Conveying meaning through shapes and lines: What practicing engineers can teach Higher Education (HE) about Information Literacy in g/local worksites

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Conveying meaning through shapes and lines
What practicing engineers can teach Higher Education (HE) about information literacy in g/local worksites

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September 25-26, 2015 - Coastal Georgia Center, Savannah, GA
September 25, 2015 - Room 1220 B - 2:45pm-4:00pm
We thank the many people that assisted us in recruiting participants for our study.

We gratefully acknowledge the following organizations for allowing us to conduct our studies on their premises and worksites: GAPRES, Gabinete de Projectos, Engenharia e Serviços, S.A. Gecolix - Gabinete de Estudos e Construções, Lda.
Background
● Central place of **visuals and visualization practices** in science and technology practices (e.g., Hutto 2007; Lemke 2004).

● **Human and contextual factors** diversify people’s abstract/cognitive and material practices (e.g., Kostelnick, 1995; Durão, Pinto, Henneke, & Balch, 2015):
  ○ Personal experiences (education, emotions, language…).
  ○ Cultures (educational systems, worldviews, color associations…).
  ○ Material contexts (technology, access to technology, technological literacy…).
The Project and the Study

**Topic:** Visualizing Science and Technology across Cultures.

**Project:** VISTAC – Science and Technology Visuals in Action project:

- **Pilot study:** VISTAC – Science and Technology Visuals in Action Engineering Pilot Study (May 2015 to date).

Research Questions

1. Understand when, where and how engineers use and produce science and technology visuals in their workplaces.

2. Interpret differences and similarities in science and technology visuals.

3. Understand how engineers produce and are informed by such visuals.
Questionnaire results
# Country Codes / No. Respondents

## Questionnaires Completed

<table>
<thead>
<tr>
<th>Country</th>
<th>Code</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greece</td>
<td>GRC</td>
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</tr>
<tr>
<td>Morocco</td>
<td>MAR</td>
<td>1</td>
</tr>
<tr>
<td>Portugal</td>
<td>PRT</td>
<td>2</td>
</tr>
<tr>
<td>Sweden</td>
<td>SWE</td>
<td>2</td>
</tr>
</tbody>
</table>

## Next Wave of Questionnaires

- MEX
- USA
- and others.

**Q 1. What is your current position?**

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>GRC-001**</td>
<td>Telecommunications Engineer.</td>
</tr>
<tr>
<td>GRC-002</td>
<td>Electrical Engineer/ Renewable Energy.</td>
</tr>
<tr>
<td>GRC-003</td>
<td>Mechanical Engineer/ Renewable Energy.</td>
</tr>
<tr>
<td>GRC-004</td>
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<tr>
<td>GRC-005</td>
<td>Responsible for Maintenance Department.</td>
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<tr>
<td>GRC-006</td>
<td>Mechanical Engineer/ Elevator Certification.</td>
</tr>
<tr>
<td>GRC-007</td>
<td>Mechanical Engineer/ Public Sector Employee.</td>
</tr>
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<td>GRC-008</td>
<td>Freelance Engineer.</td>
</tr>
<tr>
<td>MAR-001</td>
<td>General Manager.</td>
</tr>
<tr>
<td>PRT-001</td>
<td>Civil Engineer/ Construction Manager.</td>
</tr>
<tr>
<td>PRT-002</td>
<td>Senior Partner/ Structural Design Office.</td>
</tr>
<tr>
<td>SWE-001</td>
<td>Production Operator.</td>
</tr>
<tr>
<td>SWE-002</td>
<td>Operator.</td>
</tr>
</tbody>
</table>

** Participant number by country.**
Q 4. *In which countries have you worked and for how long did you work in each of them?*

- **Greece**: Greece, India (half year)***, Japan (2 months, 2 months).
- **Morocco**: Morocco, France (5 years).
- **Portugal**: Only Portugal.
- **Sweden**: Only Sweden.

*** Indication of time spent working in other countries, only.
Q 5. What age are you?

GRC  32, 35, 35, 39, 39, 44, 44, 48
MAR  39
PRT  43, 64
SWE  32, 47
Q 6. What academic degrees do you hold?

GRC  Electrical Engineering (diploma, bachelor’s); MBA & Electrical Engineering & Computer Engineering (diploma); Engineering (diploma); Mechanical Engineering (diploma, master’s); Technological Civil Engineering.

MAR  Engineering & Executive MBA.

PRT  Civil Engineering (bachelor’s).

SWE  Civil Engineering (minus last exam): Technical Upper Secondary School.
Q 7. **What professional training have you done that directly contributed to your current professional activities?**

Selected answers: seminars, certifications, other diplomas.
Visuals in Workplace 1

Results from Q 11a

Use of Visual Imaging While Thinking

GRC 4 of 8 use visual imaging often.
MAR Uses visual imaging often.
PRT 1 of 2 uses visual imaging often (other sometimes).
SWE 1 of 2 uses visual imaging sometimes (other rarely).
**Results from Q 11d**

Use of Visual Imaging While Creating Text

GRC  
4 of 8 use visual imaging often.

MAR  
Uses visual imaging rarely.

PRT  
1 of 2 uses visual imaging often (other sometimes).

SWE  
2 of 2 use visual imaging rarely.
Q 13. In what specific workplace situations do you find yourself most likely to use visuals?

**GRC**
training/study of new systems; creation of technical standards; presentation; reports; draft/project design; showing part/whole of completed building; visuals of accessory parts.

**MAR**
synthesis reports; exec. comm. presentation; preparing balance sheet of activities; balanced scorecard & dashboards.

**PRT**
when I need to explain where we need to apply a specific material; conceptual design/designing and detailing of structures.

**SWE**
layouts, visualization of flows/data; factory layout, quality problem (technical drawings).
Q 16. What percentage of your work involves using visuals in collaboration with people from other countries?

<table>
<thead>
<tr>
<th>Code</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRC-001</td>
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<tr>
<td>GRC-002</td>
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<tr>
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</tr>
<tr>
<td>GRC-006</td>
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</tr>
<tr>
<td>GRC-007</td>
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<tr>
<td>GRC-008</td>
<td>unanswered</td>
</tr>
<tr>
<td>MAR-001</td>
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</tr>
<tr>
<td>PRT-001</td>
<td>10%</td>
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<tr>
<td>PRT-002</td>
<td>15%</td>
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<tr>
<td>SWE-001</td>
<td>3%</td>
</tr>
<tr>
<td>SWE-002</td>
<td>1.5%</td>
</tr>
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</table>
Q 18. What do you produce visuals for?

GRC-001 understanding of technical (or other) subjects easier.
GRC-002 for presentations; project design; reports; enrichment of content.
GRC-003 enrich presentations; better understanding of results; easy procedure.
GRC-004 achievement of design as near as possible to the wished result.
GRC-005 for graphic visualization of information.
GRC-006 for recording/writing down.
GRC-007 for the understanding of the subject.
GRC-008 for understanding of the object/subject.
Q 18. What do you produce visuals for?

MAR-001  presentations; illustrations, etc.
PRT-001  design homes; determine the areas that require intervention.
PRT-002  Drawings and sketches in structural design projects.
         Photos and graphics in structural engineering consultancy.
SWE-001  To make flows visible, showing place of objects, showing changes over time.
SWE-002  To support assemblers. To standardize work procedures. Create factory layouts.
**Q 19. What percentage of the information you produce is conveyed through visuals?**

<table>
<thead>
<tr>
<th>Code</th>
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</tr>
</thead>
<tbody>
<tr>
<td>GRC-001</td>
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<tr>
<td>GRC-002</td>
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<td>GRC-003</td>
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<tr>
<td>SWE-002</td>
<td>50%</td>
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</table>
**Q 21. What percentage of your work involves producing visuals in collaboration with people from other countries?**

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<thead>
<tr>
<th>Code</th>
<th>Percentage</th>
</tr>
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<tr>
<td>GRC-002</td>
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<td>GRC-002</td>
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<td>GRC-004</td>
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<td>often</td>
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<tr>
<td>GRC-006</td>
<td>never</td>
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<tr>
<td>GRC-007</td>
<td>never</td>
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<tr>
<td>GRC-008</td>
<td>almost always</td>
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<tr>
<td>MAR-001</td>
<td>almost always</td>
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<tr>
<td>PRT-001</td>
<td>sometimes</td>
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<td>PRT-002</td>
<td>almost always</td>
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<tr>
<td>SWE-001</td>
<td>sometimes</td>
</tr>
<tr>
<td>SWE-002</td>
<td>often</td>
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</tbody>
</table>
Ethnographic shadowing study results
Civil engineer, project manager.


Reflexive interview: July 7. In a café opposite the construction site.

* To maintain the participants’ anonymity, all participant names are pseudonyms.
Visualization tools

**Hands** to point, measure, draw.
**Pencil** to draw and write.
**Tape measure** to measure.
**Leveling and alignment laser** to mark surfaces.
**Colored markers** to register progress.
**Cell phones** to send and receive documents and pictures; take pictures; view plans to verify information.
**Computers** to view plans, check layouts and measurements, do calculations, transfer pictures.
Visualization Process

1. **Analyze** (plans are the “major guide about where things are going to be” and the basis of modifications).

2. **Mold** (on site, starts “identifying the building with what we will actually be doing. We start to relate; here’s going to be a wall, here’s going to be a bathroom . . .“ “here we’ll need to dig, I need a machine, I might take a week”).

3. **Interiorize** (“this starts to be in my head” “sometimes with measurements, with numbers”).

4. **Embody** (“there’s a moment there when . . . it becomes the reality, that is, we have in our heads what will in reality be done”; plans only “for verification and to define measurements”).
Visuals
**Types**
- **photos**: “Making notes, otherwise it gets lost.”
- **sketches** on walls: palimpsests.
- **plans**: hardcopy and AutoCAD.

**Functions**
- **show** measurement, place, process, shape.
- **make** notes, describe, instruct, problem-solve.
- **verification**, **validation**.

**Creation**: individual or group events.

**Usage**: more at start of new project or task, with collaborators he know less well, in larger projects with more diversified hierarchy.

**Preparation** of project drawings before starting work.

**Reflect** evolving physical context, constraints, requirements, stakeholders interests, professional competence.

**Beware** of type visuals.
Senior partner at a structural design office.

Ethnographic shadowing: June 17-18, 2015.
At the company office in the outskirts of Lisbon.

Reflexive interview: July 13, 2015.
In the company office meeting room.

* To maintain the participants’ anonymity, all participant names are pseudonyms.
Visualization tools

**Hands** to point.

**Pencil** to draw, write and point.

**Colored markers** to color code documents.

**Sharpie markers** to annotate plans and point.

**Engineering scales** to measure and point.

**Computer** to view and send email, view charts, archive documentation.

**Camera** to take pictures.
Visualization Process

1. **Architectural objective** ("what the architect wants to execute").
2. **Reality** ("meditate taking into account what exists, that is, reality").
3. **Purpose of structure** ("to support the building and assure its safety").
4. **Imagining** ("I anticipate reality," “when I imagine, I try to imagine a 3-dimensional vision . . . try and visualize how things work in space,” “we need to imagine the building being constructed").
5. **Projecting** ("from there to concretize, normally here with paper and a pencil, to check whether it actually works on this level . . . if there isn’t a geometrical conflict with something that exists or with an objective of the architect").
Visu...
Types
- Highlights.
-Annotations.
- Graphics (along time, multivariate data…).
- Tables.
- Pictures.
- Plans.
- Digital 3-D designs.
- CD-Rom.
- Analogical versus digital images.
- Photos versus video.

And information
- Searching and selecting.
- Annotating.
- Organization (by stages, disciplines...).

And cultures
- Western(-speaking) vs. non-Western(-speaking) countries (translation, visuals).

And technology
- Advantages and limitations of design software.
Implications for HE Information Literacy
Rhetorical awareness: purpose, audiences (cultures), context.

Visualization: visualize in 2-D and 3-D.

Embodied cognition.

See visual production as ongoing individual and collaborative process.

Visuals as problem-solving tools.

Skills: information architecture, critical use of software (complement with visualization and paper and pen), photography and filming skills.
References


Thank you!

Rosário Durão
Kyle Mattson