The Spirit of Invention in CS Education

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1938
Enthusiasm needed!

- Access to materials, examples, pathways to learning
- A place to work; individually, teams, with clients, presenting, testing...
- Collaborate across engineering
- Solve for requirements
- Aware of history and methods of prior art (previously known as a library)
Rise of PBL activities in CS learning

- Maturity in PBL approaches
- Scenario Weeks – case studies
- IXN projects
- Coding Curriculum
- IEP activities
- Robot Racing and others.
CS Curriculum Design 90’s to 10’s

- Transition from “Java Houses” to technology agnostic
- Requirements come first
- Lab refreshes, doing things differently
- More opportunities given, complexity in support rising
- Scalability in teaching is now a priority for class sizes
SDI Methodology

• Restructuring syllabus in line with a constructionist view, in three phases

1. **Scaffolding** – linear problem solving and learning the rules/approaches

2. **Discovery** – open or guided, non-linear PBL with exploration to solve requirements

3. **Innovation** – Identification of optimal solutions from scaffolding and discovery

Intent: raising an inventive trait in CS learning
Proof of Concept (PoC) ethos
Scaffolding approaches

- New ways to teaching base principles of programming in labs with exercises
- Reflective Practice with mid-term MCQs
- In class buzzers / flipped classes
- Recovery Classes booked in advance for weaker students
- SEAT – assessing capabilities as classes progress
• Scaffolding has to lead into more open learning pathways.

• *If you understand something in only one way, then you don't really understand it at all. The secret of what anything means to us depends on how we've connected it to all other things we know. Well-connected representations let you turn ideas around in your mind, to envision things from many perspectives until you find one that works for you. And that's what we mean by thinking!*  

• Marvin Minsky -“Turtle” (AI, MIT lab)
Discovery approaches

• Proving you can find alternate good, bad and better (near optimal) solutions, through experiments and exploration of materials – the research ethos.
• Discovery can mean guided or open, means different things – shared knowledge domains
• Projects Projects and more Projects! Client experiences brought to CS education, different views.
• Open playing field, iterative design through experiences to become knowledgeable.
Discovery - Inclusion

- What can students do to improve inclusion in distribution of team project workload? A student's effort on their task is not reflected in their output. 100 points system, greenlights system.

- Integrative work packages enabling teams with motivations and systems integration by requirements and design, not afterthought.

- VSTS Discovery toolkit – sharing workload, VSTS Portfolio Generator – identifying individual contributions, VSTS Meeting Scheduler to handle meetings, taking minutes and tracking past meetings.
## Marking Guidelines

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<tr>
<th>Percentage</th>
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<tr>
<td>90-100%</td>
<td>Perfect</td>
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<td>80-90%</td>
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<td>50-60%</td>
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- **90-100% Perfect**
  - Report and talk exceed best professional standards
  - Evidence of considerable extra-curricular reading and original interpretation
  - Innovative ideas and substantial high-quality deliverables
  - Close to faultless in execution and write-up

- **80-90% Outstanding**
  - Report and talk are of the best professional standards
  - Evidence of extra-curricular academic reading, critical thought and original interpretation
  - Excellent architectural decisions with substantial high-quality deliverables
  - Only very minor faults in execution, depth of understanding or write-up

- **70-80% Excellent**
  - Very well written report with logical structure
  - Demonstration of critical thought, understanding and extra-curricular reading
  - Good architecture and substantial deliverables
  - Some minor faults in execution or understanding

- **60-70% Good**
  - Clear project-write up with logical structure
  - Evidence of understanding, and at least some evidence of extra-reading and critical thought
  - Good architecture and deliverables but not substantial enough to warrant distinction mark
  - May contain some ambiguities or faults

- **50-60% Satisfactory**
  - Adequate report, lacking clarity or detail in places, or containing irrelevant material
  - Mostly demonstrates understanding, but with occasional mistakes of judgment
  - Deliverables not particularly ambitious, or not entirely completed
  - Lacks particular reading or original thought
Innovation

• Issue for academics and universities!
• What do we provide as support to enable this?
• Did we give the full opportunity for these to be acquired?
Innovation Approaches

- How to better reveal, compare and reflect on student innovations
- Students publishing is rising – good thing!
- Academic often faced with the challenge of overseeing many projects at a time
- Problem for project management and assessment, pressure on students to achieve is comparatively high.
- VSTS Innoflow - projects inform transitions in requirements to supervisors, support feedback and comparison with other projects.
- Generating metrics as a means of assessment and self-improvement.
- *This is a complex issue to be discussed further.*
Improvements

• Syllabus inspections now due!
• Reduce fiction in problem domains, how many opportunities for recovery, for innovation?
• “John will love Mary”, find the opportunities that will make the best progress based on student motivations
• Benchmarks need to be designed
• In class ranking tables may/may not be effective
• Adopt and refine Scaffolding, Discovery and Innovation approaches
• Validate with externals whilst in progress and when exiting from courses
• Compare with other universities
Summary

Many untapped aspects of CS teaching can raise motivation through inventive behaviour.

The spirit of invention needed to make change is neither gifted to a student nor taught; it has to be sought after.

HP and other garage inventors did not need marks to make the difference...