0130

Soft Skills and Scientific Methods

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Module A: Efficient Learning - Working Methods

Attendant

Undergraduates in Humanity and Social Sciences, Mathematics, Statistics, Computing, and Environmental Science.

Key topics: *Communication Skills - Talking- Reading - Writing ...*

Disclaimer

This curriculum was adapted from:

- materials inspired from the Statistical, Mathematical, Economic and Environmental Perspectives, and
- notes created by Pr. Vu N. Duong, a VNU-HCM University of Technology & University of Science faculty member, for the course entitled *Methods and Models in Scientific Research*.

Time Distribution

Time Distribution: Theory + Discussion+ Practice, be respectively spanned in 15 + 9+ 18 h (in 7 weeks, each 6h; or in 14 weeks x 3h).

Practice: self-working in team, learning ways to effectively learn or to carry out specific case studies in universities or work places

Key references for Module A:

1. *Collapse- How have societies failed or succeeded*? Jared Diamond, 2005
2. *Applied Economic Issues in Malaysia*, University of Malaya Press, 2006
3. *Quality Planning, Control, and Improvement in Research and Development*, ed. George W. Roberts, Marcel Dekker Inc., 1995
4. *Five Equations That Changed The World*, Michael Guillen, 1995
5. *Tip Collection on how to survive in academic world*, Dianne Prost O'Leary, University of Minesota Duthlux (online texts)

Syllabus of Module A: Efficient Working Methods in 42 hours

Audiences: for year 1 students
Components: 3 parts.

Part I: Understanding of Learning Process- a background (6h)

Topic: Introduction to *Bloom Taxanomy*: 6 levels (follow ABET standard)
Key aim: to understand basic rules of learning and how to exploit it.

Part II: Soft Skills for University undergraduates (9h)

Aim: to train mordern workers with a set of soft skills, be vitally needed for their
future professional development, such as:
a/ Effective Communication Skills: effective talking, reading, writing ...
b/ Team working: how to join efforts to achieve the common goal?
c/ Oral Presentation: how to talk interestingly and convincingly to audiences?
d/ Technical Writing: how to write good structured reports with rich content?
e/ Other useful behaviors/ characteristics/ personalities:
- observable and/ or radical mind
- open mind and modesty
- patient and determination
- fidelity and keeping promises ...

Part III: Exercise for Self Practice and Presentation (18 h)

To practice items of a/– d/, form group of 3-4 students,
conducting 'how-to' projects, such as:

- How to brief the IT development in the past ten years in Vietnam? Provide your comments and suggestions.
- How to brief the education development in the past twenty years in Vietnam? Provide your comments and suggestions.
- Provide your comments and suggestions on the metropolitan development using concrete / scientific/ convincing/ sound / reasonable facts (say, in architecture and transportation aspects) in the past thirty years in HCMC-Hanoi or Vietnam...

Final Discussion of Module A (9h)

* Providing a concrete story to illustrate Item e/.
Example: from using historically well-known figures or from current life; or
* Developing Creativity by Lateral Thinking:
- Search in the falsified domains
- Negation of a norm or standard that has been accepted as an evidence
- Find a replacing solution to the negation.
Example: how to manage in a menu-less restaurant?

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Module B. Scientific Method [42 hour / semester]

Audiences: Second year students

Key topics: *Techniques and Models for effectively and scientifically doing things*; including Basic Data Analysis & Management

Time Distribution: Theory + Discussion+ Presentation

15 + 9 + 18 h (in 7 weeks, each 6h; or in 14 weeks x 3h).

Practice: self-working in team, learning ways to professionally solve practical problems in specific interest domains; expect to work up to 3h/ week

Module C. Scientific Research Method [42h/ semester]

Audiences: Third year students

Key topics: *Processes, Techniques and Models for successfully scientific researching or discovering*, including Experimental Designs and Modeling in various domains.

Time Distribution: Theory + Practice

24 + 18 h (in 7 weeks, each 6h; or in 14 weeks x 3h).

Practice: learning ways to successfully solve practical problems in science, engineering, technology, management or business; expect to work up to 3 hours / week on team project

Key references

To Module B:

1. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, John W. Creswell, Sage Publications Inc., 2nd edition, 2003
2. *Statistics for Environmental Engineers*, chapters 22-35, Paul Mac Berthouex and Linfield C. Brown, Lewis Publishers, CRC Press, 2002
3. *Practical Business Statistics*, chapters 1-11, Andrew F. Siegel, The Irwin Series in Quantitative Analysis for Business, Boston, 1990
4. *Statistics for the Bio-Sciences*, chapters 1-3, and chapter 9, William P. Gardiner, Prentice Hall Europe, 1997
5. *Handbook of Statistical Methods for Engineers and Scientists*, chapters 2-9, ed. Harrison M. Wadsworth, McGraw-Hill Inc., 1990

To Module C:

6. *Building a Successful Career in Scientific Research: A Guide*, Phil Dee, Cambridge University Press, 2006
7. *Mathematics For Economics and Finance: Methods and Modeling*, Martin Anthony and Noeman Biggs, Cambridge University Press, 7th edition, 2003
8. *Statistical Methods in Medical Research*, P. Armitage, G. Berry and J.N.S. Matthews, Blackwell Science, 4th edition, 2002

9. *Mathematical Modeling and Computer Simulation*, D. Maki and M. Thompson, Thomson Brooks/ Cole, 2006

10. *Quality Process, Advancing Performance Excellence*, American Society for Quality, articles in 2003

11. *Fundamentals of Statistics*, Lecture Notes, Steven G. Gilmour, School of Mathematical Sciences Queen Mary, University of London, 2006

12. *Interactive Operations Research with Maple*, Mahmut Parlar, Birkhouser 2000.

Syllabus of Module B: Scientific Method for modern workers

Audiences: for year 2 students.

Overall aim Ways for effectively and scientifically doing things

Course Objectives: After the course, students should be able to:

1. **Read and Synthesize** general scientific or technical articles
2. **Generate** interrogations from any observations
3. **Formulate** overall objectives and success criteria for an experimental evaluation project aiming at finding answers to the raised questions or hypothesis.

   [Note: Module A provides tools for objectives 1. to 3.]

4. **Develop**, as a three-person team, the strategy and tactics for the design of experiments and for the collection of experimental data
5. **Setup and run** the experiments and collect experimental data, and perform data analysis in the direction set out to achieve the above objectives
6. **Effectively communicate**, orally and in writing, the key aspects of the project, from the concept to the conclusion of the findings

Components: 4 parts

Part I: Guidelines to Problem Formulation Process (9h)

- Brief history of Science and Scientific Method with various illustrations

- Selecting a Research Topic or Problem- Literature search

  Steps in Conducting a Literature Review- using the Internet efficiently?

- Formulating a Problem- Goals and Elements of Research Plan

  Defining a Research Hypothesis

- Required Methods: Planning and Methodology

  Estimating Feasibility of an Investigation

- Conducting Research Process- Obtaining data, evidence and facts

- Analysing and Making Decision [see Part III on Data Analysis]

Part II: Discussion to choose practical case studies (6h)

- Using histogram to represent household size: the five-number summary

- How to know and analyze immigrant components in HCMC to decide suitable educational and cultural policies?

- How to measure brand loyalty/ fidelity of customers to your company/ products / services to decide suitable business actions?

- Making megacities or small but well-organized towns in developing nations, which one is economically approriate and ecologically friendly? Provide sound facts to support your idea...

Part III: Basic Data Analysis and Management (9h)

The aim: targeted to the above objectives 4. to 6.

- Introduce basic *Statistical Methods for Scientific Investigation*, applied to management, metropolitan planning, decision making in business administration, humanity and social matters.
- Emphasize on statistical estimation and basic inference.
- (Optional) Use of computers to apply statistical methods to problems encountered in management and economics.

Key topics: [see from Part I how to have dataset]

1. Organizing Data- use descriptive statistics
2. Sampling and making survey- Non-probability Sampling
3. Case Study Method
4. Exploring relationships in data
5. Drawing conclusions from data

Part IV: Exercise for Self Practice and Presentation (15 h)

The selected research topic in part II will be used as a mini-research topic at all stages of the course. Based on the outcome of Part III, form groups of 3-4 students [so max 10 groups to be formed] to

Discuss a research topic using lateral thinking approach,

Refine the topic though the problem formulation process (literature search, hypothesis definition) as an initial research idea that fulfills the originality criteria.

Carry out the investigation

Analyze, make decision or provide suggestions to the boss/ community

Finally, 3h to wrap up the course.

Syllabus of Module C: Scientific Research Method

Audiences: for year 3 students.

Overall aim Methods for professionally and successfully scientific researching or discovering things. In details, to train undergraduates with modern scientific methodology to have a successful career in R & D sector, and a useful citizen.

Course Objectives: Through theoretical lectures, classroom exercises and personal mini-research project, the course aims at introducing:

- The different characteristics of the *typical procedures and models* related to the selection and the execution of a scientific research topic.
- *The techniques* to help research students solving the practical problems often encountered in scientific research, typically:

  - Where am I? Where am I going? and How can I do / reach that?
- Develop *Scientific Spirit* through lectures about *history and philosophy* of sciences, and ethical aspect of scientific research as part of the Scientific Method.
- Practically, *how to write a sound research proposal and report*. Emphasizes on the so-called important details for a beginner in scientific research:

  Defining research subject- Writing research proposal

  Formulating or modeling the research problem

  Experimenting or demonstrating research analysis

  Writing reports and papers to scientific conferences

Key topics

I/ Warming up Review

a/ Distinguish 'method' and 'methodology'

b/ A pragmatic view: scientific research can be approached as problem solving:

Problem Definition, Hypothesis,

Approach for Solving Problem,

Experimentation and Feedback,

Conclusion

II/ Typical models. Categories of Research from distinct angles:

- Methodology: Empirical vs. Theoretical Research
- Applicability: Fundamental vs. Applied Research
- Locality: Academic vs. Industrial Research

III/ Typical procedures. Major phases of Research:

Collecting information (literature search)

Formulating research topic /hypotheses.

Conducting research (modelling, simulation, testing, collect and analyze results).

Writing reports, communicating results and problems.

IV/ The techniques.

- Research Methods

  Descriptive Methods: Observational Methods and Survey Methods

  Predictive Methods: Correlation Research - Quasi-Experimental Design

  Explanatory Methods:

Between-Participants Experimental Design

Correlated-Groups and Development Design

Advanced Experimental Designs

What else? [Qualitative Methods, Survey Methods, Experimental Method ...]

- Modeling & Simulation: useful techniques from Mathematics and Statistics

  Experimental Designs- Computationally Mathematical Modeling ...

- Analyzing - Synthesizing: make use the right and powerful tools ...
- Criticizing Results: must be evidence-based reasoning ...
- Scientific Report Writing- writing short but sound and reasonable- using suitable software ...

V/ Ethical Considerations in Research

Truth and Freedom

Responsibility

Collaboration

Professionalism

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