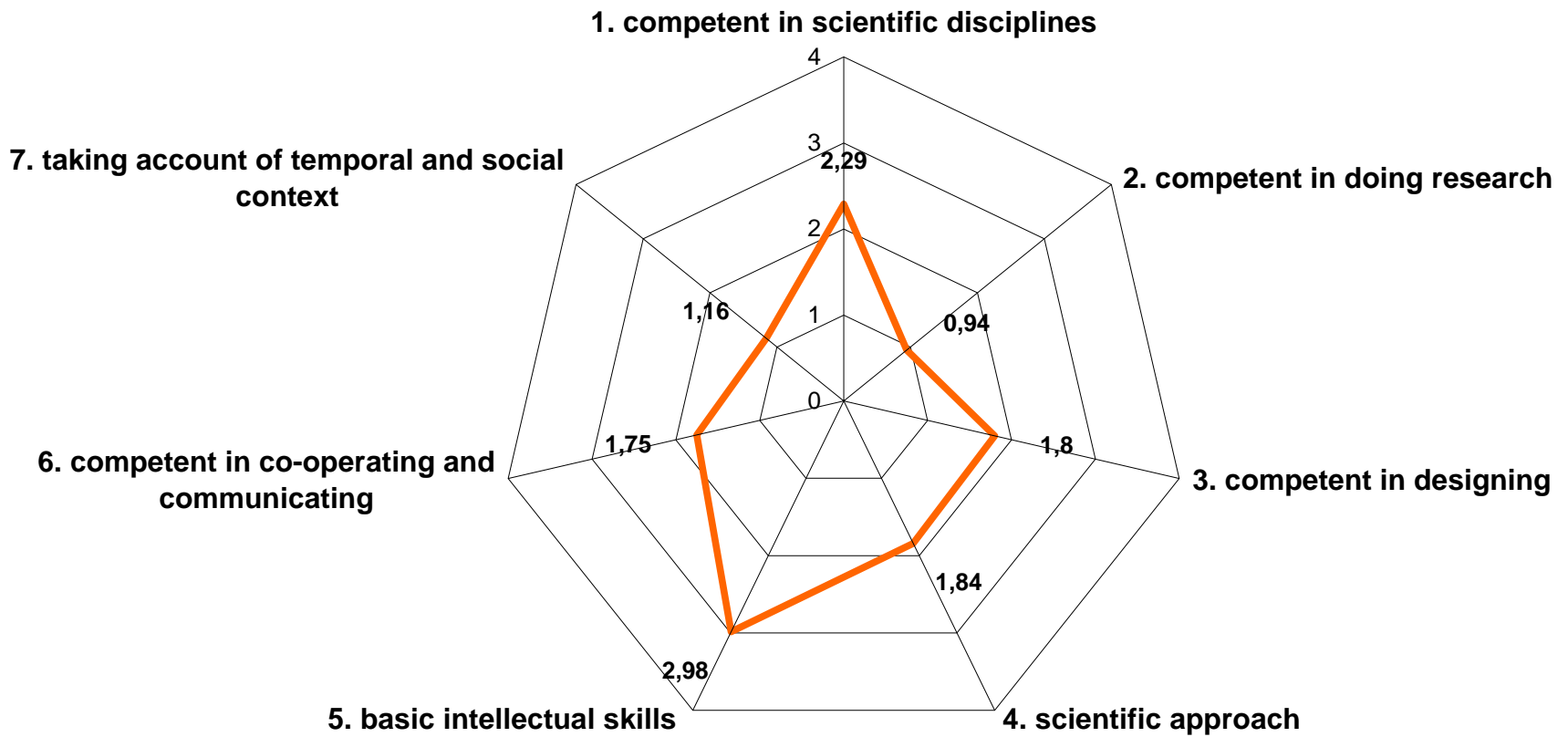
percentage of workload (N=37)





Levels of Competences: Bachelor Programme Computer Science

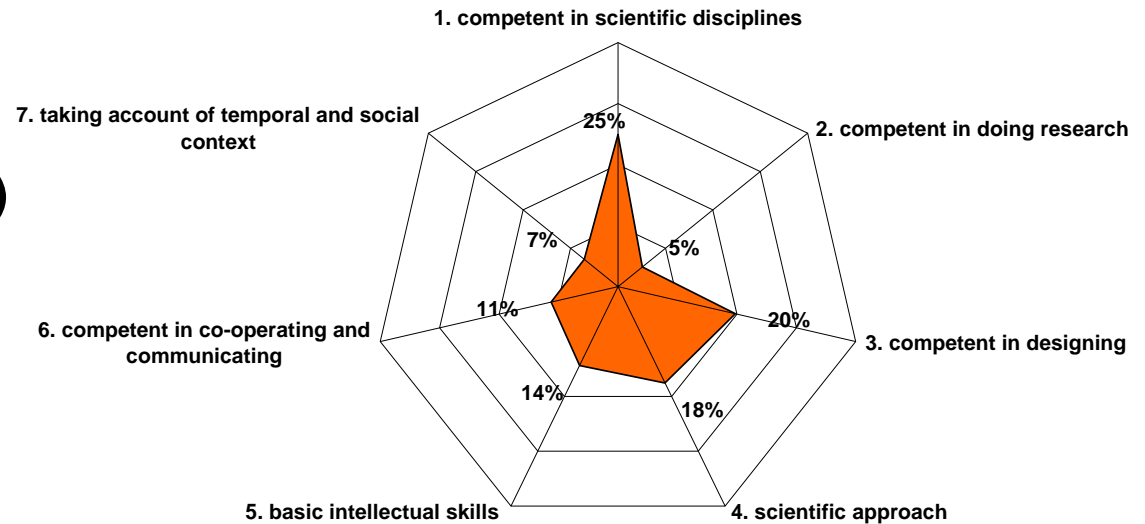
mean values of competences (N=37)



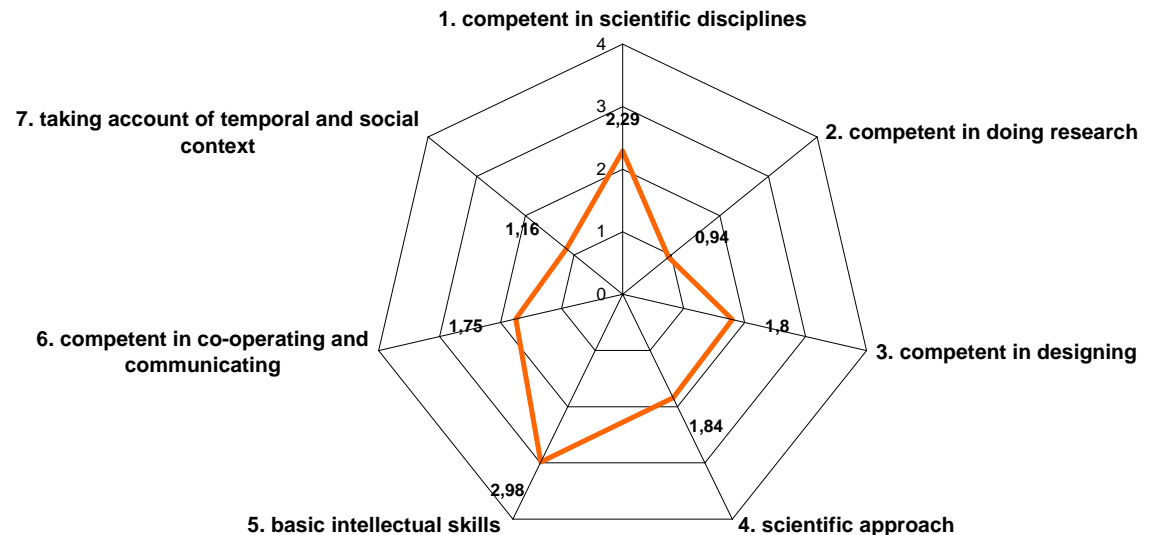
The levels of competences (1-5) describe the degree of requirements and the degree of complexity as well as the extent of the necessary responsibility in fulfilling the study task. (Roscher/Sachs: 1999)



Competence Profile (percentage of work load)



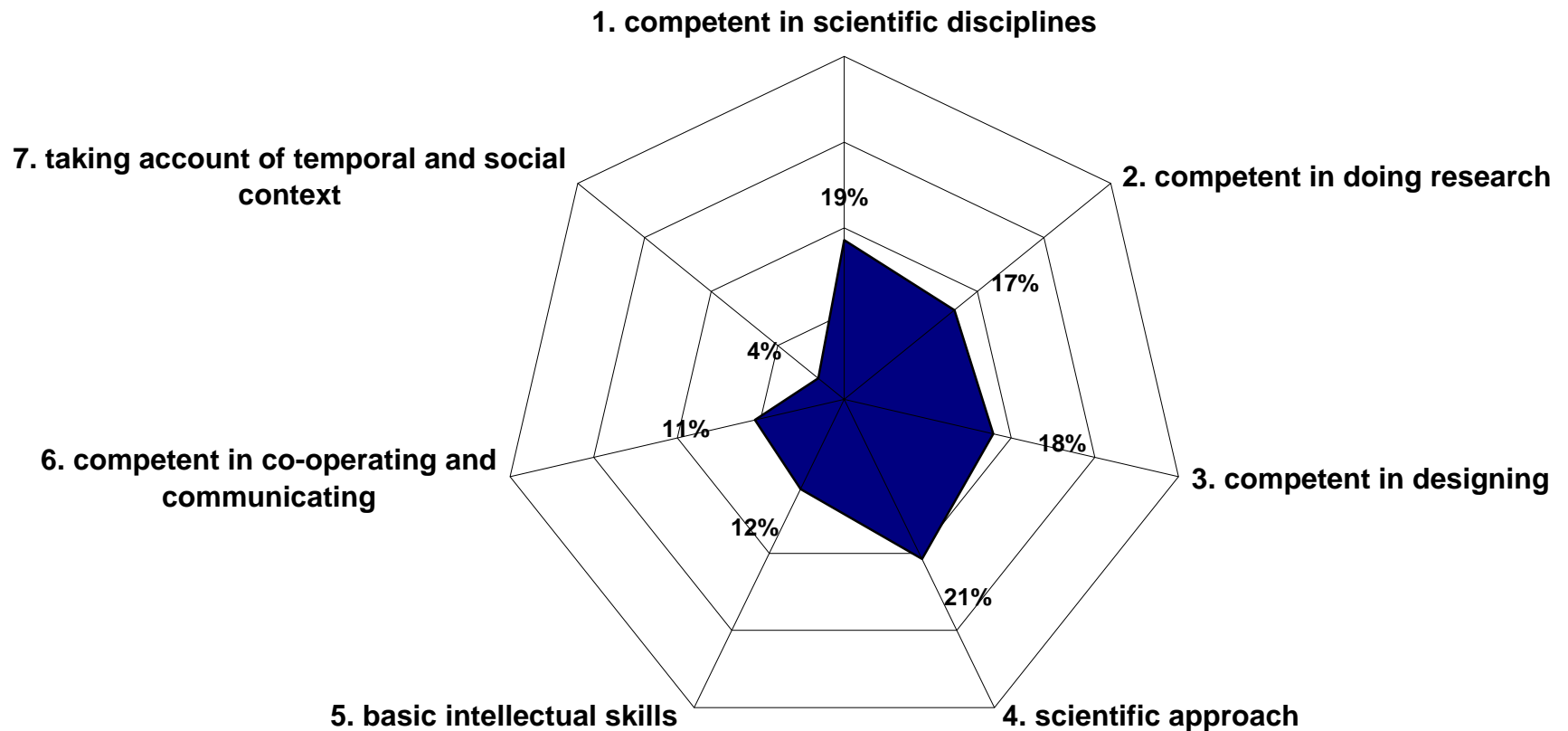
Levels of Competences (mean values)



Computer Science (BA)



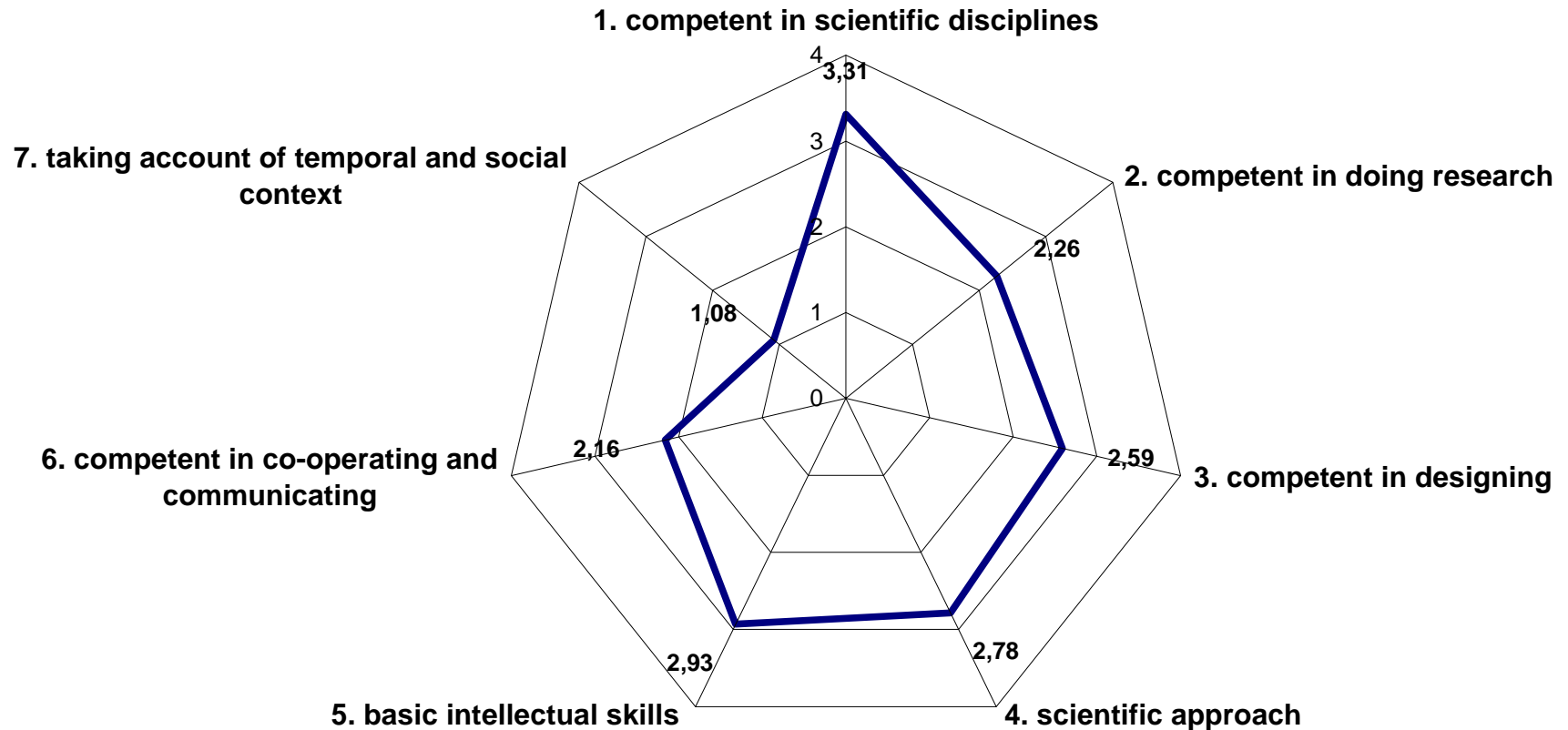
Competence Profile: Master Programme Computer Science percentage of workload (N=33)



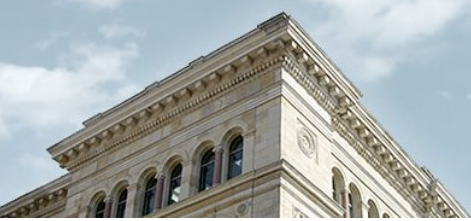


Levels of Competences: Master Programme Computer Science

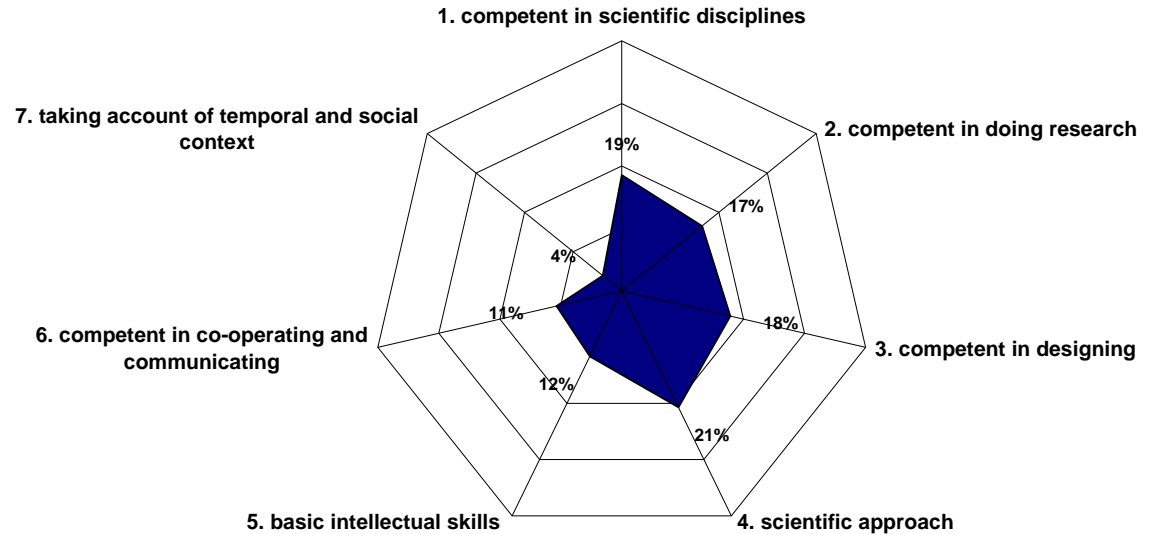
mean values of competences (N=33)



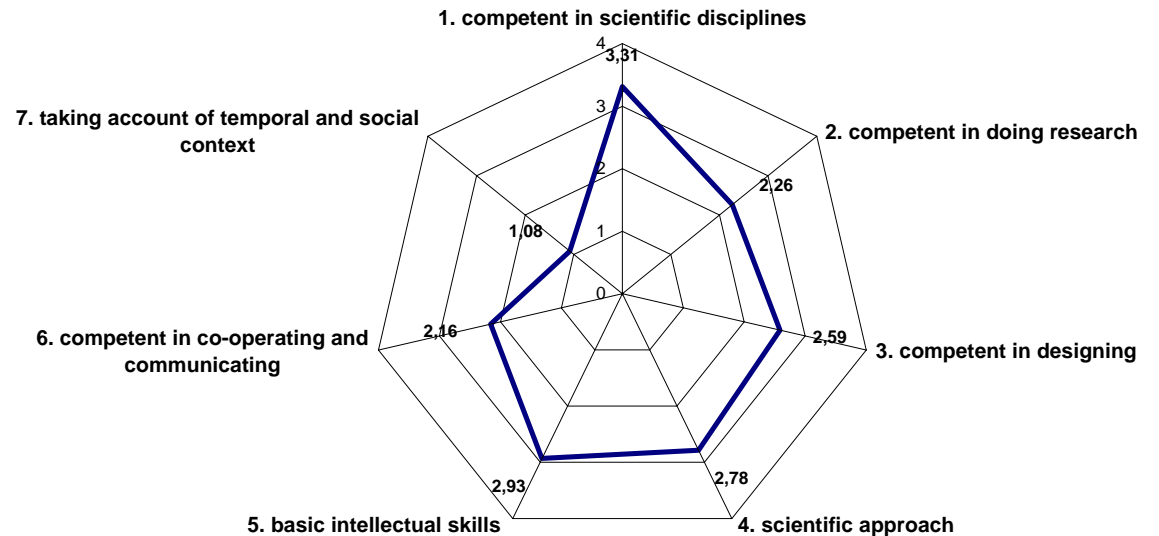
The levels of competences (1-5) describe the degree of requirements and the degree of complexity as well as the extent of the necessary responsibility in fulfilling the study task.



Competence Profile (percentage of work load)



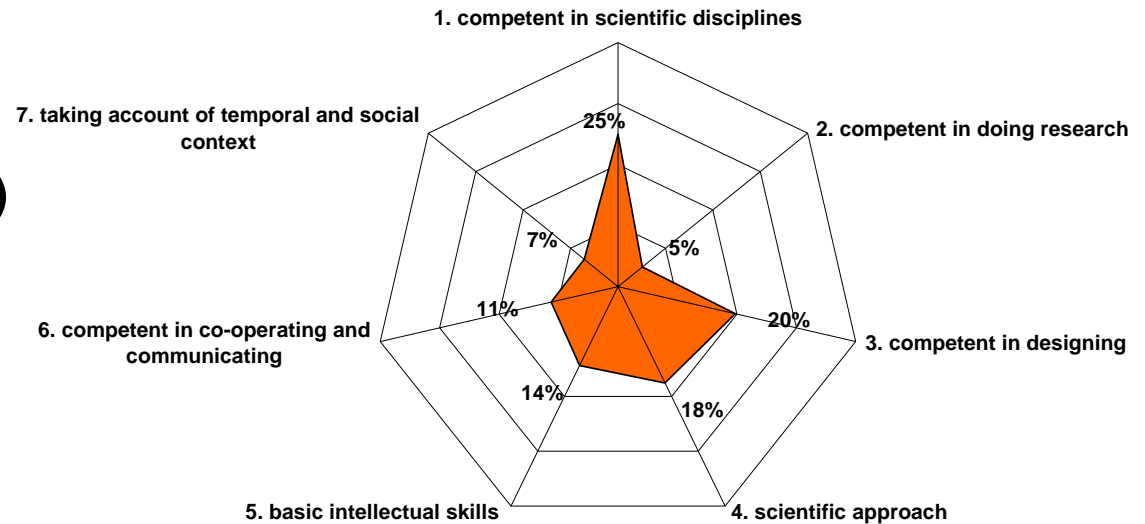
Levels of Competences (mean values)



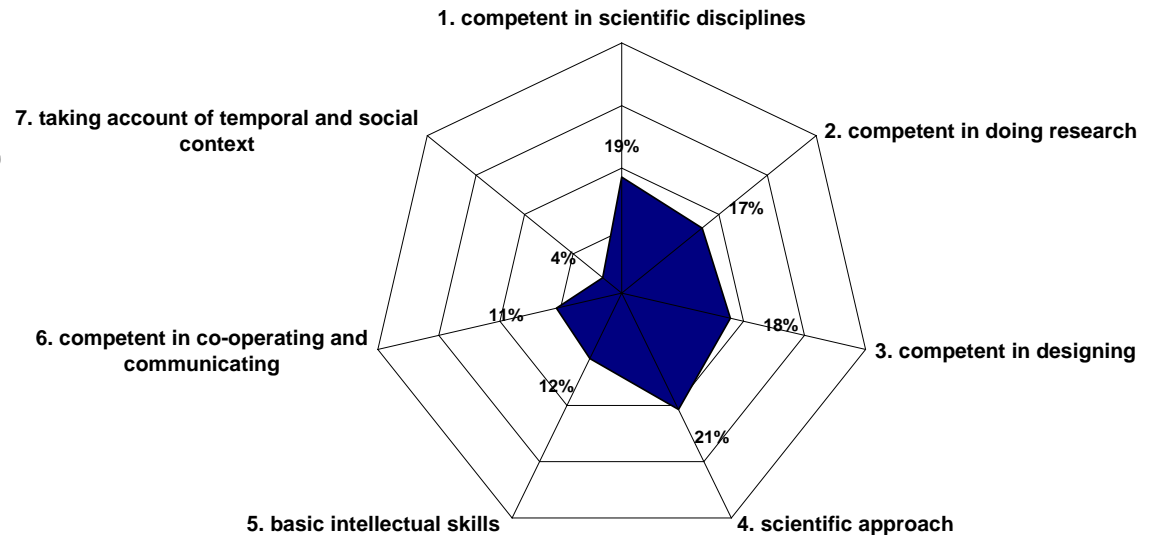
Computer Science (MA)

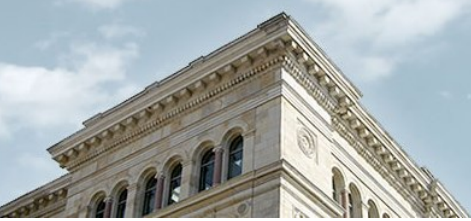


Bachelor Profile (percentage of work load)



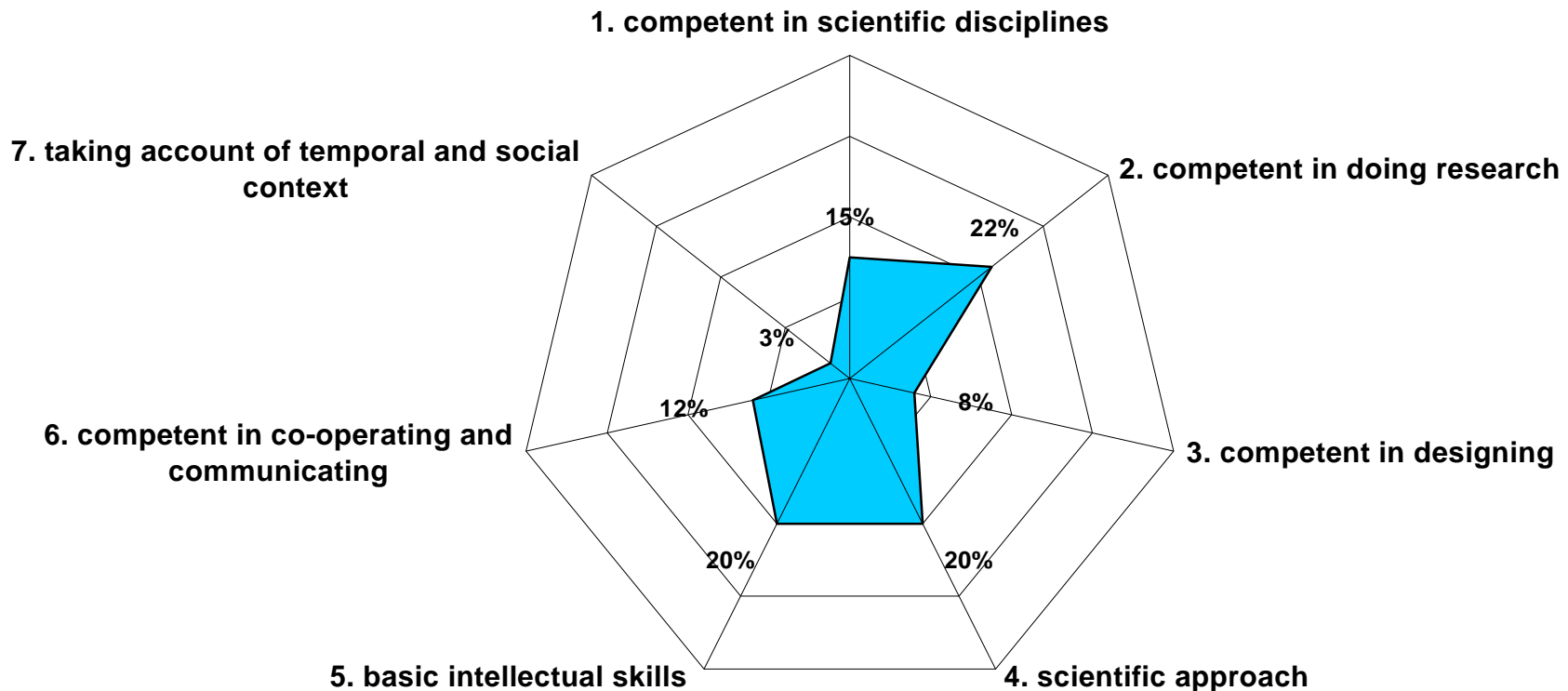
Master Profile (percentage of work load)





Competence Profile: Dependable Systems

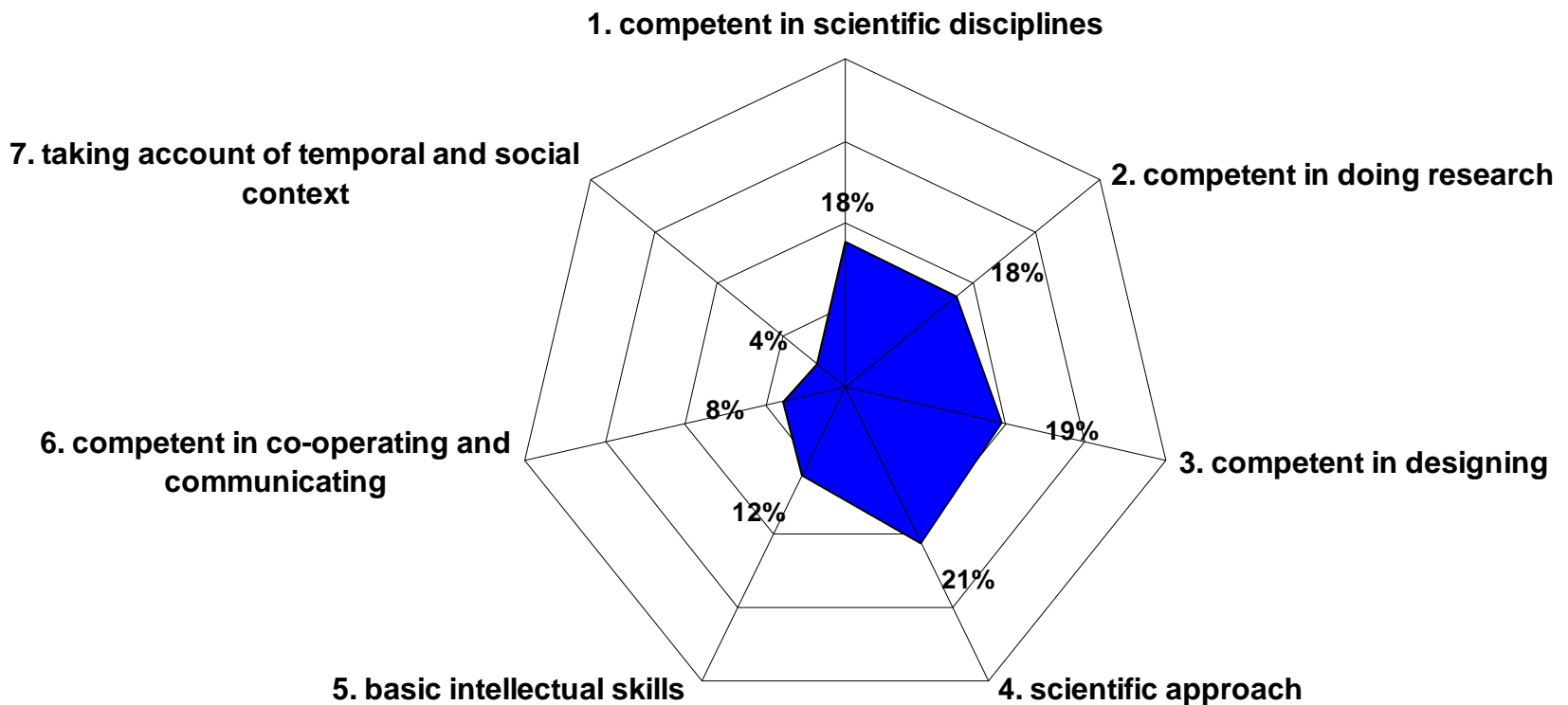
Computer Science, MA
percentage of workload (N=6)





Competence Profile: Communication Based Systems Computer Science, MA

percentage of workload (N=9)

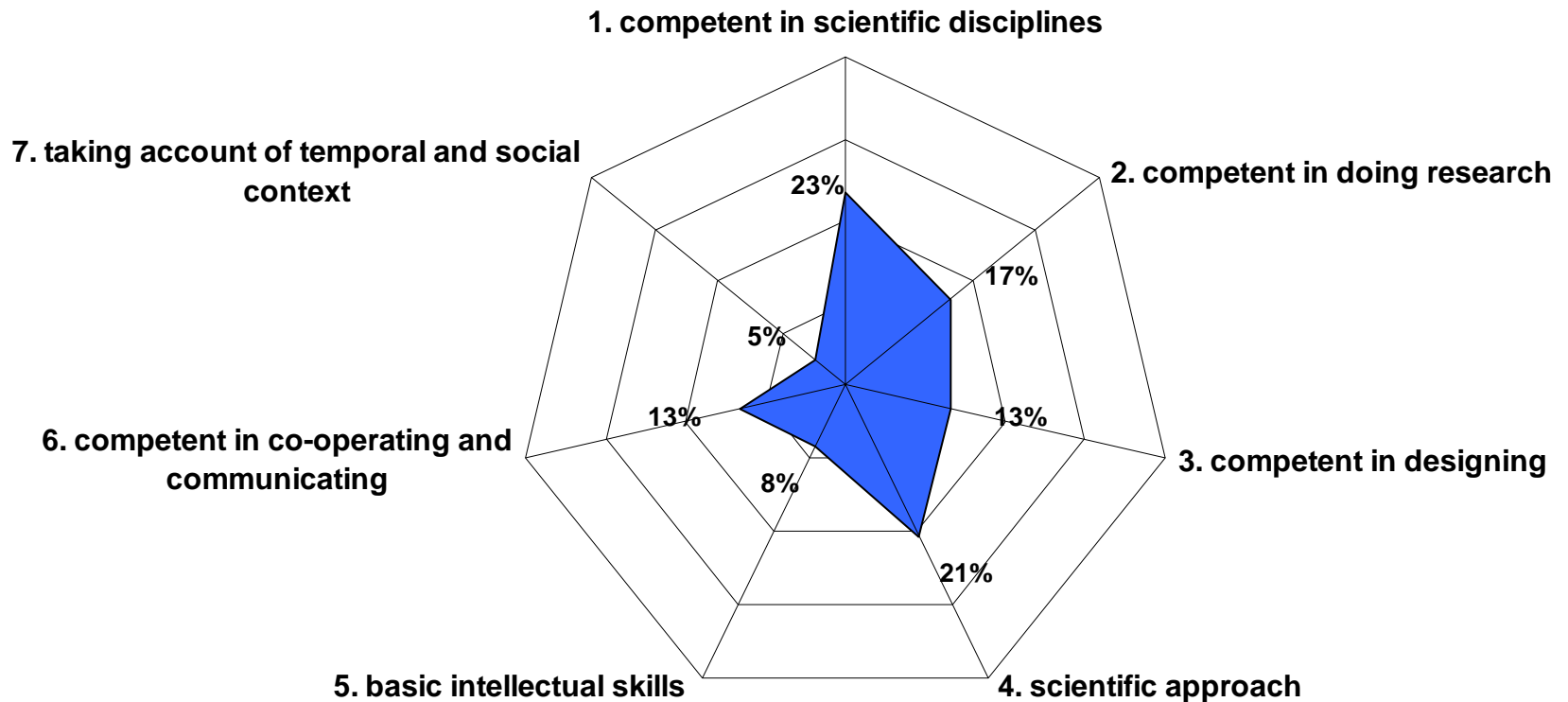




Competence Profile: Intelligent Systems

Computer Science, MA

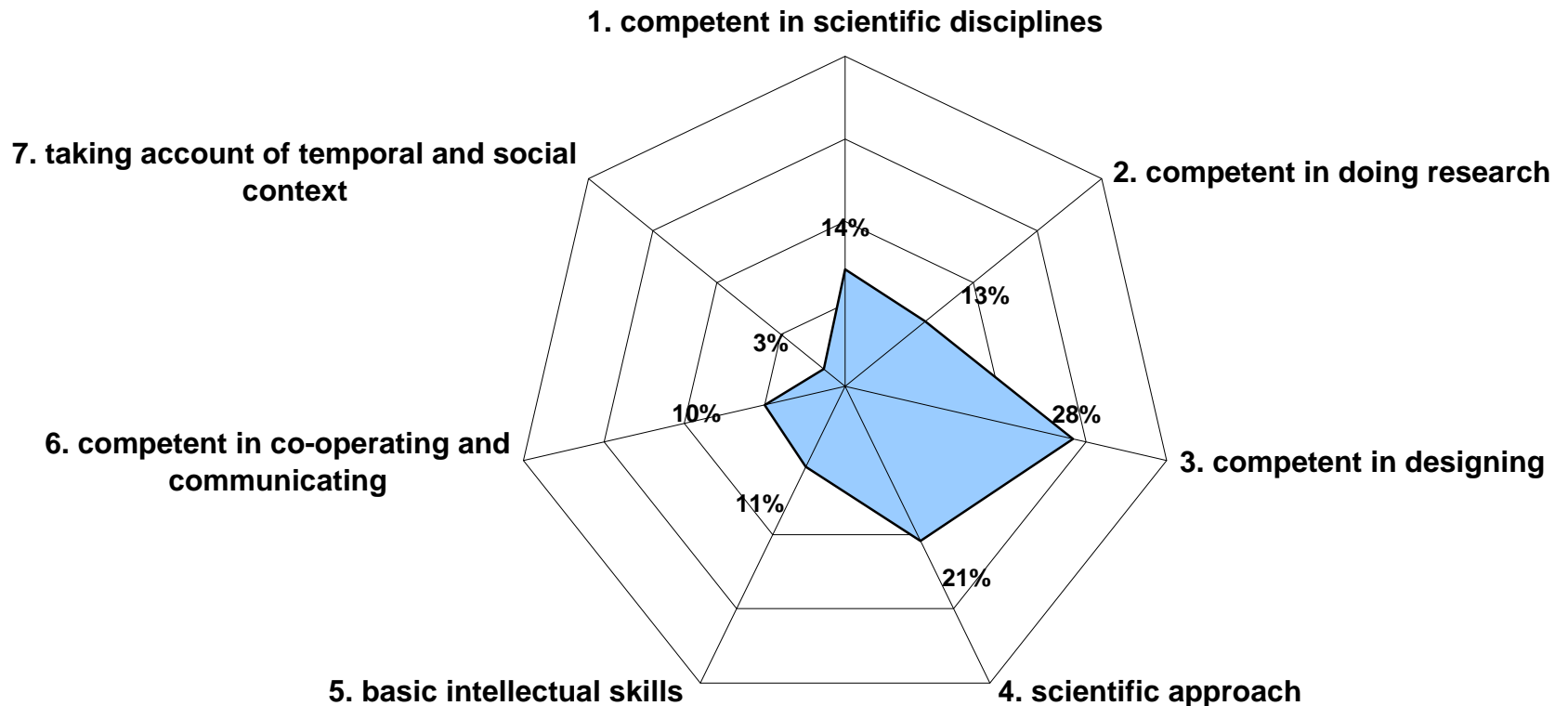
percentage of workload (N=11)





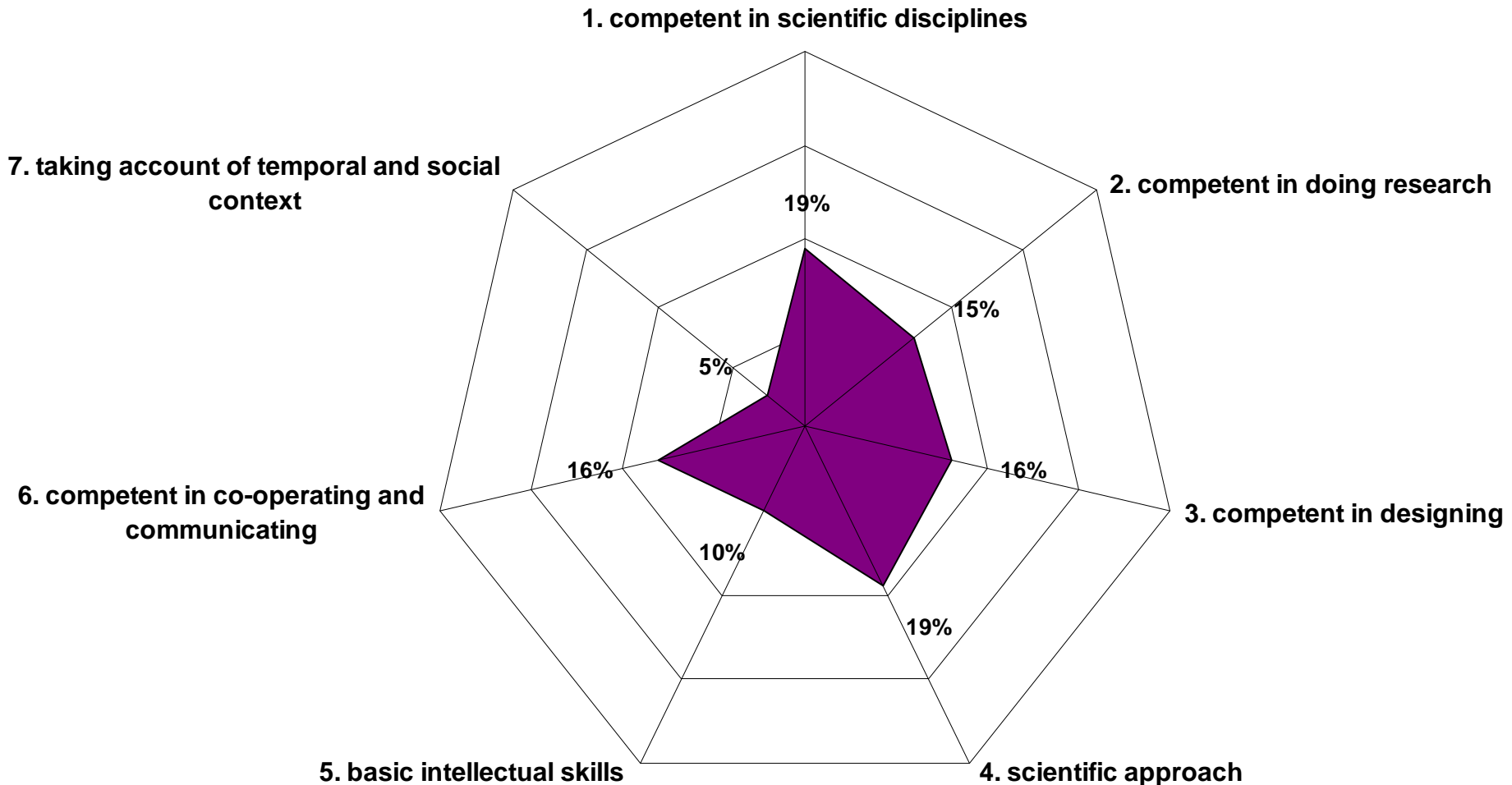
Competence Profile: System Engineering Computer Science, MA

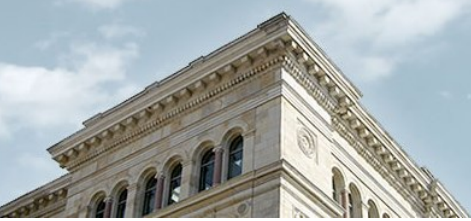
percentage of workload (N=6)





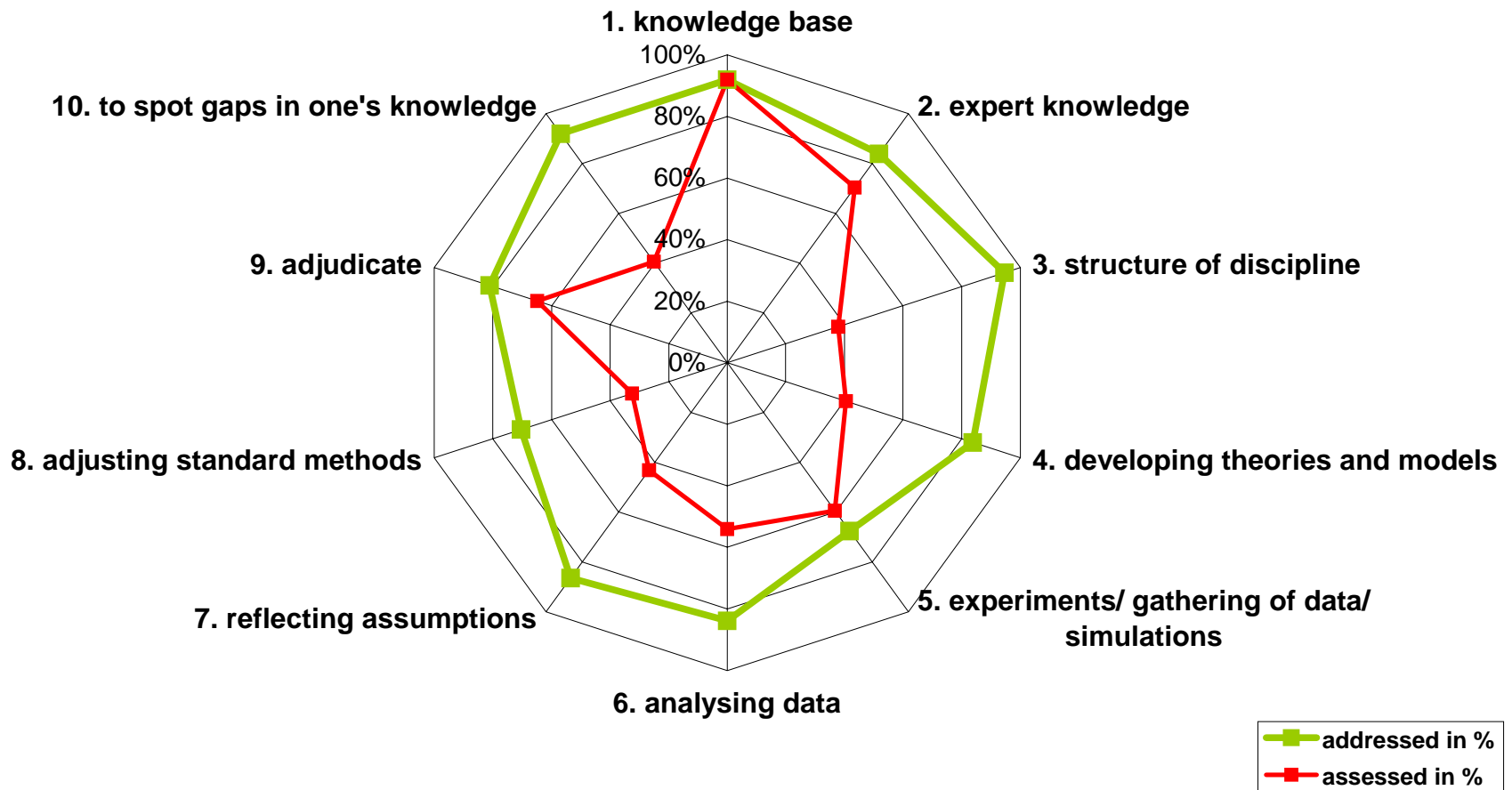
Competence Profile of the Master Thesis percentage of workload (N=5)

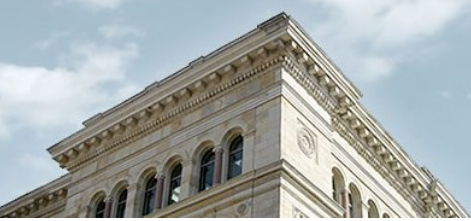




Scientific Discipline – Computer Science, BA

Comparison of Addressed and Assessed Competences percentage of respondents (N = 37)

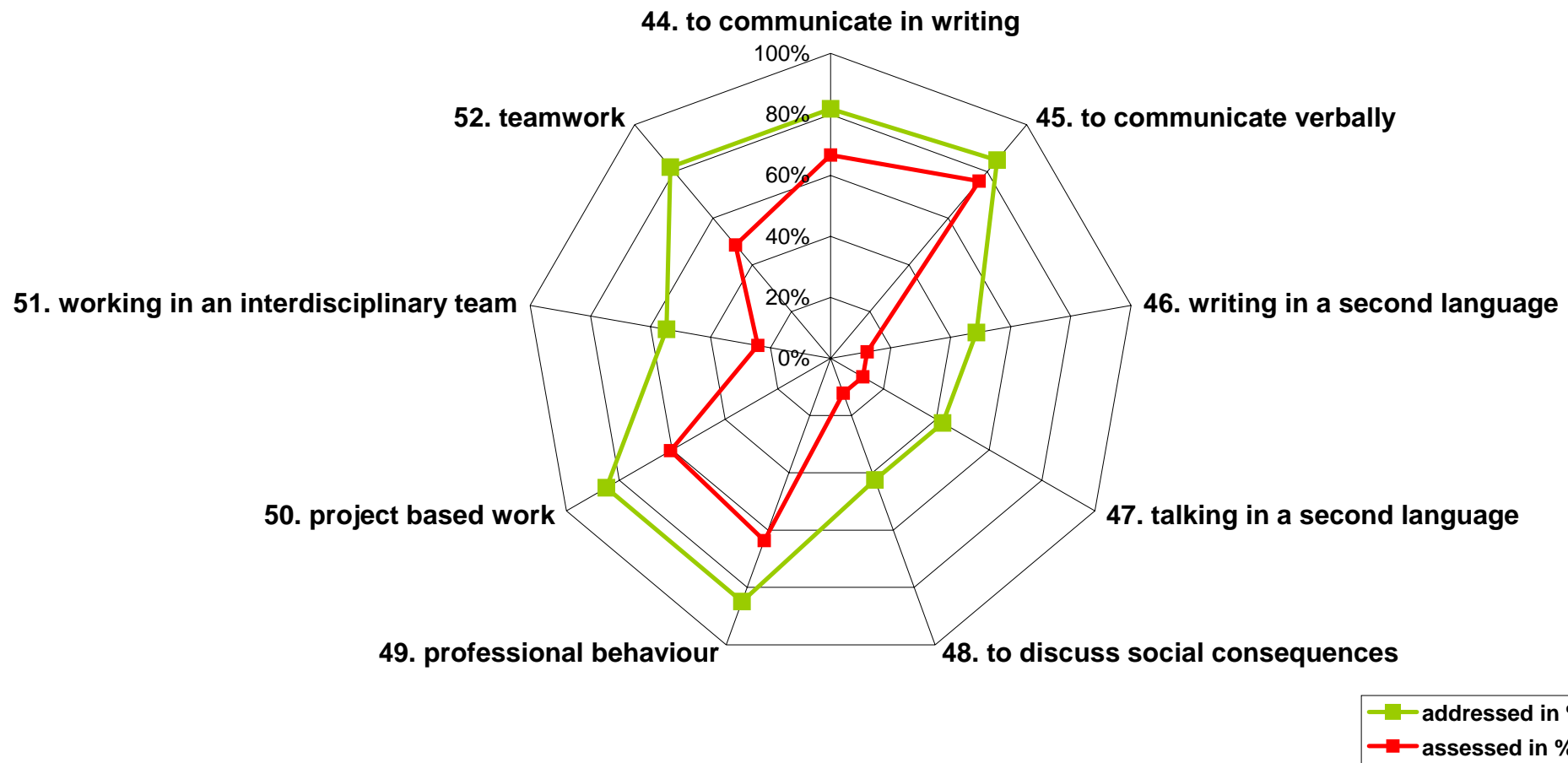




Co-operating and Communicating – Computer Science, MA

Comparison of Addressed and Assessed Competences

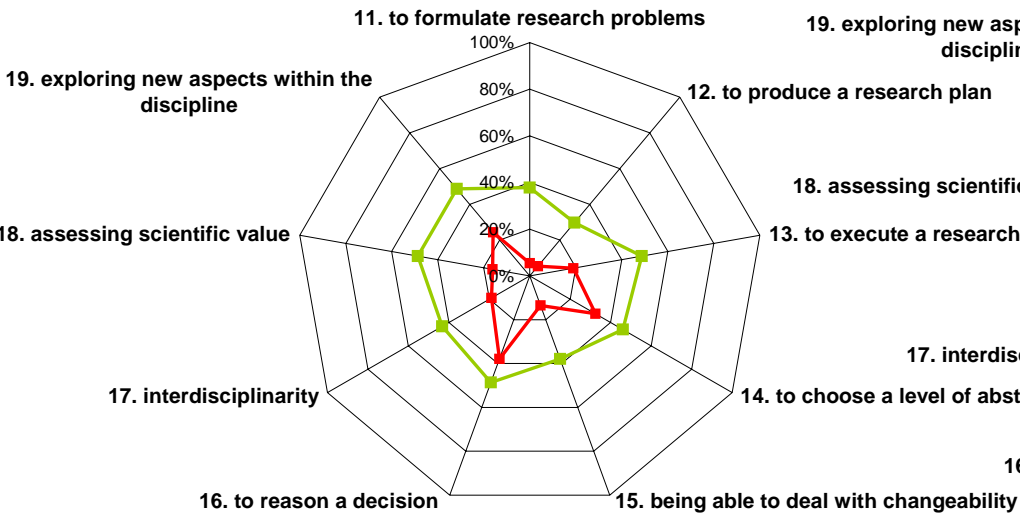
percentage of respondents (N = 33)



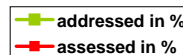
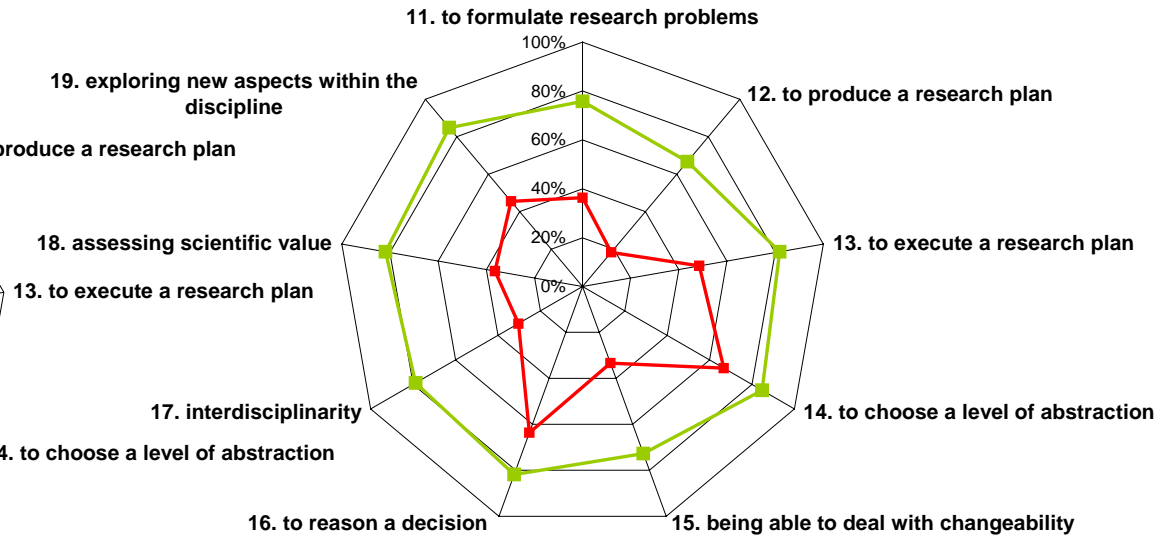


Doing Research – Comparison of MA & BA (Computer Science) Addressed and Assessed Competences

Bachelor



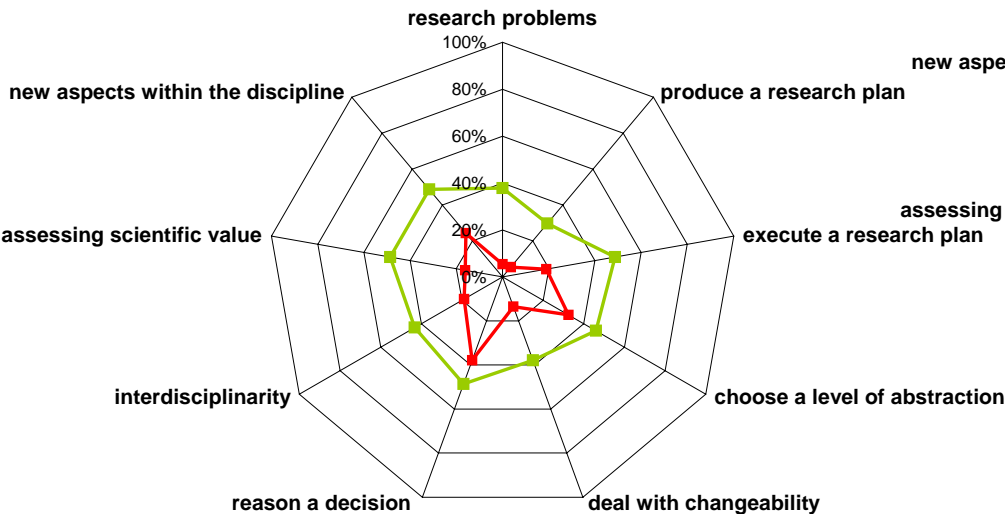
Master



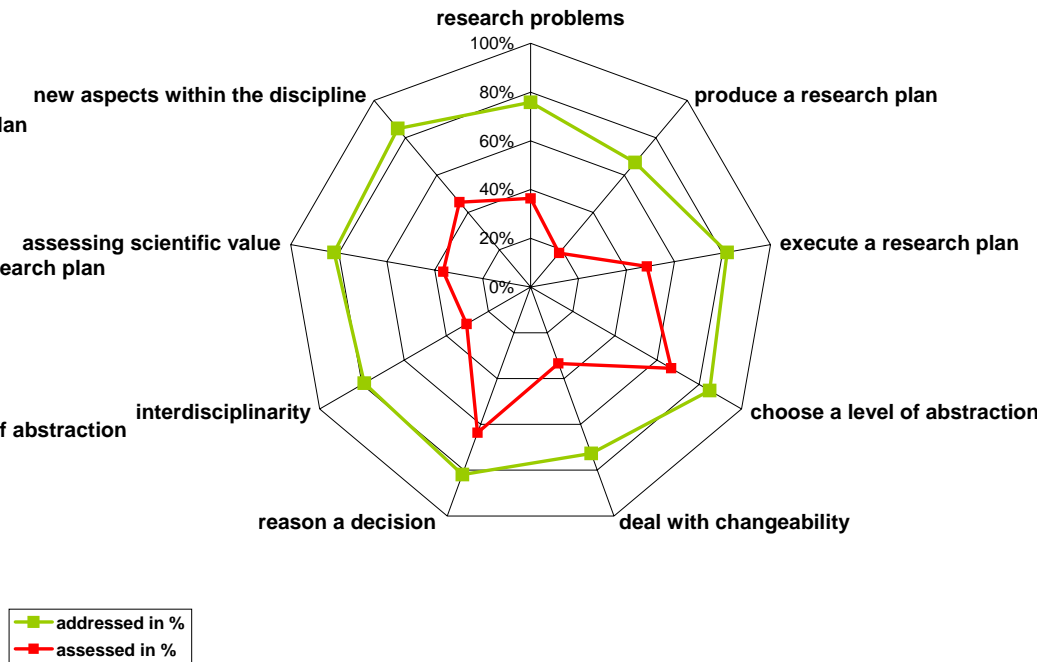


Doing Research – Comparison of MA & BA (Computer Science) Addressed and Assessed Competences

Bachelor



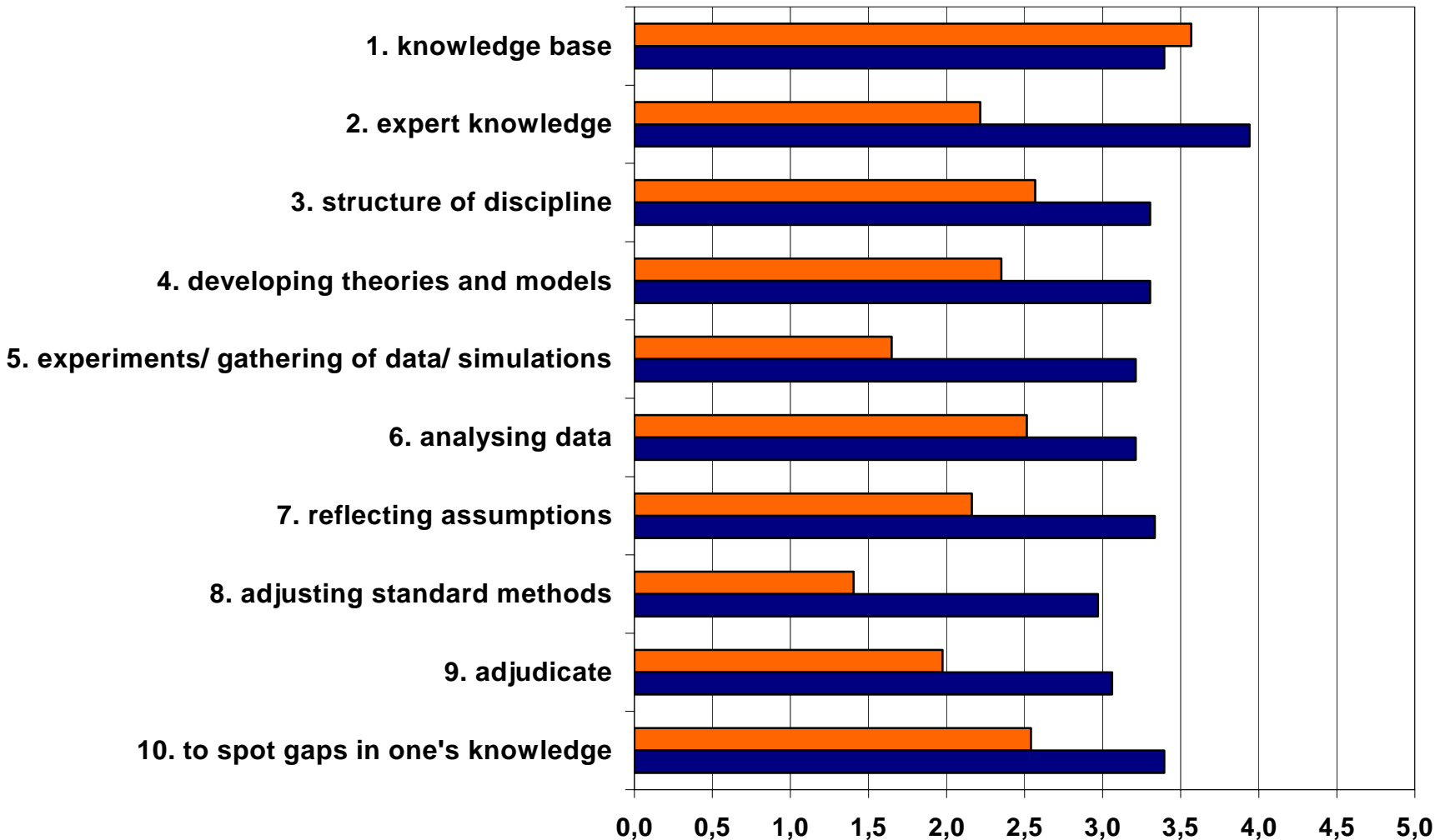
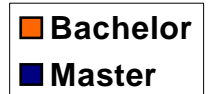
Master





Level of Competences in Scientific Disciplines

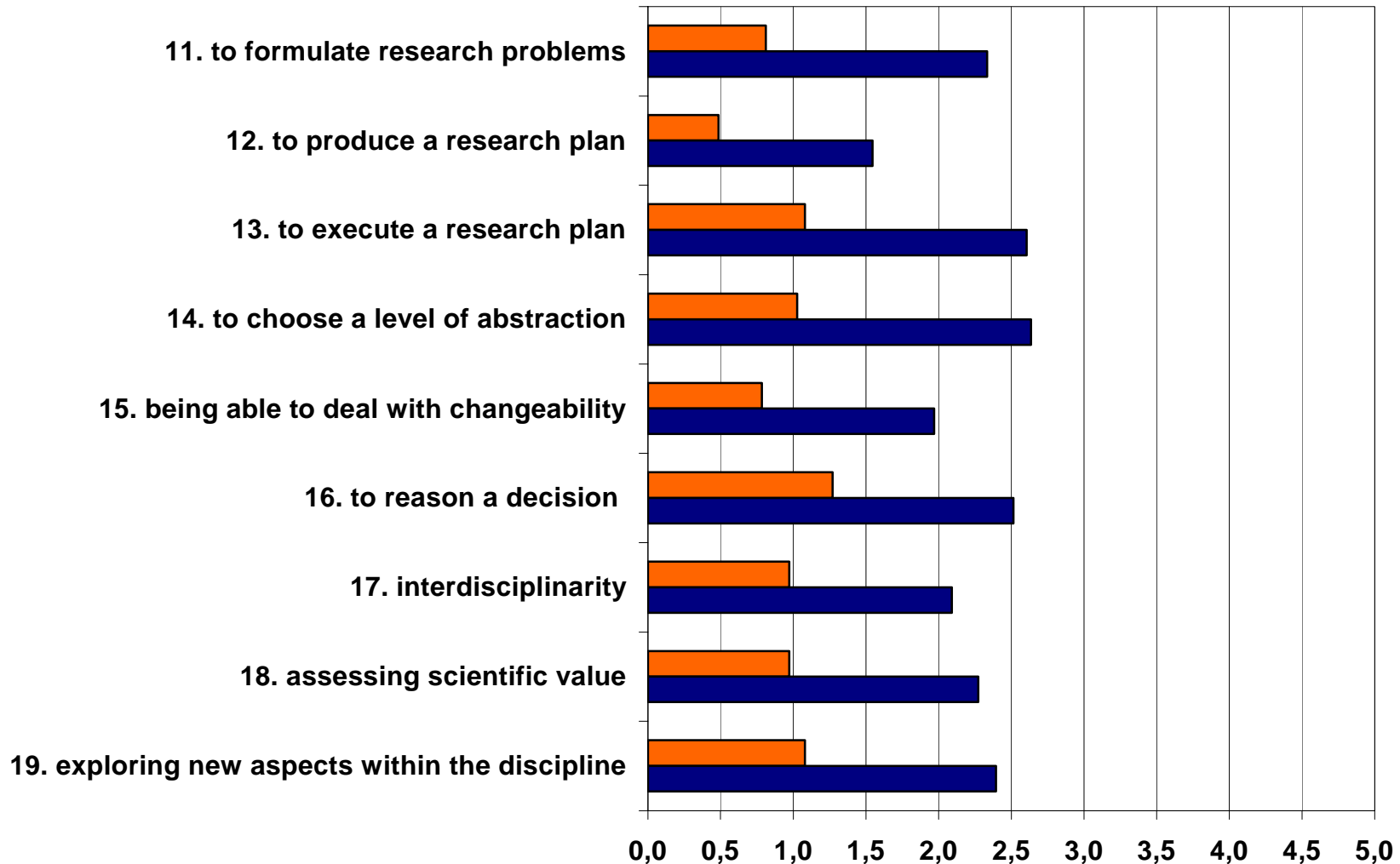
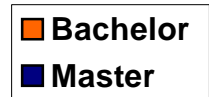
mean values: Bachelor (N=37) und Master (N=33)





Level of Competences in Doing Research

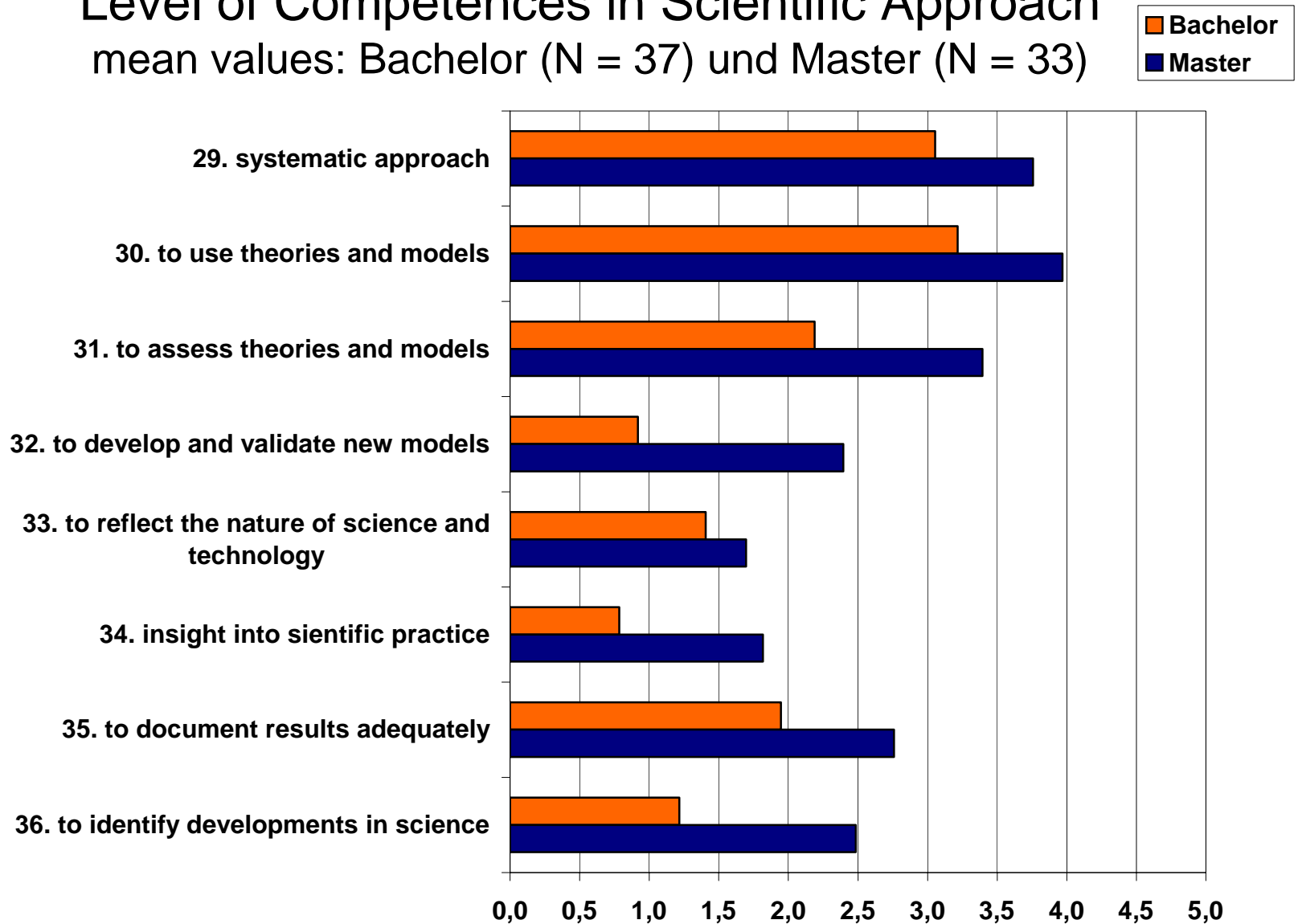
mean values: Bachelor (N=37) und Master (N=33)





Level of Competences in Scientific Approach

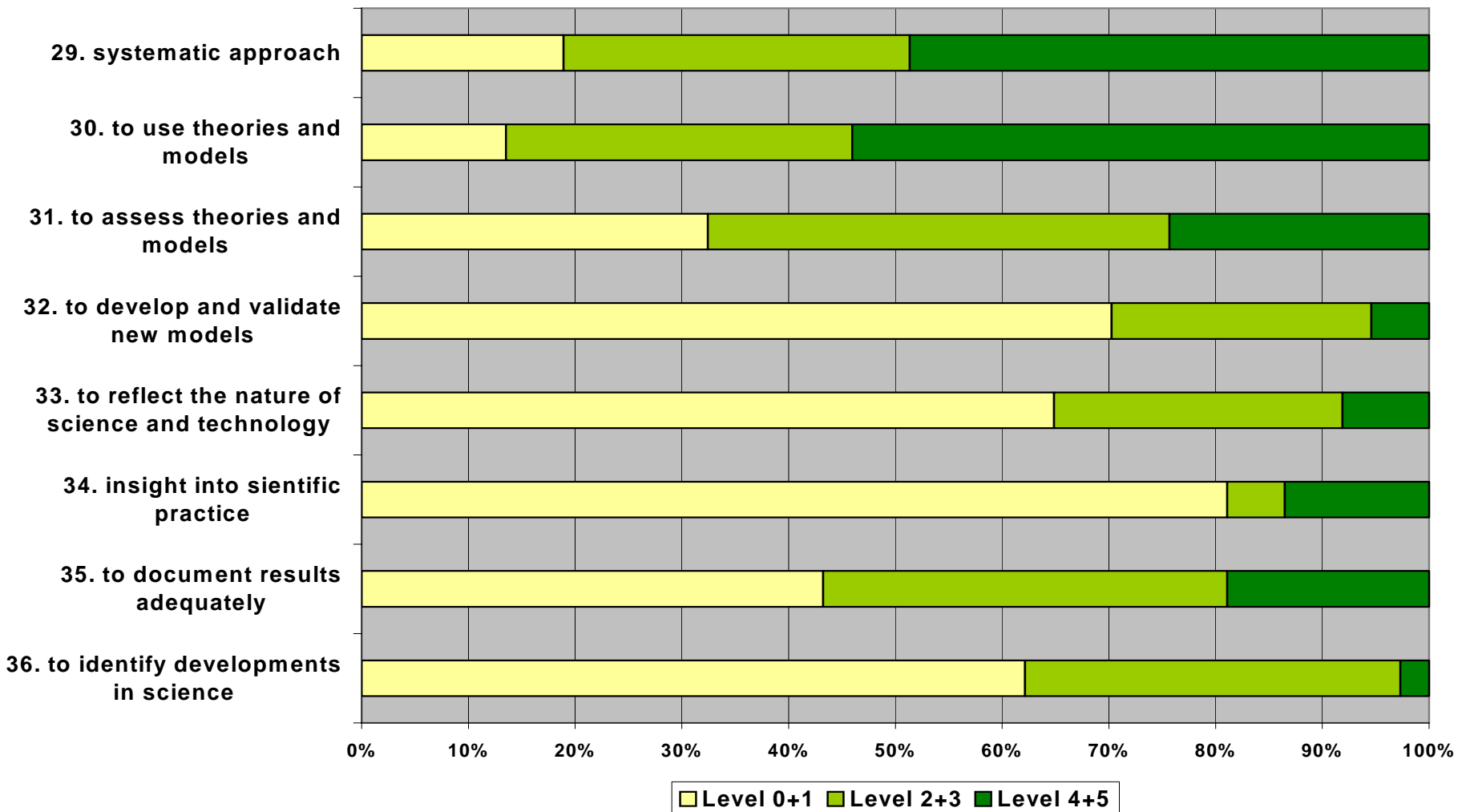
mean values: Bachelor (N = 37) und Master (N = 33)





Scientific Approach - Computer Science, BA

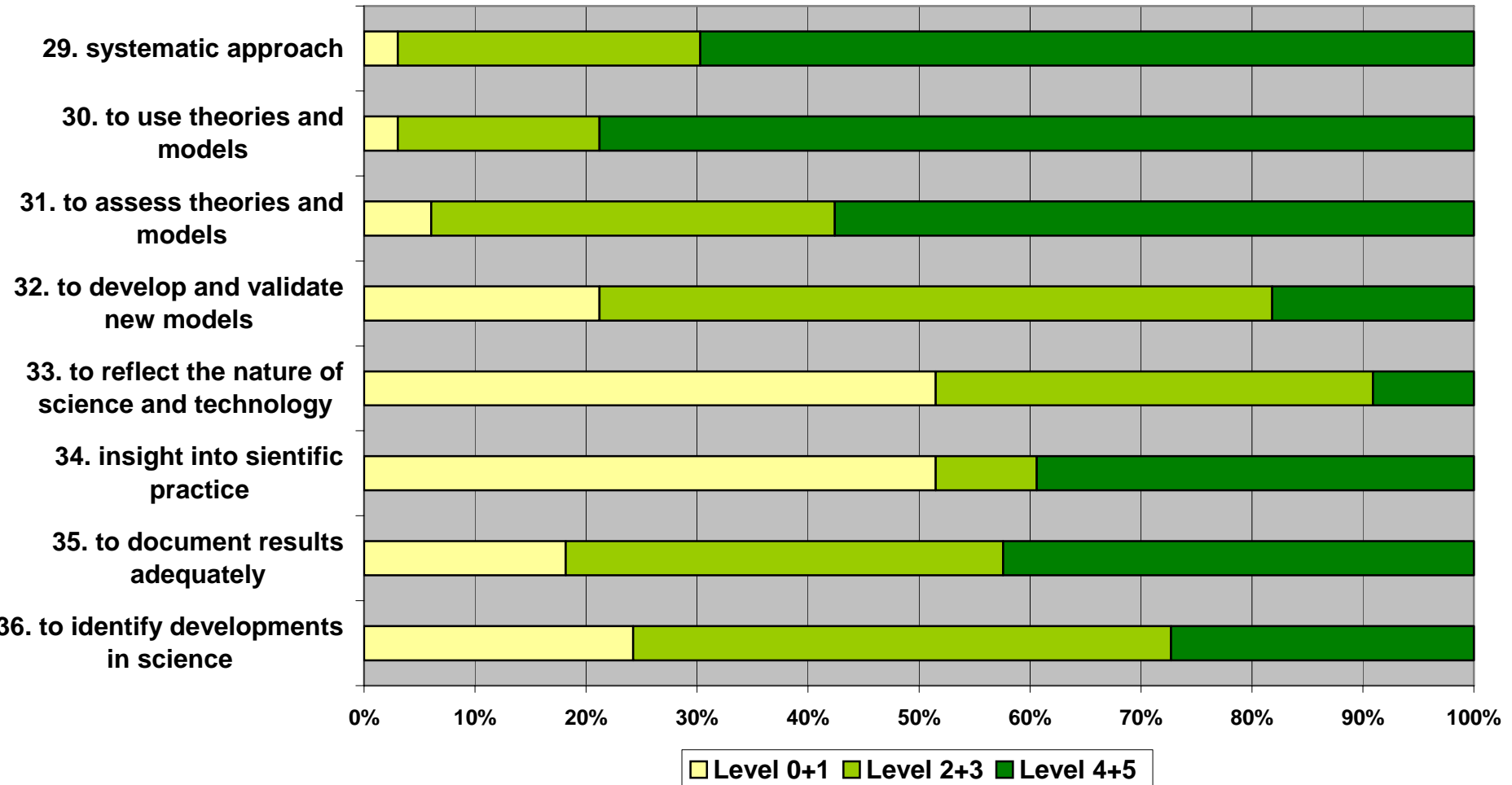
distribution of levels (N=37)





Scientific Approach - Computer Science, MA

distribution of levels (N=33)





Conclusion

- Helps to force lecturers to (re)consider target competences and how to achieve them
- Helps program manager to identify strengths and weaknesses in program's profile
- Gives some evidence for program's outcome qualifications by breaking them down to module's outcome qualifications

Caveat:

- Based solely on teachers' intentions



Further steps

- Interview students about perceived acquisition of competences (module level)
- Interview alumni about perceived acquisition of competences (program level)
- Interview employers about perceived competences of alumni
- Compare, conclude and react



Thanks for your attention.

Any questions ?

