The research teaching nexus in the computing disciplines: a comparative study

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Many institutions make claims in strategy documents and official publications that students will receive an education which is research-led, research-informed, or guided by the scholarship of teaching and learning. Academics who teach regularly experience at first-hand the sometimes conflicting demands of research, teaching and supporting learning. Curricula guidelines are unlikely to help in developing any sophisticated understanding of ways in which research and teaching can be symbiotically applied, since such guidelines most typically deal with the content rather than the educational process experienced by our undergraduates. For these reasons an academic’s understanding of the research teaching nexus is more likely to be informed by their own workaday experience of designing and delivering educational experiences than from an analysis of the students’ perspective. If academics in the computing disciplines are to effectively deliver on their institutional missions to be scholarly, research-led or research-informed in their educational approaches, a clearer understanding of the possible meanings and implications of these terms in the context of the typical computing curricula would be of assistance. This paper presents and analyses the results of a survey conducted at two Universities which sought to identify how far their undergraduate curriculum was informed by research. This data is presented alongside qualitative data gathered from academics which explores their attitudes towards, and understanding of, the various terms commonly used to describe a research-informed approach to education in the computing disciplines.
Shape of this talk

1 – The Motivations
2 - Background
3 – Findings and Analysis
4 - Conclusions

Plan for the order of presentation
Motivations – why we are motivated to be interested in this
Background – previous work
Method, Findings and analysis
Conclusions, discussion and future work

Collaborate and compare

Distant universities. Also quite different
Soton – research intensive, CS, SE
Northumbria – Forensic Computing, Games Computing, Business Computing, some part time
We all have students
And – relationship between R&T is on the agenda for both (soton and Northumbria)
Also on the agenda for every institution
But I believe the relationship between R&T is of interest to all in our discipline
Half life of information, information age mindset, and ref back to Humboldt

Carnegie foundation, debate over the future of University education – with which we can see parallels to the arguments so current in SIGCSE and CPHC and ? European fora about the future of our discipline – requirements of agaility, nature of graduates, how to retain etc
Enter politics and educationalists in the UK??
Community concerned with the scholarship of teaching and learning
Many universities are not research intensive
Many university teachers are not active researchers
Some feel that the Boyer perspective draws people towards a simplistic model
where the relationship between research and teaching is typified by I research, I
teach my specialism and I supervise project students, so my teaching is research
led
Maybe this has something to do with the nature of our discipline

Put the models side by side they are quite different.
Tried to do matrix but not yet completed my thinking (aside) – matrix will feature
in journal version of paper alongside additional data
cf – Kolb and bloom
1 concrete experiences
2 observation and reflection
3 forming abstract concepts
4 testing in new situations
Tutored, based, led, oriented
Fours scholarships
The R&T nexus as it is experienced
Stakeholders and agendas are also an issue
Learning is both formal and informal -> life long learning, and back to information half life, and the net generation, millennial generation
GenX GenY,

Think about the affordances of the means of instructions
What we can do, and how we can teach will be constrained/enabled by the space
Also, although we mostly consider education from the perspective of the cognitive domain (bloom’s taxonomy) we need to remember that there are components of our UG teaching which operate in other domains, affective and psychomotor (crude definitions of attitudes – what it is like to think as an engineer/computer scientist) and psychomotor – who to manage a computer environment -> relates to disciplinary demands and field of study
Iterative refinement of understanding, training>education
Aims and views...

This course aims to develop critical thinking, effective working within teams, peer-learning and discussion, and individual responsibility as these are transferable skills that are essential within a highly competent technologist, computer scientist, software engineer or researcher.

“Artificial Intelligence, for the philosophy of AI part, I give students directed reading, which then forms part of their expected background knowledge for the examination. Sometimes the required reading is classic stuff, like Turing’s 1950 paper in Mind, but sometimes it is up-to-the-minute commentary, and so could be counted as ‘research’.”

How do you relate teaching and research? Is your teaching: research tutored, research led, research oriented, research based?

More views

“The lecturers, xxx in particular, is able to explore the concepts with clarity and make the content interesting by displaying a genuine passion for the subject.”

The colleague concerned commented

“I believe this reflects my deliberate use of research related material/knowledge…”

Something about the method

Surveyed two departments

Examined the curriculum, module descriptions, stated aims and outcomes

On a larger scale study might be possible (?) to quantify, although there is a gap between formal description and what actually happens in the class

Surveyed colleagues to ask them what they considered to be Research tutored, research led, research oriented, research based

Active researchers tended to relate things back to How they research, what matters to them as researchers, classroom techniques they are proud of

Ref – my freshman year
Many examples were necessarily left out

2.1 First year
Typically modules are concerned with establishing the basics. Teaching approaches include large lecture classes, with laboratories to learn, practice and master programming. Students may be given problems to solve but they are typically expected to use this stage of their education to master basic skills. However it is possible to view lab work as an introduction to working as an engineer, since students are receiving instruction in a format which is designed (for them) to work towards attaining unknown outcomes. On many degrees there is an element of undergraduates learning how to become team players, scientists/software engineers, and part of that education is learning how to think like a computer scientist/software engineer. This aspect of learning how to think and behave is particularly exercised by activities which are open challenges - often goals which may be addressed by students who are demonstrating more advanced levels of achievement in assessment. Many colleagues expressed the view that there are little or no realistic opportunities at this level of study for the students to be actively involved in producing research results, or undertaking activities which were a proxy for research. In many basic modules colleagues considered that there was no realistic opportunity for teaching to be research related. A number of colleagues did however explain that is some courses (for example data-structures and algorithms) they may typically give examples of their own or others cutting edge research in order to demonstrate concepts and make the subjects covered more interesting to students. Such and approach was also used in order to communicate an excitement for the discipline as a whole. In one example, students were given the opportunity to find out about current research as a task within their professional issues course where they work in groups to investigate a topic and then prepare a presentation. Some colleagues also indicated that they used small group tutorials/supervisions as an opportunity to talk to students about topics which they are currently researching as a means of communicating what is new in the discipline and motivating the students to engage in their studies. One way in which there is a difficulty in achieving this form integration of perspectives related to research in the teaching for level one students is a consequence of differing skill levels across the cohort - something which is often most prevalent at entry onto programming modules.

3.2 Second Year
At this stage of their studies students are expected to consolidate their basic skills. Content in this year is often large and may be an obstacle to achieving approaches which bring together research and teaching. Typical teaching approaches continue to concentrate on large lecture classes. Again colleagues indicated that they might relate what they were teaching to current topics of their own and other's research by way of example of applications of the theory being presented. Assignments may involve reading research papers and postulating new ideas based on the reading. Most UK students undertake group software projects at this level, and the skills they are required to demonstrate are akin to those of researchers working in teams.

Some teaching at this level can explicitly be designed to develop research skills. One of the universities offered a research methods module which focused on preparing students for study at final year undergraduate University level and to developing the students' requisite academic skills for completing their studies, in particular research techniques and methods in preparation for final year project and for developing skills in critical analysis and reflection. The other university encourages students to engage with research by getting them to participate in a student conference. Students have to put together an abstract which is peer (and tutor) reviewed, prepare a paper then present at the student conference – an in-house event, but run along the lines of a conference. Students develop their research skills as part of this process.

In smaller optional classes there is a chance for class discussions of directed reading for example "Artificial Intelligence for thePhilosophy of AI part. I give students directed reading, which then forms part of their expected background knowledge for the examination. Sometimes the required reading is classic stuff, like Turing's 1950 paper in Mind, but sometimes it is up-to-the-minute commentary, and so could be counted as "research". In such cases students mimic the behavior of researchers but do not generate any actual new knowledge. Other examples of reading courses were offered, although large student numbers often precludes effective group discussion which is a necessary accomplishment to this type of educational approach.
### Disciplinary exemplars

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<tr>
<th>Research-tutored</th>
<th>Research-based</th>
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<td>e.g.: classic tutorial structure - typically small group supervisions in the computing disciplines. Supervision class where students are taken through recent publication(s) and are invited to discuss/debate their understanding of the activity. Possible at each level of study, but for organisational/management reasons may only apply in particular years of study.</td>
<td>e.g.: authentic research activities, inquiry/exploring research based learning. Students are given a task which requires them to use and develop skills (practice and understanding) which are equivalent to those used in authentic research. May be practiced at any level of study, but may be more typically found at advanced levels.</td>
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<tr>
<th>Research-led</th>
<th>Research-oriented</th>
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<td>e.g.: curriculum follows current research. Most typically advanced level options. Can also be a component of teaching at any level, where students are exposed to state of the art research concepts (e.g. agile programming).</td>
<td>e.g.: teaching processes of knowledge construction. Typically found in capstone courses where students undertake some research activity, individually or as a group. Students at less advanced levels may practice this as part of research based activities.</td>
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### Boyer

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<th>Discovery</th>
<th>Integration</th>
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<td>Core to enquiry based curriculum</td>
<td>Capstone modules</td>
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<td>Natural in lab based courses</td>
<td>Final year projects/dissertations</td>
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<td>Well aligned to conventional approaches in teaching programming</td>
<td>Synoptic assessments</td>
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<td>Internships</td>
<td>Design classes</td>
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<th>Application</th>
<th>Teaching</th>
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<td>Final year options</td>
<td>Professional issues</td>
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<td>Masters curriculum</td>
<td>Skills modules</td>
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<tr>
<td>Proxy activities in follow on courses – apply previously learnt skills, knowledge, understanding</td>
<td>Peer instruction</td>
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<tr>
<td>Proxy discovery in lab classes</td>
<td>Small group teaching methods</td>
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<td>Internships</td>
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Tried to fit the feedback into the Boyer model

Which was the better fit and why?
Conclusions/ reflections

There is evidence of activities which create a link between research and teaching at each year of study. Some colleagues have difficulties with the concepts. Some issues are related to Disciplinary Differences or Engineer/Scientist tensions.

Academics in CS are not social scientists. Many found it easier to relate to Boyer’s explanation than to Healey’s.

Future work

Looking for more data:
- Evidence of current practice
- Academic perspectives
- Student Perspectives
- Educational approaches
  - Technology based
  - Enquiry based
  - Traditional face to face

Possible Perspectives?
- National
- Curriculum type
- Institution type
- Educational Objectives

Want to collaborate?

Sounds like a working group
Questions?

Acknowledgement:
Contributions of colleagues at our respective institutions.

References:

Boyer E. Scholarship reconsidered: Priorities of the Profession. 1990.
The plan is to complete the matrix (available as word file/pdf direct from saw@ecs.soton.ac.uk)
Recruit partners - institutions
Put the survey up on the web to gather data irrespective of institution
Get backing from CPHC Learning Development Group
Ideas in the ether….

• Nathan - My freshman year
• Wesch - Digital ethnography
  Kansas State University
• Frand – Information Age Mindset
• Prensky – Digital Natives,
  Digital Immigrants,
• C. Haythornthwaite & M. M.
  Kazmer (Eds.) Learning,
  Culture and Community in
  Online Education: Research
  and Practice

Digital ethnography
  http://mediatedcultures.net/ksudigg/

The Machine is Us/ing Us (Final
  Version)
  http://youtube.com/watch?v=NLlGopyXT_g

Information r/evolution
  http://youtube.com/watch?v=K2CF2l8w7ya

A vision of students today
  http://youtube.com/watch?v=0CnPIj46aY

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  Douglas Adams on YouTube
  http://youtube.com/watch?v=OwCJ4I6yvD0&rel=related

Digital natives data
  http://www.digitalnative.org/Introduction_to_the_Life_of_Digital_Natives

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Haythornthwaite, C. A. and Kazmer, M. M., Learning, Culture, and Community in
Online Education: Research and Practice: P. Lang, 2004.

Nathan, R., My Freshman Year: What a Professor Learned by Becoming a

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Prensky, M., "The Emerging Online Life of the Digital Native: What They Do
Differently Because of Technology, and How They Do It " Games2train,
http://www.marcprensky.com/writing/Prensky-


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