Teaching, Learning and Reporting in Science: Engineering Education

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Technical University of Denmark
What characterises a good engineer?

What does an engineer do?

To be able to engineer
To be able solve problems
To be able to design solutions
To be innovative
Shifting focus in engineering education

Multidisciplinary engineering skills

- Pre-1940: Practice
- 1960: Science & practice
- 1980: Science
- 2000: CDIO

Technical-disciplinary knowledge
4 study forms / strategies

1. Sciences oriented
   - This discipline is really interesting! I develop my knowledge all the time!
   - Assessment is an annoying waste of time

2. Competence oriented
   - I want to develop my competences – and get a job where I can develop
   - Assessment is a chance to show our skills and get feedback

3. Job oriented
   - I want to get a good job – in a nice environment
   - To pass an exam is one step further

4. Looking for engagement
   - I was good at math in high school
   - I am looking for a study that will engage me
   - My father is an engineer
Teaching teaching

Understanding understanding

Teaching for Quality Learning at University
Fourth Edition

John Biggs and Catherine Tang
If you ask the teacher, …

GOOD student

BAD student

Labeling transfers the responsibility from the teacher to the student!!!

"We can’t do anything, it’s just the way students are"
Level 1 Teacher

"Blame the student" approach
Exam: to sort Good students from Bad students
Level 2 Teacher

”Blame the teacher” perspective
Good teacher vs. Bad teacher

Good Level 2 teacher: focusing on teaching techniques, tricks, entertainment!
"Blame the teacher" perspective
Good teacher vs. Bad teacher

"Great teacher. Funny, keeps us alert... I missed the point and didn’t understand everything, but still great!"

Result: Passive students. Engaging students isn’t enough!
Be concerned about what the student DOES before, during and after teaching – LEARNING OUTCOME!
Let’s understand understanding!

Homo Sapiens are bad at memorizing random information
7 ± 2 pieces of random information in the short term memory

Knowledge is constructed as a result of the learner’s active behavior

“It is what he does that he learns, not what the teacher does!”

SOLO Taxonomy
Deep understanding vs. Surface understanding
Bloom’s Taxonomy of Learning (New Version)

- Creating
- Evaluating
- Analyzing
- Applying
- Understanding
- Remembering

Increasing difficulty
Good teacher gets the students to use the higher level cognitive processes.

Teach, so that Robert behaves like Susan!
Indoor Climate course

Course Base 2014/2015

11222 Indoor Climate

Danish title:  Inddklima
Language:  English
Point (ECTS):  10
Course type:  MSc
Taught under open university

11222 Indoor Climate

General competence course, MSc Eng., Civil Engineering
Technological specialization course, MSc. Eng., Architectural Engineering
Technological specialization course, MSc. Eng., Sustainable Energy

Schedule:  F8 (Wed)
Location:  Campus Lyngby
Scope and form:  Lectures, discussions and practical exercises
Duration of Course:  13 weeks
Date of examination:  FSA
Type of assessment:  Written examination and reports
Exam duration:  2 hours, multiple choice
Aids:  All Aids
Evaluation:  7 step scale, internal examiner
Qualified Prerequisites:  11202/11203, Man and the physical environment/ Introduction to Indoor Environment
Participants restrictions:  Minimum 10

General course objectives:
The student shall by analysing the original literature and by exercises related to practice achieve detailed knowledge of the parameters of the indoor climate and their effect on man’s comfort, health and work. The student will be able to calculate, analyse and evaluate climate in practice.

Learning objectives:
A student who has met the objectives of the course will be able to:

- Account for the impact of the indoor environment on human health, comfort and performance
- Interpret indoor environment standards and the relevant scientific literature
- Account for measurement methods often used to characterize the indoor environment
- Use instruments to measure typical indoor environmental parameters like temperature, moisture and CO2
- Carry out simple laboratory investigations (including understanding how to plan and perform an experiment)
- Understand the physics of and perform dynamic calculations of the concentrations of pollutants in a space
- Plan and execute a major measurement task in a building with indoor environment problems and provide recommendations for improvements
- Carry out a major project in groups and present the work in a report and in an oral presentation

Contents:

Responsible:
Geo Clausen, Building 402, Ph (+45) 4525 4222, gc@byg.dtu.dk

Department:  11 Department of Civil Engineering
Department involved:  37 Department of Systemic Biology
Registration Sign up:  At Compris

Last updated: 28. maj. 2014
# Indoor Climate Course

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<th>Time</th>
<th>Session</th>
<th>Topics</th>
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<tr>
<td>08:00-10:00</td>
<td>Science</td>
<td>Thermal Environment</td>
<td>Thermal Brush up, Microbiology brush up, IAQ brush up, Particles Brush up, Performance Brush up, Chemistry, User influence, Public Health, Workshop, Certification, Standards, JT, BA, GC, AW, PW, RKA, SL, GC/JT, GC, ET, Indoor Environment and Energy</td>
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<tr>
<td>10:00-12:00</td>
<td>Practice</td>
<td>Thermal Environment</td>
<td>Thermal Environment, Microbiology, IAQ, Presentation of Literature Review, Particles, Labeling schemes, green economy, Chemistry, Air cleaning, Special environment: Schools, Remediation, Guest: Consulting engineer, JT, BA, GC, AW, JT, Henrik, CW/GM, PW, GB, GC, JT, GC, John, Indoor Environment and Energy</td>
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<tr>
<td>13:00-14:00</td>
<td>Toolbox</td>
<td>Course Outline, Literature Search, Writing reports</td>
<td>Planning experiments, Data analyses, Building Audit, Simulations, Epidemiology, Modelling, Cost-Benefit Analyses, Comissioning, Life-cycle analyses, GC, DTV, GC, JT, JAK, PAW, JT, PAW, JT, RKA, GC, GB, JT, PAW, JT, DTU</td>
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<tr>
<td>14:00-17:00</td>
<td>Exercises</td>
<td>Visit to the Labs, Literature review</td>
<td>Technical and passive systems (Groups 1-12), Tasks (Groups 13-24), Tasks (Groups 13-24), Tasks (Groups 13-24), Technical and passive systems (Groups 12-24), Poster session, Course Evaluation</td>
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Dialogue-based teaching

Traced back to the ancient Greek philosophical teaching of Socrates described in the famous dialogues by Plato.

- Prior knowledge
- Ask questions, don’t give answers
- Discover errors
- Reasoning
- Very time consuming
  - Let the students teach each other – teaching is a good way of learning
Teaching large classes

Students tend to become very passive - and often absent-minded - during sessions dominated by oral one-way communication.

- Variation
- Activate the students
- Introduce breaks during longer sessions

Grandmother’s 1st law: He who works, learns

Grandmother’s 2nd law: He who sleeps, learns nothing
Inductive teaching

The topic is introduced by presenting concrete examples, cases or problems

The instruction begins with a set of observations or experimental data to interpret, a case study to analyze, or a real-world problem to solve. As the students attempt to solve the problem, interpret, analyze, they generate a need for facts, rules, procedures, and guiding principles.

The theories are taught – or the students are helped to discover them – after the need to know them has been established
Engineering working process: define and solve problems, design solutions

We construct our knowledge through experiences we have and learn to use it
Flexible Learning and E-learning

Open university, distance learning

Student control and take responsibility for: when, where and how to work with the course:

- Supports different styles of learning
- Supports different styles of living
- Uses teaching methods and media most useful for the students - especially e-learning: Use of computer based tools

www.toolbox.llab.dtu.dk
Online massive courses
Feedback on teaching

3xC: Constructive, Caring, Concrete

“You are the worst teacher on campus”

“I cannot concentrate when you show so many slides and speak for a long time”

- Feedback persons
- Quiz, test
- Midterm evaluation
- Peer-coaching for your teaching
- Final evaluation and its presentation (Exam: what they **CAN**, what did they learn)
- Reflection: What to preserve, what to improve
A small toolbox

- Quiz questions (e.g. finding errors, challenge their own ideas)
- Paired discussions
- Poster presentation
- Online tools: TED talks, YouTube, Gapminder, EPA, WHO, CDC
Knowledge, skills and competences:

- At the highest international level within the research field
- Must have made a significant contribution to the research field
- Must be able to participate in international discussions
- Must be able under supervision to start up and develop national and international collaboration on research and development
- External research stay
- Rigorous application procedure, minimal dropout

Salary: 25 000 – 28 000 DKK per month (3400 – 3800 Euro)

English: the only language - after B.Sc. Level

PhD thesis: 3-4 peer-reviewed articles
Declaration of the High Tatras

Editorial
Declaration of the High Tatras

The sixth international conference on Indoor Climate of Buildings was held in November 2007 in Štrbské Pleso, High Tatra Mountains, Slovakia. The conference is held every third year and organized by the Slovak University of Technology. The programme of the 2007 conference included a PhD student workshop tailored to address difficulties and problems encountered by PhD students during their studies. The PhD candidates participating in the workshop came from various countries including Slovakia, Czech Republic, Denmark, Sweden, Italy, France, Hungary, Japan and Poland. Board members representing the International Society of Indoor Air Quality (ISIAQ) and the International Academy of Indoor Air Sciences (IAIAS) took an active part in the discussions.

The workshop showed clearly that the form and length of PhD/doctoral studies vary from country to country. Within some countries it even varies from university to university. Obviously the workflow that the PhD candidate has to follow also varies, as do the obligations that he/she has to fulfill. The quality of the PhD work depends largely on these conditions and on the candidate himself/herself, as well as on the supervision.

The most important outcome of the meeting was that many doctoral students around the world have to face various kinds of obstacles, problems and limitations. The severity of such problems seems to be partly country-specific. It became clear from the discussion that the main problem for the students from universities in Slovakia, Czech Republic, Hungary, Poland and some Italian schools is insufficient financial support to cover research work, travel and living expenses. Inadequate language skills, lack of foreign contacts among the majority of the university staff and little research experience of supervisors were also addressed. A poor interpersonal relationship between the students and their supervisors was also pronounced in these countries.

Attendees at the workshop agreed that collaboration with foreign universities and extensive study periods at more prominent institutions may improve the quality of doctoral dissertations at poorly funded universities. However, in some of the countries, only a limited number of students are given such an opportunity. Moreover, even if the students undertake some part of their research work abroad, they face administrative obstacles that make an integrated PhD difficult.

The ISIAQ and IAIAS may be able to provide help for students via information services and various other activities. But local authorities in the relevant countries should take the initiative to change the current conditions which are unacceptable for many students undertaking a PhD study.

The following 'Declaration of the High Tatras on the Quality of PhD Studies and the PhD Students' Work Environment' was compiled based on contributions of the workshop participants at ICB 2007. The names of participants are listed in the 'Acknowledgments' section.

Declaration of the High Tatras on the Quality of PhD Studies and the PhD Students' Work Environment

1. Preparation for a PhD study on the BSc and MSc level requires changes in many countries. It is crucial to have a free choice of courses and more extensive contact with research work. Moreover, the number of MSc students at the university departments should not be lower than that which ensures beneficial high-quality collaboration between the staff and the students.

2. Clarification and communication of the purpose and message of doctoral studies is necessary. The driving force for a PhD study should be scientific rather than private, commercial or political.

3. Doctoral students have the right to work on research topics internationally relevant to their respective research field. The number of PhD students at a department should be determined on the basis of funding and project availability, rather than on the need for a teaching workforce.

4. The financial compensation should enable PhD students to work full-time on a project. Where applicable, the extremely high ratio of the time that PhD students spend on teaching and administrative work to that time that they spend on research should be reduced substantially.

5. Supervisors of PhD projects should support the PhD students’ rights and opportunities to collaborate closely with industry or foreign research institutions, to receive additional scientific supervision if needed and to participate in international conferences and study visits in order to broaden their contact network and future work opportunities.

6. The interpersonal relationship between PhD students and department staff/supervisors should demonstrate equality and be sufficiently informal in order to promote a good atmosphere, open communication and motivated collaboration. It should be understood that supervisors share responsibility for the quality of the PhD work.

7. Universities should fully support English as the language of dissertations. Publication activities should not be limited to compilation works and articles in local languages, but should aim for high-quality articles in reviewed journals. Universities should offer the opportunity to submit doctoral dissertations as compilations of peer-reviewed articles and should provide clear rules for students who decide to avail themselves of this opportunity.

8. Countries where the importance of indoor environmental quality is still not recognized should promote brain-drain and invest significantly more in young, skilled staff members and researchers with good language capabilities, international contacts, strong motivation for research and broad research experience obtained mainly abroad.

9. Universities currently not involved in research on the effects of indoor environmental quality on health, well-being and productivity of people should do their best to obtain research facilities, provide access to up-to-date scientific literature, initiate research projects and deliver high-quality research work.

10. More financial support should be available for research on the effects of indoor environmental quality at universities in countries currently having no research in this field.

Acknowledgments

We would like to thank the participants of the workshop for the lengthy and rich discussions and for their comments on the draft of the declaration. The participants were (see the picture, from left to right, starting from the top row): Ivan Baláž, Jakub Kolář, Angela Simon, Edie Barra, Malin Larsson, Erikn Bloom, Sylvain Courtois, Dalibor Haláš, Vit Kveder, Martin Hantík, Rune Andersen, Olejek Hojerg, Thorbjørn Gustavsson, Barbora Halušková, Michal Důlka, Pavel Wargocki (IAIAQ), Jan Sandell (IAIAQ), Dušan Petríček conference president, Vice-Rector for International Cooperation and Public Relations, Slovak University of Technology, Gabriela Brček (workshop organizer), Barbara Kolářík.

Gabriela Brček and Jakub Kolářík
1 Technical University of Denmark, Denmark
2 Silesian University of Technology, Poland
Air filtration, perceived air quality
Ventilation and air flow measurements and modeling
Exposure to pollutants
Health effects: Epidemiology, Public Health (allergy, asthma, CV function)
Chemicals, Biomarkers, Ultrafine Particles
My case
- Goal: Become better than your supervisor!
- Read Read Read….
- Final Thesis: 3-4 peer reviewed papers
- Course on ”How to write a scientific paper”
How to **READ** a scientific paper, report, PhD thesis!

Expert Readers:

1) Abstract: what is this all about?
2) References: did they read *my* papers?!
3) Acknowledgments: who paid for this?
4) Conclusions: what do they think they found?
5) Results: did they really find that?!
6) Methods: what did they do wrong?
7) Introduction, if at all
Wrong Title: "Thermal effects on performance"

1976: The effects of moderate heat stress on patients with ischemic heart disease
1996: The effects of moderate heat stress on driver vigilance in a moving vehicle
2002: Heat and noise distraction effects on performance in open offices

Note that all 3 of these articles deal with "Thermal effects on performance"
Author List

Who, in what order: rules exist – Vancouver Convention

Follow the instructions of the journal
1. Editor decides if the manuscript is within the scope of the Journal
2.

• Editor decides if the manuscript is worth reviewing
3.

- Editor selects two or more competent Reviewers in the field
4.

- Reviewers independently anonymously review the manuscript
5.

Each Reviewer recommends one of the following alternatives:

• Publish as is
• Publish with some recommended changes
• Publish only if specified changes are made
• Reject
6.

- Each Reviewer lists General and Specific comments
- General comments refer to content, approach, style, relevance, competence
- Specific comments identify errors. They are constructive suggestions for improvement
7.

- Reviewers send in their reports to the Editor
8.

- Editor makes a decision based on the Reviewers’ reports and informs the authors, enclosing the (anonymous) reports
9.

A revised manuscript is submitted, either:

1) With all the recommended changes, or...
2) With a reasoned reply to every one of the Reviewers’ comments, explaining respectfully why some of the changes should not be made, e.g. because the criticism was based on a misunderstanding, due to authors’ ambiguity, now corrected....
10.

• Editor resubmits the revised manuscript to those Reviewers who have specified mandatory changes
11.

- Reviewers decide whether the changes that have been made are acceptable and inform the Editor of their opinion
12.

- Editor accepts the final version of the paper and begins the editorial process

- or rejects the paper and returns it to the authors
13.

- Editor sends proof to the corresponding author for proof-reading and correction
Guiding Principles

• The review process: long and tedious
  Nothing is so good it cannot be improved, reviews: constructive criticism
• Many are called but few are chosen: 50+% rejection rate
• Several months to write, up to a year to appear in print
• Max 1-2 papers per year as first author
• About 1 million DKK per paper (100,000 - 140,000 Euro)
• Teamwork – 10-15 iterations before submission
4 CONCLUSIONS
The indoor environment in all of the three office buildings was generally in agreement with the requirements of current standards listed in international standards (EN 15 251, CEN CR 1752 and ISO 7730). Low-exergy systems represent a good way how to ensure heating and cooling in buildings with glass facade without significant risk of local thermal discomfort, draught, higher air velocity on some parts of the human body on the working places. The negative effect from the facade is good diverted with radiant panels and a thanks for higher surface temperature (one of the effects radiant heating) is indoor environment perceive subjective very well.

In frame of the especially in sum of the construct capillary pipes is CFD simulation because it fit with...
Phthalate and PAH concentrations in dust collected from Danish homes and daycare centers
Sara Langer1,3, James J. Wescott1,3, Andreas Fischer2,3, Gabriel Belô2,3, Jøn Toftum1, Geo Clausen1
1Department of Chemistry and Materials Technology, DTU Technical Research Institute of Denmark, 2730 Vojens, Denmark
2Technical Research Institute of Denmark, 2730 Vojens, Denmark
3International Centre for Indoor Environment and Energy, Department of Civil Engineering, University of Copenhagen, 2100 Copenhagen, Denmark
ABSTRACT

Phthalate and polycyclic aromatic hydrocarbons (PAHs) are among the most frequently measured indoor pollutants. For the purpose of this paper we consider them to be the most common organic compounds in indoor air. This is based on their widespread presence in household products as well as in cigarette smoke and cookstove exposure. The presence of these compounds in indoor air is dependent on sources, such as cigarette smoke, cookstove exposure, and occupational sources. Exposure to these compounds may lead to health effects such as cancer, respiratory disease, and neurodevelopmental effects.

Squalene and Cholesterol in Dust from Danish Homes and Daycare Centers
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3International Centre for Indoor Environment and Energy, Department of Civil Engineering, University of Copenhagen, 2100 Copenhagen, Denmark
ABSTRACT

Squalene and cholesterol concentrations in dust were measured in the literature. We present new data on squalene and cholesterol in dust from Danish homes and daycare centers. The concentrations of squalene and cholesterol in dust were significantly higher in daycare centers compared to homes.

Modeling ventilation rates in buildings based on occupant characteristics and behavior
Gabriel Belô1, Jøn Toftum, Geo Clausen
1International Centre for Indoor Environment and Energy, Department of Civil Engineering, University of Copenhagen, 2100 Copenhagen, Denmark
ABSTRACT

Assessment of the effects of ventilation rates on the indoor environment is fundamental for the design and operation of buildings. The indoor environment is influenced by a number of factors, such as outdoor conditions, building design, and occupant behavior. This study aimed to develop a model that predicts ventilation rates based on occupant characteristics and behavior.

The present paper explores the possibility of predicting the ventilation rate in homes. Further studies were limited to simplified models that considered only a limited number of parameters. More detailed models, such as those for different types of buildings and different climates, are needed to fully understand the complex interactions between ventilation rates and indoor conditions.

1. Introduction
The concentration of pollutants in the air is a balance between sources and sinks. Information about indoor sources can, to some extent, be obtained from data obtained from measurements or estimates. However, in many cases, ventilation is a major contributor to indoor concentrations. A key parameter in determining the concentrations of pollutants in the indoor environment is the ventilation rate. In this study, we developed a model that predicts ventilation rates based on occupant characteristics and behavior.
Get inspired!!

- Have the drive!
- Know what you want and dare to dream!
- Be international!
- Visit foreign universities, institutions!
- Don’t get scared away by practicalities!

SEEK INSPIRATION!
It’s so easy today – it’s all over the net!