An IE Design Experience Reflecting upon Moral Development and Well-being

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Our Aims

• Foster student engagement with broader contexts that surround engineering design projects
  – Develop ethical values, sensibility, responsible well-being and social responsibility (Castro-Sitiriche, Papadopoulos, Frey, Santiago-Roman, & Jimenez, 2014)

• Engage stakeholders in developing problem statement through Participatory Action Research Methodology
Course Context

• Ergonomics & Methods Engineering
  – Junior year design project experience in coffee harvesting or processing
  • 45 IE students (22 females and 23 males)
  • Apply ergonomic methods and tools
Course & Project Methodology

• Core course (4-credit; 75 contact hours)
  – Laboratory and Design project
    • Proposal → Written report → Oral presentation → Poster

• Course outcomes
  1. application of design strategies for work systems design
  2. design of products, workstations and systems using data and design principles
  3. evaluation of the physiological requirements of a task
  4. identification of occupational risk factors
  5. evaluation, enhancement or design of work systems following ergonomic principles
Course & Project Methodology

Phase I - Participatory Action Research

Class
- Create mixed groups

3 Team Visits
- Guided group visit
- Get to know workers
- Understand task & process

Proposal
- Define project object.

Phase 2

2 visits
- Final Project Report

Phase 3

- Oral Pres.
- Survey

Gather data
- Propose recomm.
- Eval. impact
- Present Results

Student Reflection

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2017 ANNUAL CONFERENCE & EXPOSITION
Research Methodology

Post-Project questionnaire

| Open-ended questions about impact of project, insights from experience | Closed survey questions about skills and experience relevance |

Content analysis methodology

| Summarize responses into trends & common ideas | Quantify impact of experience & commonalities |

Theoretical alignment

| E. decision making & moral develop. skills | Capabilities approach | E. values of well-being, agency & justice |
Open Survey Questions

Impact & Experience

- IEs influence in society & Well-being
- Impact in Consumption & Well-being
- Personal & professional impact
- Skills, ideas & knowledge gained or reinforced
- New things learned
- Value of Experience
- Keys for success

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Closed Survey Questions

Skills & Value

Complement
Ethics
Social
Legal
Teamwork
Oral & Written Comm.
Real-World
Technical

5-Point Likert Scale
Completely Agree
Completely Disagree

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Results:
Project Experience

“The experience ... was excellent, as for the first time I have been able to apply my knowledge in a system different to Industry.” “The experience was completely new and interesting, without a doubt, I was able to observe and learn how IE is not only about industry, but it can also be applied in agriculture.”

“The experience was very pleasant; I have never been exposed to this environment ... in this area there is a need for lots of help...”
Results:
IE’s influence on Society & WB

• 30% perceived that IEs made an impact by creating safer working environments

“...compared with other engineering fields, within IE, well-being is one of the basic parameters considered when changes to a design, process or method is proposed.”

“As IEs we have the tools to enhance the quality of life, reducing risks and enhancing processes in all aspects...we have an instinct for improvement that needs to be present and be used for the well-being of others.”
Results: Consumption & Well-being

67% - WB as worker safety, comfort and reduced effort

49% - Project recommendations impact C & WB

47% - Work methods, tools & equipment

42% - C&WB as reduction of costs & wage increase

29% - Increased productivity & quality as a means to achieve WB
Results:
Personal & Professional Impact

• >40% students were more attuned with the reality of agricultural work & expressed:
  – increased knowledge about agriculture
  – empathy towards agricultural workers

“how difficult is the task of coffee collection, the low wages for agricultural workers, the need to interact and relate to others as part of the project, the sacrifices involved in agricultural work & admiration for others in this line of work”.

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Results: Personal & Professional Impact

- Better understanding of IE applications and techniques (44%)
Results: Skills, ideas & knowledge

• Gained or refined in the project
  – teamwork (47%)
  – communication skills (33%)
  – people skills (20%)
  – problem solving, critical thinking, creativity, time management, observation, & information skills (>10%)
  – values as relevant skills (>10%)
    • perseverance, responsibility, empathy, commitment & leadership
Results:
Keys for success

- 64% suggested teamwork as a key for success in the project

“fellowship, active listening, dedication, shared initiative, diverse personalities, assertiveness, support, creativity, positive attitude, availability, team effort, work ethic and shared work”.
Results:
Value of process & project

• Professional → gain experience in design process (40%)

“glimpse into the professional future”... “so that I can make a difference”
Results:
Closed Questions

Average Ratings

- Legal: 4.00
- Oral Com.: 4.28
- Teamwork: 4.42
- Ethical: 4.44
- Social: 4.49
- Written Com.: 4.60
- Complement: 4.67
- Real World: 4.71
- Technical: 4.73
## Results: Relationships

<table>
<thead>
<tr>
<th>Questions</th>
<th>Closed Survey</th>
<th>Results</th>
<th>Diff.</th>
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</thead>
<tbody>
<tr>
<td><strong>Open Ended</strong></td>
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<tr>
<td>Project experience</td>
<td>Complement</td>
<td>Open</td>
<td>93%</td>
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<tr>
<td></td>
<td></td>
<td>Closed</td>
<td>96%</td>
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<td>C-O</td>
<td>3%</td>
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<tr>
<td>IEs influence in society &amp; WB</td>
<td>Social</td>
<td>Open</td>
<td>49%</td>
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<td>Closed</td>
<td>89%</td>
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<td>40%</td>
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<tr>
<td>Impact in consumption &amp; WB</td>
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<td>67%</td>
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<td>C-O</td>
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<tr>
<td>Personal &amp; Professional impact</td>
<td>Technical</td>
<td>Open</td>
<td>44%</td>
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<td></td>
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<td>Closed</td>
<td>98%</td>
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<td>C-O</td>
<td>54%</td>
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<td>New things learned</td>
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<td>Open</td>
<td>44%</td>
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<td>C-O</td>
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<tr>
<td>Skills, ideas &amp; knowledge reinforced</td>
<td>Teamwork, Oral</td>
<td>Open</td>
<td>47%</td>
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<td></td>
<td>Comm., Written</td>
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<td>90%</td>
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<td>Comm., Real</td>
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<td>43%</td>
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<td>Keys for success</td>
<td>--</td>
<td>Open</td>
<td>64%</td>
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<td>Closed</td>
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<td>C-O</td>
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<tr>
<td>Value</td>
<td>Real World</td>
<td>Open</td>
<td>40%</td>
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<td></td>
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<td>Closed</td>
<td>98%</td>
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<td>C-O</td>
<td>58%</td>
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<td>Ethics</td>
<td>Open</td>
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<td>Closed</td>
<td>87%</td>
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<td></td>
<td>Legal</td>
<td>Open</td>
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<td>Closed</td>
<td>73%</td>
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<td>C-O</td>
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</table>
Proposed Model of Action

Pre-Project Reflection
- Perceptions
- Impact on Society & WB
- Expectations

Design Project
@ Real-world scenario

Post-Project Reflection & Discussion
Experiences, perceptions, how profession impact society & WB, personal & prof. impact, skill & knowledge gained/reinforced, valuation of learning, support sources
Discussion: Skills of Ethical Decision Making

Introspection develops capabilities that secure self-transcendence, generate meaning (Harris, 2015), and form a conception of their future career as IEs.

AWARENESS [87%]: “Fundamental IE knowledge, allows us to improve & ease the life of human beings within society in response to the challenges imposed by technology & environment.”

PREVENTION: Relationship between “worker safety, comfort, effort and risk reduction”

INTEGRATION: how recommendations and solutions to the problem would “support the actual work process, reducing waste and increasing product quality”; as “… solutions impact productivity with benefits to owner and worker, increasing production, impacting revenues and worker salary”.

VALUE REALIZATION: Enhancing “safety & health, improve environmental quality, find appropriate technologies & practices that realize better living conditions”; “the work system works like a domino effect; workers can [do their jobs] more effectively & without much risk to their well-being, then production rates increase, & ultimately the company is more prosperous”.
Discussion: Capabilities Approach

- Project results and recommendations influenced worker capabilities
  - bodily health and control over economic environments (Nussbaum, 2011)
  - physical and social capabilities (Harris, 2015)
Discussion: Social Justice

• Evidence towards design for “Community” and “Social Justice” (Leydens et al., 2014)
  – emphasizing the need to transform the current agricultural worker situation by removing obstacles, allowing for a better quality of life.

“Agriculture ... is vital for anyone, a nation, an island, or an individual, necessary for survival and independence but ... we take it for granted”

“...if the worker is injured there will be no workers available and without them, the services offered and products suffer. Our recommendations focus on worker comfort”
Conclusions: Participatory Research

- Participatory research (Neet & Neubert, 11):
  - reflect upon stakeholder benefits
  - create knowledge and awareness
  - opportunity for workers to participate creating alternative work methods
  - improved practices & livelihoods
Thanks!

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ADDITIONAL SLIDES
## Results: Survey Questions

<table>
<thead>
<tr>
<th>Questions</th>
<th>Content Analysis (*&gt;10%, **&gt;20%, ***&gt;30%, ****&gt;40%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project experience</td>
<td>“new experience”; “liked, pleased”; “different”; “challenging, difficult”; “satisfied, gratifying”; “good”; “interesting”</td>
</tr>
<tr>
<td>IEs influence in society &amp; well-being</td>
<td>Simplify, enhance, redesign effectively (designs, processes, procedures, work stations, equipment, production and services); efficiency, comfort, work-life; safer working environments; physical, mental and economic well-being and worker health; use of ergonomics, identification of muscular skeletal disorders and avoiding risks for injury; augment, maximizes, simplify or optimize productivity, cost, and efficiency; implement knowledge and methods learned as well as analysis techniques; improve facilitate quality of life of humans</td>
</tr>
<tr>
<td>Impact in consumption and well-being</td>
<td>Yes; Worker safety, comfort and well-being; Product cost and worker wages; Methods tools and equipment; Productivity and quality</td>
</tr>
</tbody>
</table>

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## Results: Survey Questions

<table>
<thead>
<tr>
<th>Questions</th>
<th>Content Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal and Professional impact</strong></td>
<td>Understand the challenges in the work****; first experience to apply knowledge*** working in a team**; communication skills**; problem solving*</td>
</tr>
<tr>
<td><strong>New things learned</strong></td>
<td>Implementation of knowledge, methods learned and analysis techniques****; coffee process****; communication with workers and team members*; challenges in agricultural work*; data collection and analysis*</td>
</tr>
<tr>
<td><strong>Skills, ideas and knowledge reinforced</strong></td>
<td>Teamwork and oral communication****; patience, interpersonal relations, intuition and empathy**; specific concepts and techniques presented in the course**; relevance of interviews*; critical thinking*</td>
</tr>
<tr>
<td><strong>Keys for success</strong></td>
<td>Teamwork****; instructor mentoring and laboratory activities*; responsibility*</td>
</tr>
<tr>
<td><strong>Value</strong></td>
<td>First experience with strong professional component****; understand diversity and importance of IEs in a work environment*</td>
</tr>
</tbody>
</table>
## Results:

**Closed Survey Questions**

<table>
<thead>
<tr>
<th>Closed survey statements</th>
<th>Positive</th>
<th>Neutral</th>
<th>Negative</th>
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<tbody>
<tr>
<td>(1) Technical skills</td>
<td>98%</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>(2) Teamwork skills</td>
<td>84%</td>
<td>13%</td>
<td>2%</td>
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<td>(3) Oral communications skills.</td>
<td>81%</td>
<td>19%</td>
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<tr>
<td>(4) Written communications skills</td>
<td>96%</td>
<td>4%</td>
<td>0%</td>
</tr>
<tr>
<td>(5) Ethical issues</td>
<td>87%</td>
<td>11%</td>
<td>2%</td>
</tr>
<tr>
<td>(6) Legal issues</td>
<td>73%</td>
<td>18%</td>
<td>9%</td>
</tr>
<tr>
<td>(7) Societal issues</td>
<td>89%</td>
<td>11%</td>
<td>0%</td>
</tr>
<tr>
<td>(8) Complement educational process</td>
<td>96%</td>
<td>4%</td>
<td>0%</td>
</tr>
<tr>
<td>(9) Real-world</td>
<td>98%</td>
<td>0%</td>
<td>2%</td>
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