Informatics in South Africa: An Overview

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Abstract

In this contribution the author provides an overview of the state of Informatics teaching and research in South Africa, taking as point of departure the peer reviewed contributions of academics at South African Higher Education Institutions. Contributions in the fields of information technology for development, emerging trends in information technology, informatics research, human-computer interaction, and informatics pedagogy are reviewed. While the vast majority of Informatics scholars that contributed reside in South Africa, there are also authors from as far away as Britain and Japan. Besides a review of current trends in Informatics, *Alter*nation 12.1a and *Alter*nation 12.1b also contain contributions about emerging and possible future trends in Informatics.

Informatics in South Africa

As the editor of the two special *Informatics* issues of the interdisciplinary journal *Alter*nation, it is a pleasure to write a brief overview of the contents of the first of the two consecutive issues of the journal. The research reported here is important, not only for scholars of Informatics, but also for those of other disciplines, because Informatics has become the atmosphere in which 21st century open societies live, in which interpersonal communications increasingly take place, in which knowledge driven economies thrive and in which academic trans-disciplinary discourse predominantly takes place, irrespective of one's discipline.

Let me begin with a conundrum. Due to the large number of excellent contributions received, *Alter*nation will dedicate both issues of 2005 to Informatics, and for the first time ever a single issue, *Alter*nation 12.1, will consist of two separate volumes, namely *Alter*nation

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12.1a and *Alter*nation 12.1b. Together these three volumes provide an excellent perspective on the current state of Informatics teaching, research and practice in South Africa.

This contribution presents an overview of the articles that appear in *Alter*nation 12.1a and *Alter*nation 12.1b focusing on themes like information technology for development, emerging trends in information technology, informatics research, human-computer interaction, informatics pedagogy and computer programming.

Buthelezi *et al.* report the results of research about how Telecentres could be used to support conventional education delivery in higher education as well as in public secondary school education.

Sikhakhane *et al.* investigate problems experienced in rural local communities in the KwaZulu-Natal province of South Africa, and review several approaches that were followed worldwide to solve the problem of the digital divide, showing which ones succeeded.

Focusing on the restructuring of the South African Higher Education system, **Maharaj** concludes that there is no doubt that information systems and information technology are the glue that holds together an information organization and warns that the South African higher education environment is in danger of floundering due to the lack of visionary leadership at both the local and national level because large scale social engineering has not taken into account the key issues that are redefining the direction that universities are being forced into internationally.

Revealing that the future is upon us, **Cowley & Kanda** report the results of their research on "friendly machines", interaction-oriented robots that among others use facial expressions to simulate human behaviour, or visual and auditory data that mimic aspects of human personality as they begin to freely participate in human social life, and as they attract humans to establish inter-"personal" relationships with them.

In the first of two consecutive, thematically related articles **Klopper** analyses the emergence of electronic communication in the mid nineteen fifties as the most recent manifestation of a variety of forms of human communication that have emerged over time in response to the ever increasing complexity of human cultural behaviour. Klopper argues that nonverbal forms of human communication like facial expressions, gesture, body stance, body movement and tone of voice emerged as part of a survival imperative during the hunter-gatherer phase of human existence, that graphical and written forms of communication emerged during the pastoral phase of human existence in response to the greater levels of cultural complexity brought about by pastoral societies. Klopper notes that electronic communication is incorporating human nonverbal communication, and that communication instruments are disappearing from desktops into walls, furniture and our clothes. He predicts that advances in nanotechnology and neuroinformatics will cause electronic communication to disappear into our bodies, and will give rise to sentient communications between human cyborgs and a variety of forms of artificial intelligence.

Gordon & Bhowan analyse the factors that influence online shopping behaviour worldwide as context for South African online shopping behaviour. They show that globally just over a third of Internet users shop online, and that about a third of the online shoppers, that can be characterised as "relatively young, busy, working, elite people" cite convenience as an important reason for online shopping. Based on the global and local trends that Gordon and Bhowan identify, they make particular recommendations for online marketers, policy-makers and media owners.

Writing about ethical aspects of cyberspace, **Pretorius & Barnard** state that, apart from being able to identify ethical problems, computing professionals need to be able to analyse ethical problems that arise in the computing context in general, and also in particular for the development of software artefacts for solving real problems. Pretorius and Barnard argue that computing professionals should have the

knowledge and skills to decide on ethical courses of action in resolving such problems. Their contribution focuses on a number of issues relevant to ethical decision making skills required of computing professionals active in cyberspace.

Lubbe & Mudaray analyse the impact of research on tertiary activities in Southern Africa. They show that many of the overseas universities use research output for promotion and tenure whereas the same is not happening in South Africa. Most of the research output in South Africa is done by academics who are involved in postgraduate research supervision. Lubbe and Mudaray propose that the South African approach to research will to have change – junior staff must be motivated to produce more papers.

Pather *et al.* address the problem of poor research dissertation completion rates at Masters level at many Higher Education Institutions. Their contribution details various measures to support part-time Masters students in the Faculty of Business Informatics at the Cape Peninsula University of Technology, including offering a structured study program that directly supports the skills and resources that a Masters student needs to complete a dissertation.

Lubbe *et al.* focus on the problem of the poor completion rate of PhD studies. According to them the completion rate for doctorates ranges from poor to abysmal worldwide and state that the responsibility for this must be shared by candidates, supervisors and the institutions to which they belong. They review a number of problems experienced by postgraduate students that cause their studies to derail. While supervisors can change particular supervision protocols to improve doctoral throughput rates, the extent to which postgraduate students themselves take ownership of their research, will ultimately determine their degree of success. Lubbe, Worrall and Klopper's contribution discusses some of the problems that frequently occur and present some insights from their own experience as supervisors of doctoral candidates.

Harypursat *et al.* report research findings about the thinking styles of second year students in Information Systems and Technology on the Westville Campus of the University of KwaZulu-Natal, situated in Durban, South Africa. The article explores whether there is a relationship between student thinking styles and their examination marks against the background of primary thinking styles identified in Harrison and Bramson (1984), namely the Analyst, Synthesist, Pragmatist, and Realist thinking styles. Most of the findings reported by Harypursat, Lubbe and Klopper support those of Harrison and Bramson (1984). They highlight the implications of their findings for both teaching and research in Informatics.

According to **Alexander** visualization of information is an important human computer interaction (HCI) research topic which is however, not generally included in university courses. Alexander identifies Geographical Information Systems (GIS) as excellent examples of applications where visualization is used to represent information. She argues that GIS require sophisticated interfaces so that the users can manipulate and query the underlying data. Hence, in practical exercises using GIS students interpret information and use interfaces that differ somewhat from standard Windows objects and text. As this context and form of interaction are unfamiliar to typical Information Systems students, this experience can be exploited further to emphasize the fact that end users frequently operate outside their comfort zones when they use information systems. Alexander's contribution describes a strategy to enhance the teaching of HCI in the form of an HCI evaluation of GIS software in a usability laboratory where students play the roles of end-users and researchers / evaluators. Alexander reports that such an exercise allows the lecturer to demonstrate exactly how usability data, including satisfaction questionnaires, can be collected and analyzed.

Krauss states that to date aesthetics has not played a significant role in human computer interaction (HCI) research despite its centrality to human thought and practice. He states that traditionally, the

field of HCI's main emphasis has been on efficiency considerations. Although aesthetics applies to all human sensory domains Krauss mainly focuses on the visual domain. Krauss states that visual aesthetics exists in everyday life, and it subconsciously influences many of our choices, including web design. Krauss foregrounds the importance of visual aesthetics in website design through his research so that it will become a prominent feature of successful website design.

Averweg reports the results of research about the Technology Acceptance Model (TAM) in the Arab world (Saudi Arabia), Malaysia and Africa (South Africa). Research in Saudi Arabia supports the applicability of TAM to the Arab culture. The TAM can also be applied in the Malaysian environment. However, in South Africa the study does not provide any direct evidence to support the applicability of the TAM's determinants of usage. Averweg concludes that while the TAM literature suggests that results are mostly convergent, there are situations where they are conflicting. The author provides new evidence about this matter.

De Villiers states that with the advent of e-learning, educators and designers of learning resources should view technology as a tool and a medium, but should not confuse it with the message. The title of her article poses the rhetorical question as to whether e-learning artefacts and variants are based on sound learning theory. It traces the evolution of e-learning and describes characteristics that indicate underlying theoretical biases in traditional educational software, as well as in online courses and web-based instruction. De Villiers presents a synthesis of contemporary learning theory, the Hexa-C Metamodel (De Villiers, 2002, 2003), whose six elements can play a role in the design and development of e-learning environments and instructional systems, and which can also be used in evaluating educational applications from a learning theory perspective.

The article of **Mallinson & Sewrey** describes the introduction and evolution of an e-Learning module for Information Systems students, from a half-module in 2001 through to its current form as a

full module within the Information Systems Honours / Fourth year Programme at Rhodes University, situated in Grahamstown, South Africa. They state that the opportunity to use a blended approach to module delivery has afforded a wealth of pedagogical opportunities for the module facilitator, and proved to be an exciting learning environment for the learners, while at the same time taking advantage of the 'medium is the message'. Mallinson and Sewry conclude that while few problems have been experienced with regard to implementing the desired technologies for the module, it has become evident that the blended or hybrid mode of module delivery is best suited to a more lengthy delivery time span.

According to **Barnard *et al.*** recent technological advances have led to the emergence of new technologies, frameworks and methodologies in the field of computing, the regulation of which are governed by scientific principles. They provide examples such as the Internet, global connectivity and mobile agent technology, collectively referred to as cyberspace. Barnard, Pretorius and Venter also state that regulating human interaction with cyberspace has become one of the great challenges of the information age – a challenge in which legislation plays a central role. At present the regulation of human interaction with cyberspace by means of legislation, is awarded prominence on a global level by governments. It is within this context that the authors consider what influence the new South African Electronic Communications and Transactions (ECT) Act (Act No. 25, 2002) may have on a typical computing curriculum.

Mkhize & Lubbe point out that web entrepreneurship pertains to people who run a wide variety of online enterprises of which some succeed and some have failed. Examples of the latter are the enterprise heavenly-doors.com, which operated a funeral service over the Internet and other online businesses that provided retailing services that ultimately failed because sellers did not pay attention to user demands. Therefore, a significant number of such businesses have closed their virtual doors as web traders since 2000. The au-

thors report the results of their analysis of business plans obtained from a businesses plan archive website, to establish if there are common mistakes made by web entrepreneurs. This enabled them to determine where unsuccessful web entrepreneurs were short-sighted, and to identify possible solutions to be kept in mind by prospective Internet entrepreneurs.

According to **Reinhardt & Pillay** spreadsheets have become a routine application in most organizations and universities. Consequently, students are required to learn spreadsheet applications such as Microsoft Excel. The learning of spreadsheets is often accompanied by problems related to spreadsheet applications and their mathematical content. The EXITS (Excel Intelligent Tutoring System) research project aims to develop a Microsoft Excel tutor that helps students to overcome their learning difficulties. The paper reports on the first phase of the EXITS research project. The authors firstly identify barriers that may prevent a student from successfully using a spreadsheet program. They then analyse the different types of errors students make and identify their causes. They also classify the errors. This classification will form the basis for an error library that is required for our student model. At the end of the paper they give an example of how their model could be used for student modelling purposes.

Sewlal & Lubbe focus their attention on issues of establishing common Information Systems and Technology curricula on the different campuses of the University of KwaZulu-Natal subsequent to the merger of the erstwhile universities of Natal and Durban-Westville. Taking an inter-disciplinary point of departure Sewlal and Lubbe develop a definition of IS by extending the discussion raised by Colin Tully in his paper for the 1st UKAIS Conference (1996) on the associations between IS and other areas of study in related fields. The paper concludes by raising a number of general considerations all those developing the subject Information Systems and Technol-

ogy should be wary of if a clear identity is to emerge for the subject area.

Seymour *et al.* begin their analysis of web based learning tools by pointing out that several studies on technology adoption have attempted to develop models, such as the technology accepted model, that can be generally applied to any technology. According to the authors typical web-based learning technologies such as WebCT, however, are composed of several distinct tool sets, and student motivations for using each may differ, due to the different purposes and characteristics of each tool. After reporting and analysing survey results regarding the factors that affect utilisation of the WebCT bulletin board and quiz tool, the authors conclude that perceived usefulness and perceived ease of use were found to affect student intentions to use the bulletin board, while compatibility with learning style, self efficacy and long-term consequences all affected intentions to use the quiz tool.

Van der Merwe *et al.* report the results of their research on identifying a set of characteristics for a functional requirements elicitation procedure in the higher education domain. Although various application domains use requirements elicitation procedures to gather information and model the application domain, only a few guidelines mention the important characteristics that are essential for such procedures. Their research contributes to a better understanding of the elicitation procedure in the higher education domain.

Brown *et al.* investigate perceptions about web-based learning technologies technology adoption, among a group of university students within a multicultural framework by means of a number of hypotheses that are empirically tested. Following that they discuss the implications of their findings, before ideas for future research are suggested.

In response to increasing pressure from national and provincial government to improve student throughput rates in higher education **Cilliers *et al.*** report the results of their research on how the Depart-

ment of Computer Science and Information Systems at the Nelson Mandela Metropolitan University (the former University of Port Elizabeth (UPE)) can improve their throughput rates through the development of an experimental iconic programming notation, B#. The authors propose a cognitive mapping that illustrates the correspondence of fourteen cognitive dimensions to Nielsen's ten heuristics, after which they discuss each cognitive dimension in terms of an assessment from a design perspective of the way in which B# supports it.

Goosen & Pieterse report the results of their research into how difficult or easy computer science students at the University of Pretoria perceive programming in an object-oriented style to be, how well they actually learn object-oriented programming (OOP) and how well they retain their understanding of OOP. By analysing this information and ideas of best practices provided in related literature, the authors make recommendations for improving instruction of OO concepts.

Dehinbo presents the results of an evaluation of four programming languages namely C++, Visual Basic, Java and Pascal, in terms of their ease of learning, ease of use under pressure, Line of Codes (LOC) and overall rating. Survey and Experimental approaches were used to construct a research design for the study. Questionnaires were administered to respondents using any of the four languages: C++, Java, Visual Basic, and other structured languages (like Pascal or Basic) in different study groups. In addition, a simple programming exercise was given to respondents to solve and the estimated Lines of Codes (LOC) for the solution in each programming language was measured. Dehinbo concludes that unlike Pascal, there is no significant difference in the factors studied for C++, Visual Basic and Java. The findings therefore show that a careful combination of the languages can achieve the desired result.

Cohen addresses problems experienced with equipping B.Com Information Systems students with basic programming skills under conditions where lecturers have limited laboratory resources and are dealing with students from many diverse educational and technological

backgrounds but points out that elements of her approach would also be relevant in contexts where academics are better resourced. The approach that Cohen describes includes a programming concepts course that is run during lecture time, complemented by a series of detailed on-line tutorial sessions.

Singh presents the results of research on e-Commerce trends in South Africa between 2001 and 2004. To gather data a questionnaire was sent to 122 companies with an Internet presence. The results reported by Singh show that that there have been improvements in e-Commerce in South Africa with respect to income generation, customer service and cost reduction, but that e-Commerce has not reached its full potential and needs to be given greater strategic importance within corporate plans.

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