WebSci@UHI: Teaching Web Science in a Web Science Fashion

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Abstract: WebSci@UHI is a new undergraduate course providing a thorough and comprehensive introduction to the technological, social, political, economic, and psychological aspects of the 20 years of the Web. It explores the breadth of disciplines that today contribute to Web Science research in a Web Science fashion, that is, through a novel approach to teaching that exploits recent Social Web technologies for delivering the course beyond space, time, and matter.

Keywords: multidisciplinary teaching, blended e-learning, web science

1. Introduction

Online learning is a viable mode of instruction, but it should not be a replication of stand-up education. Structure can vary, but the learners' needs and the learning situation should always be foremost in the minds of the education professionals. Success in e-learning depends on support in a variety of ways considering several factors: the readiness and openness of a culture to share information in a comprehensive manner, the readiness of management to invest resources in developing a robust infrastructure, and the readiness of lecturer to design learner-centred curriculum along an ever-expanding continuum of students' needs (Rosenberg 2001).

With these three factors in mind, we designed WebSci@UHI (*http://sentic.net/websci*), a new undergraduate course on Web Science at the University of the Highlands and Islands (UHI), a partnership of colleges, learning and research centres located throughout the Highlands and Islands of Scotland. WebSci@UHI is a project started in 2010 in collaboration with Moray College, a UHI partner college based in Elgin, and Sitekit Labs, the research branch of Sitekit Solutions Ltd. in the Isle of Skye. The course is taught collaborately with prepared lectures from Erik Cambria, associate researcher at the MIT Media Laboratory, and guest speakers with discussion tutorials supervised by Ian Barnes, lecturer in computing and IT at Moray College, Elizabeth Brooks, subject network leader for computing and IT at UHI, and Chris Eckl, Sitekit Labs research director.

The module provides a thorough and comprehensive introduction to the technological, social, political, economic, and psychological aspects of the 20 years of the Web, and explores the nature and history of Web Science as an emerging research area, along with the breadth of disciplines that today contribute to Web Science research. The course was designed by ensuring that in-site lectures always had the time to properly integrate face-to-face and online material (Aycock et al. 2002), and trying to be as much as possible sensitive to the needs of learners as individuals (Graff 2003), active learning (Hinterberger et al. 2003), repetition and elaboration (Boyle and Nicol 2003), the requirement for prompt and frequent feedback (Morris and Walker 2006), and design principles related to the course outcomes, e.g., attention to detail (Stubbs et al. 2006).

The structure of the paper is as follows: Section 2 presents some background information and related initiatives in the field of Web Science; Sections 3 explains how the course is delivered beyond space, time, and matter; Section 4 shows how and why the course is evolving from year to year; finally, Section 5 comprises concluding remarks and future directions.

2. Background

Since its inception, the World Wide Web has changed the ways scientists communicate, collaborate, and educate. There is, however, a growing realization among many researchers that a clear research agenda aimed

at understanding the current, evolving, and potential Web is needed. The Web is an engineered space created through formally specified languages and protocols.

However, because humans are the creators of Web pages and links between them, their interactions form emergent patterns in the Web at a macroscopic scale. These human interactions are, in turn, governed by social conventions and laws (Berners-Lee et al. 2006). Web Science, therefore, is inherently interdisciplinary – its goal is to both understand the growth of the Web and to create approaches that allow new powerful and more beneficial patterns to occur.

In recent years, growing interest in the field of Web Science has been proved by initiatives such as the opening of the Southampton Web Science Doctoral Training Centre and the organization of a Masters Program in Web Science at the Department of Mathematics in Aristotle University of Thessaloniki. There are also a number of Web Science courses, mainly in UK and US, for master students but, till last year, no such opportunity had been offered to undergraduates in the UK, mostly for the broad vision and the research approach needed to handle the multidisciplinarity of the field, which risks being too confusing for undergraduate students. In this context, WebSci@UHI pioneered the first course at undergraduate-level that aims to guide students' first steps towards a holistic vision of what the Web is today and what it is becoming.

Besides course target, WebSci@UHI's novelty lies in the combination of different modes of web-based technology (e.g., live virtual classroom, self-paced instruction, collaborative learning, streaming video, audio, and text) to accomplish an educational goal, the combination of various pedagogical approaches (e.g., constructivism, behaviorism, cognitivism) to produce an optimal learning outcome, the combination of different forms of instructional technology (e.g., online video and web-based education) with instructor-led tutorials. The main aim of WebSci@UHI, in fact, is to provide students with the knowledge, skills, attitude, and values to begin to understand and study the Web with a holistic approach, rather than in a limited and compartmental way.

3. A student-centric way of teaching

Currently, the most common type of blended learning is the provision of supplementary resources for courses that are conducted predominantly along traditional lines through an institutionally supported virtual learning environment (VLE) (Sharpe et al. 2006). WebSci@UHI, in turn, aims to make use of the Web to facilitate interaction and communication and replace other modes of teaching and learning, while helping students to take a holistic view of the interaction of technology and their learning, including the use of their own technologies.

While students recognize the value in the blend of face-to-face and technology supported activities, in fact, there are large individual differences in how they experience the blend. Thus, it is important that students understand the role of technology in their learning and the implications for their study strategies and engagement in learning activities. There is an increasing recognition that students are making use of their own technology, as well as those provided for them, and that they are doing this in ways that are not planned for, difficult to predict, and may not be immediately visible to their teachers and researchers. Hence, as well as the Web evolved from information-centric to user-centric, Web Science teaching has to evolve from content-centric to student-centric.

3.1 Beyond space

WebSci@UHI is delivered via the UHI VLE and Video Conferencing (VC) systems, which allow both students and lecturers to participate in lessons and tutorials from wherever they were located. This use of technology, for example, allowed Jon Udell, Microsoft evangelist, to join the class for the tutorial session from his home in New Hampshire after the class had viewed a lecture, which had been previously given by him at Harvard University. This gave students the chance to ask questions and discuss the topic directly with Jon, which would otherwise have been impossible.

The WebSci@UHI Facebook page (http://facebook.com/websciatuhi*)* and the discussion board in the UHI VLE*,* moreover, allow students and lecturers to interact both before and after the VC lecture. Since only two of the lecturers are usually located in the same office, distance also presents a possible barrier to collaboration

before lectures and delivery of those lectures and the following tutorials. To this end, we use Google Docs and Etherpad (for collaboratively editing course slides and documents), email and the VLE (for organizing course logistics), and Skype (for regular discussions about students' feedback).

Figure 1: A screenshot of UHI VLE

3.2 Beyond time

Because Erik Cambria is based in Boston, it is not always practical for him to deliver all the lectures live by VC. Erik addresses this by preparing lectures in advance as an audio track to accompany the slides, YouTube is used to store video recordings of a prologue and epilogue for each lecture and the audio track and slides are used as the lecture. The advantage of this is that the lecturers can pause the slides and answer students' queries. This investment in the teaching materials has given us re-usable learning objects, which can be used in future years.

Through the VLE discussion board, moreover, we can keep students engaged and prevent them from feeling disenfranchised or marginalized by the use of technology (Dickey 2004). In an online learning environment or in blended learning where face-to-face contact is limited, in fact, discussion boards and chatrooms can provide a sense of involvement in, and interaction with, a community of learners (Weller 2007). Interaction and learning climate, moreover, are among the primary determinants of student learning satisfaction with blended e-learning system environments (Motteram and Forrester 2005), but it is also important to avoid the information overload that could occur if students posted too much or posted contributions not very relevant to the discussion topic (Kear and Heap 2007). We also monitor students' attitude toward the learning environment by means of sentic computing (Cambria and Hussain 2012), a novel concept-level approach to opinion mining that enables the automatic analysis of VLE discussion board's contents and, hence, the detection of emotions such as interest, satisfaction, or frustration.

3.3 Beyond matter

The module aims to provide students with the knowledge, skills, attitude, and values to begin to understand and study the Web with a holistic approach rather than in a limited and compartmentalized way. As a result of its interdisciplinary nature, WebSci@UHI is offered, for the very first time at UHI, to all degree students across the UHI network of partner colleges and in particular across all disciplines. The first time we ran the course, we had one non-computing student in the class. Having her different perspective offered during class discussions

greatly enriched the course experience for our main group of computing students. Since content feature is a primary determinant of student satisfaction with blended e-learning system environments (Wu et al. 2010), WebSci@UHI also offers students the possibility to look at Web Science from many perspectives by involving four different guest lecturers every year, coming either from academia or the business world.

4. An evolving course

WebSci@UHI program evolves each year as the Web evolves. This is due to the need to both keep the course contents up-to-date with fast-evolving Web technologies and meet students' needs and interests according to their feedback on module contents and teaching modalities. To this end, we undertook an analysis of the successful and less successful features of the current course, including student feedback (Boyle 2005). The main issue raised by students at the end of the first course (second semester 2010/2011) was that it was too abstract.

Students had the impression that, on the one hand, a lot of the materials were a bit over their heads, while, on the other hand, it seemed very general, with no detail filled in, at times to the point where it appeared simplistic. While this style might be appropriate for highly motivated graduate students with good research skills who can fill in all the gaps for themselves, for undergraduates it was a bit confusing. We responded to this by introducing more tutorial/lab exercises to supplement lectures and discussions. For example, we asked each student to find a Wikipedia page and attempt to engage the community of people maintaining that page, by editing it to correct an error or by posting on the associated comments page. The goal here was for them to enter and observe the community a bit like an anthropologist visiting a village in the New Guinea highlands for a few months.

We also added a lecture on search engines and graph theory in order to add a little bit of semi-mathematical/computer science content to the course. The lecture covered enough graph theory to explain the simplest version of the page rank algorithm, but also covered more general and interdisciplinary issues around search engines. Followed up by a practical exercise to calculate page rank by hand for a very small web. For the first assessment—reviewing a research paper—the main change this time was that we told them what paper to review, and they all reviewed the same paper. This made the assessment more transparent and consistent, and also meant that they were all looking at a paper that we had chosen carefully to have some interesting features, e.g., an interdisciplinary approach and a somewhat controversial position that went against other research in the field.

Additionally, we included a section on Referencing in Lecture 2 in order to address the lack of knowledge among students about how to cite and reference sources that we were surprised to encounter the first time. WebSci@UHI, in fact, is not just about learning Web Science, but also acquiring a Web Science methodology.

5. Conclusions

The Web has now become so prevalent in the lives of undergraduates that discussions about whether to exploit it or not for education no longer seem relevant. The pertinent questions now are around how we should use it for education and evaluate such use, in parallel with face-to-face teaching.

To this end, WebSci@UHI is exploring how the breadth of disciplines that today contribute to Web Science research can be taught to undergraduates in a Web Science fashion, that is, through a novel approach to teaching that exploits recent Social Web technologies for delivering the course beyond space, time, and matter.

As well as we do in our research, in fact, in our teaching activity we always try to bind cognitive with affective knowledge by generating interest and engagement through real-world examples, case studies and metaphors to show the applicability of what we are learning and to make challenging topics more assessable to students, possibly trying to involve off-site students as much as possible. Successful participation within an online community, in fact, involves emotional dimensions and an understanding of the norms of the community (Guildberg and Mackness 2009).

We believe that teaching is a two-way process in which both lectures and students interact with and learn from each other, in a dynamic and engaging environment that challenges and prompts students to actively

participate in their learning process with the goal of improving their higher-order cognitive and decision-making skills.

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