Is education responding to the challenge of BIM adoption in the industry?

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Are we educating for the past or for the future?

How can we get talented people interested in working in the AEC industry?
Need for a new teaching paradigm
<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"
Key findings of BIM Academic Forum (UK 2013)

- Up-skilling of staff in the academia
- Student employability
- Framework for learning
  - Needs at each learning stage include:
    - providing wider industry context and background relating to the introduction and implementation of BIM in the first stages of study;
    - greater collaboration across the disciplines; use and adoption of the technology;
    - realising the impact on project/business structures, communications and behaviours.
  - Learning requirements can be categorised by/as:
    - knowledge and understanding;
    - practical skills;
    - transferable skills.
- Keeping pace with BIM development in IT and industry


Source: BIM Academic Forum (UK 2013): “Embedding BIM within the taught curriculum“
How will BIM affect architectural education?

- How to integrate something (BIM) that is not yet theoretically or practically complete into an educational system, which is historically based on established theoretical and discursive models?

- Can creative artistic expression co-exist with collaborative practice?
- Can we retain our professional values?

- How do we address the emerging knowledge, roles and profiles for architects through effective provisions of the curriculum and delivery methods?

Source: Tuba Kocaturk & Arto Kiviniemi in eCAADe 2013: "Challenges of Integrating BIM in Architectural Education"
"Add & Stir" approach

Disintegrated from the rest of the curriculum
Contradicting with existing educational content
Disproportional emphasis on software
No clear pedagogical agenda

Source: Tuba Kocaturk & Arto Kiviniemi in eCAADe 2013: "Challenges of Integrating BIM in Architectural Education"
The pedagogical challenges are not only about BIM, but a bigger scale of impact of ICT and digital media on design education.

Source: Tuba Kocaturk & Arto Kiviniemi in eCAADe 2013: "Challenges of Integrating BIM in Architectural Education"
Gradual & Transformational integration

**Epistemological** *(what we know)*: Theory of design knowledge; its methods, validity and scope

**Cognitive** *(how we understand and learn)*: Impact of socio-technical scaffolding on design cognition

**Pedagogical** *(how we teach)*: Developing conceptual knowledge and managing the content of learning activities
Collaborative working

Cultural, social and technical issues

Appreciation of the differences between individual, collaborative and team work

Modelling & representation

Shift focus from drawings towards Building Intelligent Models

Creative & Operational & Purpose built

Understand the underlying concepts of creative, operational and purpose-built modelling and the required degree of abstraction, clarity and precision

Source: Tuba Kocaturk & Arto Kiviniemi in eCAADe 2013: "Challenges of Integrating BIM in Architectural Education"
### Cognitive effects of technologies

<table>
<thead>
<tr>
<th>Effects of technology</th>
<th>Effects with technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metacognition, residue left by thinking and reflection</td>
<td>Situated, artifact mediated activity, focus on context</td>
</tr>
<tr>
<td>Autonomous, self directed activity</td>
<td>Social and technical scaffolding</td>
</tr>
<tr>
<td>Individual cognition / solo intelligence</td>
<td>Distributed cognition</td>
</tr>
<tr>
<td>Contribution to the design of distributed intelligence</td>
<td>Being a part of the socially distributed intelligence</td>
</tr>
<tr>
<td>Higher order knowledge, problem solving, executive skills</td>
<td>Content level knowledge – facts &amp; procedures</td>
</tr>
</tbody>
</table>

Architectural education should support both autonomous and distributed learning

Guiding, organising and curating learning experience

Source: Tuba Kocaturk & Arto Kiviniemi in eCAADe 2013: "Challenges of Integrating BIM in Architectural Education"
What do we have to consider?
Some practical observations
Accreditation requirements?

- Many of the construction related programmes are accredited either on national or sometimes even on multinational level
  - E.g. requirements for architectural education are standardised on European level, but use of BIM is on very different levels in different countries ⇒ difficult to agree about any changes.

- Required content is often quite generic, but the interpretation of requirements can be very strict
  - Accreditation bodies can be conservative and protective about their own status and/or old paradigms. **Do they have sufficient understanding and knowledge of BIM?**
  - There are many traditional and mandatory topics in the curricula; **what can we leave out** without endangering the necessary skills or accreditation of our programmes?
Need to analyse and re-think the data flows

Do we understand the future processes?
If not, how can we teach our students?
Collaboration is a key issue, but how to teach it?

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.

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.
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

- Curricula are full of topics, there is no space for additional issues
  - What can be left out?

- Developing new or changing existing curricula can be a very difficult and time consuming process
Are we teaching issues in the right order?

Today’s children are very competent in 3D, but we force them first into 2D and teach 3D only later.
Are we teaching issues in the right order?

Shouldn’t we teach 3D first and then how to generate 2D views from the models?
Emerging technologies

How long do we really need drawings?
Augmented reality, portable & wearable computers

Google Glasses use an automatic connection to the cloud to provide access to enormous amounts of information, data and applications...

Robots in production
We are starting to 3D print houses

A couple of months ago, Dutch architect Janjaap Ruijssenaars announced that he was building a curvy, loopy and for some reason, largely see-through building, to be made with the help of Enrico Dini’s D-Shape 3D printer. The project would cost up to 5 million euros and be completed in 2014. http://www.sciencegymnasium.com/2013/04/architects-starting-to-3d-print.html

Janjaap Ruijssenaars’s twisty, loopy 3D-printed building. Universe Architecture
Conclusions

- We have to analyse our processes and **identify the valuable core** of the different professions and separate it from “old rubbish”.
- Instead of traditional documents we must bring into our education system new issues, such as lifecycle information management, enhanced communication and collaboration, and other possibilities of the modern technology.
"Man cannot discover new oceans unless he has the courage to lose sight of the shore" - Andre Gide