Transdisciplinarity and Education for Technology Innovation

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Introduction

- analysis of the transdisciplinary principles
- exercise of translation in terms of transdisciplinarity of the Section of industrial engineering in german language considered as a specific scientific system
- **hypothesis**: the transdisciplinary approach (at least a transdisciplinary spirit has been applied since the beginning, yet it is still insufficiently used in the bachelor and master studies, although significant steps forward have been done, by transcending the disciplinary boundaries
- teachers and students have to learn and internalize the transdisciplinary approach for a holistic thinking, knowledge and context creation, but also for *place creation* – (transdisciplinary and Ba)

Questions

- What are the well prepared graduates claimed by society and companies?
- What is sustainability?
- What is place creation?
- Research taxonomy/typology
- Critical thinking? (in both senses)

Well prepared graduates?

- societal dynamics is high
- dynamics of knowledge also is very high (information gets quickly obsolete, information flood makes selection and structuring the process complexity.
- need of a path for a synergy between teachers and students in dealing with new information and requirements of different levels of reality.
- Some aspects regarding the requirements of the economy need to be understood and internalized by universities so that they are able to form the new generations of young specialists, which get jobs where they add value to the business field and the society (ultimately to the world).

Sustainability (1)

- regards economic and financial aspects and the strategy of teaching-learning
- Sustainability science is influenced by market mechanisms, both with advantages and disadvantages.
- Advantages: manifold possibilities of developing small business (even in a barn, 3D-printing, Braigo) and the crowd funding platforms, which provide alternative financing for some projects (Social media and informational platforms make the market move faster)
- Disadvantages are the influence of political infringement, monopols, spiral of the violence by its effects on the research and the science
- even a sustainability science occurred and developed about six times in the last 15 years, i.e. the frequency of papers published that include sustainable or sustainability in the bibliographic records over time.
- only if the stakeholders are interested in follow-up of the transdisciplinary projects, it is possible to achieve sustainable results. Otherwise, transdisciplinary research and the results cannot influence the solution of practical societal problems.

Sustainability (2)

- growth of knowledge coexists with poverty, new diseases and a deficient health care system, a high unemployment rate mainly for young people, famine and violence spiral, separatist tendencies, maybe a new cold war
- symptoms of the dysfunctionalities of Keynesianism and the movement towards a new order, called neoliberal.
- there is no alternative to this order established in the ´90. Searching the online databases do not provide references regarding new order, which could eventually be the successor of the market economy, yet **Andrew Gamble** proposes “a combination of bold strategy and the right first steps”
- Sustainability organizations are self-organizing (auto poetic) systems. On the other hand, the sustainability science is determines the sustainability research

Place creation

- Place creation – as an attribute of transdisciplinarity. It is an abstract place, which is irreversible. Once created, even annihilated, it leaves a track. Maybe it is not just a way of speaking, when saying “take care of what you are thinking, it might come true”. Synergy can be either on positive, or on negative path. And this could make the difference between survival and development of the Earth or otherwise.
- Ba is an existential place where participants share their contexts and create new meanings through interactions. Ba lets participants share time and space, and yet it transcends time and space. In knowledge creation, especially in socialization and externalization, it is important for participants to share time and space through direct experience. The conceptualization of knowledge creation as a dialectic process is a move away from the static theories, which treat companies as information-processing machines.

Research taxonomy/ typology

	Disciplinary	Multidisciplinary	Crossdisciplinary	Interdisciplinary	Transdisciplinary
Collaboration Scope	specialists among a discipline	specialists from different disciplines	view of a discipline from the perspective of another;	among disciplines through collaboration of specialists	across and beyond disciplines, over disciplinary boundaries
Specific Focus	deeper understanding within a research field (e.g. precision mechanic among mechanic)	compatibility in complex problem/situation solving through collaboration	explain and address aspects relating to a discipline through the terminology, instruments and even methods of other disciplines	creation of integrative solutions and mutual enrichment of disciplines	finding hidden connections among knowledge elements from different disciplines
Characteristics	-study same "research object" (e.g. multiple branches of engineering -have methodologies in common -add to the body of knowledge of a discipline -tight communication	-harmonize multiple, incompatible aspects -integration limited to linking research results -eventually misunderstanding (specialized languages) -collaborators sometimes unsure about final resolution	-mixture and combination among disciplines -difficulties to "see" different perspectives ("competing truth claims") (X) -e.g. engineering-non-engineering teams researching creativity techniques for engineering innovation -e.g. cross-disciplinary pedagogy Ph.D in Engineering Education (co-supervisors were a physicist and an engineer) (Y)	-development of shared concepts, methods, epistemologies for explicit information exchange and integration -specialization causes knowledge fragmentation, occasionally contradictory knowledge	Challenge the norm and generate options that appear to violate convention -look at problems from a discipline-neutral perspective -employ themes to conduct research and build curricula -redefine discipline boundaries and interfaces -can produce an entirely new discipline

Transdisciplinarity (1)

The three axioms of the methodology of transdisciplinarity (three pillars):

1. Ontological axiom: There are, in Nature and society and in our knowledge of Nature and society, different levels of Reality of the Object and, correspondingly, different levels of Reality of the Subject.

2. Logical axiom: The passage from one level of Reality to another is ensured by the logic of the included middle.

3. Complexity axiom: The structure of the totality of levels of Reality or perception is a complex structure: every level is what it is because all the levels exist at the same time.

Transdisciplinarity (2)

Key Characteristics of Transdisciplinary Research Are:

- use of shared concepts, frameworks, tools, methodologies and technologies to solve common unstructured research problems and situations
- eliminates disciplinary boundaries for strong collaboration
- redefines the boundaries of engineering, natural science, social science and humanities by bridging them
- leads for the development of new knowledge, shared common conceptual frameworks, tools, methodologies and technologies.

Critical thinking? (1)

Multidisciplinary based on several Engineering Disciplines, there is a Disciplinary Input for solution (Double coordination of bachelor or master-thesis, e.g. Precision Mechanics and Electronics, or Industrial Chemistry and Mechanics, Software and Mechanics, Software and Medicine, Precision Mechanics and Medicine) and

the Interdisciplinary research process: based on several Engineering Disciplines, integrated solutions are provided (new fields of knowledge, new science or a new specialization, e.g. Wirtschaftsingenieurwesen, Wirtschaftsinformatik, Bionik, Mechatronik, Project Management, EU-Law).

Critical thinking? (2)

Analyzing facts and activities, in the activity of the Transdisciplinary research process, especially in Mechatronics, which is utterly transdisciplinary according Ioan G. Pop and Vistrian Măţieş: “Transdisciplinarity goes beyond merely a discipline as its identity, selection, communication and legitimacy are radically distinct to that of the disciplinary stage, the model is that of the thematic synergistic identity of mechatronics. “

Innovative education for industrial engineering (Wirtschaftsingenieurwesen). An important tool is learning and teaching critical thinking as a proper instrument for innovation and a creative stage when mind and thoughts are permanently in “tiny revolution”(RELATED to situation solving orientation). Is it actually possible or even necessary, to have minds set on permanent creation? The creative potential of the polyvalent logics (intuitive thinking and paradoxes) diminishes the contradiction and leads to the dichotomy identity-diversity (Stefan Lupasco, Sergiu Berian, Vistrian Măţieş).

Critical thinking? (3)

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The Model of FILS

<table>
<tr><td colspan="6">FILS (Faculty for Engineering in Foreign Languages</td></tr>
<tr><td colspan="6">DILS (Department for Engineering in Foreign Languages (Bachelor+Master+Doctoral School in brevi)</td></tr>
<tr><td rowspan="5"></td><td rowspan="4">Competence Center</td><td>English Section</td><td>French Section</td><td>German Section</td><td rowspan="4">Foundation for Sustainable Cooperation with German speaking companies</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td colspan="3">Department of Languages (Lectorat Francais+DAAD Lektorat)</td></tr>
<tr><td colspan="5">CTTM – Center for Technology and Management Transfer</td></tr>
<tr><td colspan="5">Student Organizations: ASAFF +RObotiqueFF+ VWI</td></tr>
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Conclusions

- This critical evaluation is a work in progress, analyse for self-assessment
- Transdisciplinarity:
  - “learning to learn” and “learning by doing”
  - „creativity” with “adaptivity-quality” and “innovation”
  - „authenticity” through “integrity” and “excellence”
  - „participation” through “communion” and “apprenticeship”

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