BIM & Education –

Do we need a new teaching paradigm?

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Digital Architectural Design
Are we educating for the past or for the future?
Where does industry look for BIM education/training?

Who do you go to for BIM education/training?

- Universities & colleges: 10%
- Others: 90%

Source: Internal Report for BRE BIM Prospects 2016
Continuing Professional Development - CPD

- Large number of BIM CPD courses are provided by commercial companies, professional associations and universities
- Content and level are very diverse, from ½ day BIM introductions to long courses for specific professionals
Solving recruitment problems, medium-long term

Which of the following would help solve recruitment problems in the medium-long term? Please select all that apply.

- Apprenticeships: 31.1%
- Sandwich courses: 24.3%
- Undergraduate courses: 21.6%
- Post-graduate courses: 23.0%

Source: Internal Report for BRE BIM Prospects 2016
Some conclusions from the BRE report

• Education is clearly not producing the BIM skilled candidates needed by industry now. As BIM adoption accelerates, as it must to meet the government mandate, this situation will be exacerbated. **There has to be closer links between industry and academic institutions.** Requirements need to be defined and comprehensive courses developed.

• SMEs, who lack the funds to finance employee training, would greatly benefit from ‘BIM ready’ industry entrants.

Source: Internal Report for BRE BIM Prospects 2016
University BIM education

Focus must be in medium/long term; understanding the concepts and impacts, not in software training
Relatively easy task: Specialised BIM programmes
Challenge: Embedding BIM within the taught curriculum

• A report on embedding BIM within the taught curriculum supported by the Higher Education Academy is now published and available at https://www.heacademy.ac.uk/resource/embedding-building-information-modelling-bim-within-taught-curriculum
## BIM teaching impact matrix

<table>
<thead>
<tr>
<th>BIM Level</th>
<th>Absent</th>
<th>Aware</th>
<th>Infused</th>
<th>Embedded</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BIM descriptor</strong></td>
<td>BIM is a nice research area but should not affect what and how we teach. Our students do not need to know about BIM.</td>
<td>BIM is a nice research area but should not affect how we teach. Our students should be aware of BIM and how it might impact their future.</td>
<td>Students should understand how BIM will affect their future and have chance to learn BIM in a discipline &amp; multi-disciplinary context.</td>
<td>BIM is so important it should become the 'vehicle' for our students’ learning experience. Teaching should enabled by the BIM model.</td>
</tr>
<tr>
<td><strong>Curriculum</strong></td>
<td>No change</td>
<td>Key modules are identified and BIM knowledge incorporated.</td>
<td>Target modules identified for a BIM review. BIM impact identified in all areas of the curriculum but BIM use restricted to a few.</td>
<td>Full curriculum review to allow every module to identify changes required for delivery through a BIM model.</td>
</tr>
<tr>
<td><strong>Structure</strong></td>
<td>No change</td>
<td>No change</td>
<td>Structural review needed but impact on current structure likely to be minimal.</td>
<td>A complete review of structure to enable the BIM model to be the driver/vehicle for learning.</td>
</tr>
<tr>
<td><strong>Staff</strong></td>
<td>No change</td>
<td>Staff in the key modules will need an understanding of BIM and how it impacts of industry.</td>
<td>All staff require knowledge of BIM and how it is impacting industry. Some staff need full competence in use of BIM.</td>
<td>All staff would need to be fully competent in the use of BIM and understand how BIM is impacting on the industry.</td>
</tr>
<tr>
<td><strong>Infrastructure</strong></td>
<td>No change</td>
<td>No change</td>
<td>Significant investment required. BIM labs needed and some delivery space suitable for BIM enabled learning.</td>
<td>Significant investment in infrastructure required. BIM labs and delivery space sufficient for BIM being the learning vehicle.</td>
</tr>
<tr>
<td><strong>Curriculum - Research gap</strong></td>
<td>Can be large</td>
<td>No change</td>
<td>Has to be small in some areas but with some flexibility.</td>
<td>Has to be small for all areas of the curriculum. Genuine integrated direction between research and curriculum/ delivery.</td>
</tr>
</tbody>
</table>

Source: BIM Academic Forum (UK 2013): “Embedding BIM within the taught curriculum"
Changing or replacing existing modules is difficult

- Changing existing curricula can be a very difficult and time consuming process
- Existing curricula are full of topics, there is simply no space for additional issues
  - What can be left out?
  - Extremely strong resistance from everyone whose expertise area’s relevance is questioned
“It will not slice a pineapple”

• “Propose to any Englishman* any principle, or any instrument, however admirable, and you will observe that the whole effort of the English mind is directed to find a difficulty, a defect, or an impossibility in it.

• If you speak to him of a machine for peeling a potato, he will pronounce it impossible: if you peel a potato with it before his eyes, he will declare it useless, because it will not slice a pineapple.

• Impart the same principle or show the same machine to an American, and you will observe that the whole effort of his mind is to find some new application of the principle, some new use for the instrument.”

Charles Babbage, 1852

*In the context of my presentation this is not an English feature, but typical for the AECOO industry

Many people try to invent excuses why not accept changes – such as BIM – but the real reason is that they do not want to change!
Processes and collaboration?
Main benefits require collaboration

- Average savings in change orders 15.74% 
- Annual value of global construction is **USD 8.5 trillion** (2015 estimate) 
- 15.74% = **USD 1.3 trillion** 
- Annual growth ~4%

A study by J.C. Cannistraro of 408 projects Valued at $559 million shows how, in the big picture, BIM saves money as the team gets more collaborative.

Need to analyse and re-think the data flows

- Phases
- Tasks
- Problems
  - process
  - skills
  - technology

80% human issues
20% technology

Do we understand the future processes? If not, how can we teach our students?
The real questions are:
- What do I need to do my job?
- What do others need from me to do theirs?
Data sharing does not replace collaboration
Silos and blinkers

• Standardised roles, but at the same time poor understanding of the information flows and needs in the process
Strong domain specific views, lack of holistic view

Blind Monks Examining an Elephant
Problematic dependencies and timing

• In real projects there are a lot of dependencies between different disciplines, and in the integrated BIM environment it is crucial to understand how these affect the workflow.

• However, having the real dependencies in education is very problematic. If one student does not deliver on time or the quality is not sufficient, we cannot punish other students because the bad marks would be a burden for the rest of their career, not just in that one project. How to simulate the dependencies without negative effects?

• In addition, what is the right stage to teach collaboration? How much the students have to know about their own discipline before learning their role in the team?

  • According to Pihlak et al (2011) the collaboration across different disciplines was productive when designers were strong and confident. Too much compromise led to less than optimal design solutions.
An additional challenge in teaching integrated BIM: Different levels of understanding and interest
Interest in BIM by discipline

Figure 6: BIM representation levels according to disciplines.

Communication?
Why do we need drawings?

- In paper-based environment drawings were the best way to communicate the building design.
- However, technical drawings are very high level abstraction of our 3D world and not easy to read for non-professionals – and even for professionals it is not easy to build a complex 3D space by reading drawings.
Document centric process = incoherent documents, different views and different abilities to understand.
Better communication and shared understanding

[Diagram of various activities related to construction and communication]

Image courtesy Granlund
Media & thinking?
Media affects our thinking

Design by experience - physical models

Manual drafting and tracing, highly illustrative drawings

Drawings required for building permit (in Finland)

Manual drafting, copying machines, simplified/abstract representation

Early CAD = automated drafting

Back to the illustrative representation

Integrated BIM

Modelling

Interoperability

Simulation

Collaboration platforms

Virtual prototyping

1775 1900 1985 2000 2010
Architectural education is still often based on drafting and other traditional documents

- Most teachers are experts in 2D drafting, some in 3D modelling, but relatively few in BIM
  - Lot of friction, in worst case active resistance in moving to 3D
  - Sketching is still a relevant skill, but how long do we need manual drafting, or even 2D drawings?
Learning the visual language

- Designers do not just learn to make drawings; they learn to think through drawings (Daniel Fällman 2003)
  - Unlearning is a painful effort; when learning a new media a design expert becomes a novice
    - Focus shifts from content to the tool
    - Significant loss of efficiency and creativity until the new media becomes an integral part of the designer’s mind-set

- Older generation cannot avoid that, but why are we forcing our students to go through that pain?
The young generation has grown up with 3D software...
...even school kids can easily learn how to use BIM

School of the Future Competition 2012
Are we teaching issues in the right order?

Often we forced students first into 2D and allow 3D only later.
Are we teaching issues in the right order?

Should we teach 3D first and then how to generate 2D views from the models?
Does BIM limit our creativity?
Robotics, 3D printing... impacts of digital production?
In the nature material is expensive and shape is free.
In the nature material is expensive and shape is free.

In the traditional construction shape is expensive and material is cheap.

Inspired by Prof Julian Vincent’s Biomimetics
In the nature material is expensive and shape is free. In the traditional construction shape is expensive and material is cheap. It is likely that in the future shape will be cheap and material expensive. Printing complex forms is not a problem!

Inspired by Prof Julian Vincent’s Biomimetics