Inspiring Undergraduates to High Achievement in STEM (and other) Subjects

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My Journey

- See [http://tinyurl.com/zsdx66s](http://tinyurl.com/zsdx66s) for more information
Agenda

- Context
- Current Issues for STEM (and other) subjects
- Pedagogy?
- Thoughts and Questions?
- Discussion
Context

- Students demand engaging approaches
- Employers demand soft skills
- Traditional education
  - Is boring
  - Fails to deliver good soft skills
  - Mediocre levels of achievement
- Very rapid change in software products
  - High stress levels
Analytics Skills

Addressing the Issues

- Need for
  - Enthusiastic students
  - Total engagement
  - Excellence in achievement
  - Outstanding soft skills for
    - Employment
    - Life-long learning
Pedagogic Philosophies

- Academic as
  - “Domain Expert”
    - Knows it all
    - Teaches domain facts, theories, software details
  - or
  - “Learning-to-Learn Expert”
    - Guides and mentors the learning process
    - “Teaches” how to learn, questions, where to find answers
Philosophy

“Education is not filling (leaky) buckets but lighting fires (of enthusiasm)” (Plutarch, modified)

Guided Learning

- No formal software teaching
- Provide access to software, manuals, training materials, CBT tests
- Provide big challenges
- Students as co-producers
Traditional Approach

- **Lectures**
  - Describe syntax and grammar
  - Use cases
  - Worked examples

- **Workshops and Tutorials**
  - Lots of Exercises
  - Tutor as problem solver, often with answers

- **Assessments**
  - Tightly defined task
  - Demonstrations / Code inspections, etc.
All too Familiar?

Thus, for any nondeterministic Turing machine \( M \) that runs in some polynomial time \( p(m) \), we can devise an algorithm that takes an input \( \omega \) of length \( n \) and produces \( E_{M,\omega} \). The running time is \( O(p^2(m)) \) on a multitape deterministic Turing machine and...

WTF, man. I just wanted to learn how to program video games.

\[ N = N_n \]

Sipser CH7

\[ N_n = (A_n \cup B_n) \cup (A_n \cup B_{n-1}) \cup \ldots \cup A_n \]
“New” Approach

- Lectures
  - Outline of capabilities and purpose of software
  - Student presentations of their learning

- Workshops
  - Explore and learn the language capabilities
  - Apply new knowledge
  - Learn and use sources of technical “how to do”
  - More questions, very few answers

- Assessment
  - Big challenge
  - Presentations of critical reflection and insights
Emerging IT Product Developments (1)

- Learn IBM Bluemix and Watson Analytics
  - IBM staff present Tutorials

- Data Analytics challenge
  - Find open source data
  - Identify interesting / valuable questions
  - Develop valuable insights
Emerging IT Product Developments (2)

- Research based Article (40%)
  - A critical evaluation of the topic “Big Data Analytics and the Internet of Things: Technology and Data Integration to develop Smart Insights”

- Reflective critical evaluation of the challenge as a 15 minute PowerPoint with voice over (60%)
  - Requirements, development, implementation and insights

- See http://tinyurl.com/h7pjv2u for best 4
Student Reflections

- “Your approach to teaching is nothing short of refreshing; not only is it inspiring but also encourages creativity and novel thinking (an important aspect of education that I often find is overlooked)”

- “This approach to teaching enables me to easily become motivated, but what’s more, I now feel like I am making a genuine impact in the field”
Student Reflections

- “The assignments that Richard sets are very broad with room for interpretation. The broadness of the question allows students to make the assignment their own; taking the topic and running with it”
- “Something that I value a lot is that finding novel ideas for our assignments is constantly encouraged”
- “This leads to a grand spectrum of findings, with the best assignments getting the opportunity to be published”
Student Reflections

- Richard reviews and gives us formative feedback on our assignments allowing us to improve not only our assignments but also our understanding of the topic at hand.
Thoughts and Questions

- Use of Contact time
- Meeting student where they are
- Formative feedback
- “Robust” assessment criteria
- Learning Analytics for confirmation