Transactions on Computational Science and Computational Intelligence

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Leonidas Deligiannidis
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Advances in Software Engineering, Education, and e-Learning

Proceedings from FECS'20, FCS'20, SERP'20, and EEE'20

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Transactions on Computational Science and Computational Intelligence

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Preface

It gives us great pleasure to introduce this collection of papers that were presented at the following international conferences: Scientific Computing (CSC 2020); Parallel & Distributed Processing Techniques and Applications (PDPTA 2020); Modeling, Simulation & Visualization Methods (MSV 2020); and Grid, Cloud, & Cluster Computing (GCC 2020). These four conferences were held simultaneously (same location and dates) at Luxor Hotel (MGM Resorts International), Las Vegas, USA, July 27–30, 2020. This international event was held using a hybrid approach, that is, “in-person” and “virtual/online” presentations and discussions.

This book is composed of ten Parts. Parts I through IV (composed of 27 chapters) include articles that address various challenges in the area of scientific computing (CSC). Parts V through VII (composed of 31 chapters) include articles that discuss advances in the area of parallel and distributed processing (PDPTA). Recent progress in the fields of modeling, simulation, and visualization methods (MSV) appear in Parts VIII through IX (composed of 17 chapters). Lastly, Part V (composed of 10 chapters) presents advances in grid, cloud, and cluster computing (GCC).

An important mission of the World Congress in Computer Science, Computer Engineering, and Applied Computing, CSCE (a federated congress to which this event is affiliated with), includes *“Providing a unique platform for a diverse community of constituents composed of scholars, researchers, developers, educators, and practitioners. The Congress makes concerted effort to reach out to participants affiliated with diverse entities (such as: universities, institutions, corporations, government agencies, and research centers/labs) from all over the world. The congress also attempts to connect participants from institutions that have* ***teaching*** *as their main mission with those who are affiliated with institutions that have* ***research*** *as their main mission. The congress uses a quota system to achieve its institution and geography diversity objectives.”* By any definition of diversity, this congress is among the most diverse scientific meeting in the USA. We are proud to report that this federated congress had authors and participants from 54 different nations representing variety of personal and scientific experiences that arise from differences in culture and values.

The program committees (refer to subsequent pages for the list of the members of committees) would like to thank all those who submitted papers for consideration. About 50% of the submissions were from outside the USA. Each submitted paper was peer reviewed by two experts in the field for originality, significance, clarity, impact, and soundness. In cases of contradictory recommendations, a member of the conference program committee was charged to make the final decision; often, this involved seeking help from additional referees. In addition, papers whose authors included a member of the conference program committee were evaluated using the double-blind review process. One exception to the above evaluation process was for papers that were submitted directly to chairs/organizers of pre-approved sessions/workshops; in these cases, the chairs/organizers were responsible for the evaluation of such submissions. The overall paper acceptance rate for regular papers was 20%; 18% of the remaining papers were accepted as short and/or poster papers.

We are grateful to the many colleagues who offered their services in preparing this book. In particular, we would like to thank the members of the Program Committees of individual research tracks as well as the members of the Steering Committees of CSC 2020, PDPTA 2020, MSV 2020, and GCC 2020; their names appear in the subsequent pages. We would also like to extend our appreciation to over 500 referees.

As sponsors-at-large, partners, and/or organizers, each of the followings (separated by semicolons) provided help for at least one research track: Computer Science Research, Education, and Applications (CSREA); US Chapter of World Academy of Science; American Council on Science and Education & Federated Research council; and Colorado Engineering Inc. In addition, a number of university faculty members and their staff, several publishers of computer science and computer engineering books and journals, chapters and/or task forces of computer science associations/organizations from three regions, and developers of high-performance machines and systems provided significant help in organizing the event as well as providing some resources. We are grateful to them all.

We express our gratitude to all authors of the articles published in this book and the speakers who delivered their research results at the congress. We would also like to thank the followings: UCMSS (Universal Conference Management Systems & Support, California, USA) for managing all aspects of the conference; Dr. Tim Field of APC for coordinating and managing the printing of the programs; the staff of Luxor Hotel (MGM Convention) for the professional service they provided; and Ashu M. G. Solo for his help in publicizing the congress. Last but not least, we would like to thank Ms. Mary James (Springer Senior Editor in New York) and Arun Pandian KJ (Springer Production Editor) for the excellent professional service they provided for this book project.

Hamid R. Arabnia, Leonidas Deligiannidis, Fernando G. Tinetti, Quoc-Nam Tran, Ray Hashemi, Azita Bahrami

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Contents

Part I
Curriculum Design, Academic Content, and Learning Objectives

Empirical Analysis of Strategies Employed Within an ICT Curriculum to Increase the Quantity of Graduates

Nicole Herbert, Erik Wapstra, David Herbert, Kristy de Salas, and Tina Acuña

1 Introduction

The University of Tasmania (UTAS) commenced a curriculum renewal process in 2012. At the time, there was concern both within the information and communication technology (ICT) industry and within government agencies about the number of the ICT graduates [1, 2]. Potential students had incorrect perceptions of the field of ICT [3], and this resulted in low commencement rates for ICT higher education courses in comparison to other disciplines [4]. High attrition rates in ICT courses, caused by a number of factors mostly relating to a lack of student engagement [5], motivation [6], and academic success [7, 8] were also impacting on the number of graduates.

This chapter reports on a broad and deep ICT curriculum change and uses data collected over a 9-year time period to conduct an empirical evaluation of the changes to the quantity of graduates. This chapter contributes to the field of ICT curriculum design as it provides implementation techniques for strategies that can have positive long-term outcomes. The research question explored is: *What is the impact of strategies designed to amend misconceptions and improve perceptions, motivation, engagement, and academic success on the quantity of graduates*?

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2 Related Work

Rapidly evolving technology has resulted in a continuous demand for competent ICT graduates. In 2019, the Australian Computer Society (ACS) released figures forecasting that Australia will require an additional 100,000 ICT specialist workers by 2024 [9]. A potential source of these workers is tertiary ICT graduates.

While the ACS reported that domestic undergraduate enrolments rose from a low of around 19,000 in 2010 to 30,000 in 2017 [9], this growth is not large enough to meet the forecasted demand, and it is further degraded by a high attrition rate. Even though there has been steady growth in completions since 2012, there were only 4400 domestic undergraduate completions in 2017 [9]. It is imperative that domestic completion rates in ICT courses improve for the growth of the ICT sector.

International students that graduate from ICT courses in Australia are also a potential source of skilled employees. In 2012, the growth in international student commencements in ICT courses had stagnated and started to decline [4], though since then, there has been significant growth, with international students comprising 39% of the national ICT undergraduate student population [9]. Similar to domestic graduates, there has been steady growth in completions since 2012, with 4000 international undergraduate completions in 2017 [9]. Even with this growth in total graduates, the supply of ICT employees from domestic and international graduates is much smaller than the predicted increase in the size of Australia's technology workforce over the next decade [9].

It is well recognized that students choose not to study ICT due to their perceptions of the field [3, 10–13]. A career in ICT is perceived as male-dominated, repetitive, isolated, and focused on the technical rather than the professional [3]. While this perception was valid in the past, the industry has transformed, and potential applicants need to be aware of how fulfilling an ICT career can be and how diverse the opportunities are.

To increase the quantity of ICT graduates, it is necessary to not only increase the commencements in ICT courses but also reduce the rate of course attrition. National attrition across all disciplines was around 17% in 2012 [4], in comparison to a national attrition rate of 43% for ICT courses [1]. There have been a number of studies identifying the causes of this high course attrition.

Poor course choice due to student misconceptions of what ICT is and what is involved in studying ICT is a leading cause of course attrition [3, 10–13]. Beaubouef et al. [11] summarized a number of misconceptions that can impact on both course commencements and attrition:

Nature of the field – ICT is much wider than producing reports and collating data and infiltrates a wide range of industries.

ICT is easy – ICT requires maths and problem-solving skills and a disciplined approach to solve complicated problems.

Social issues and communication skills – ICT careers are not solitary positions and require written and oral communication skills to convey ideas and concepts to develop systems that meet user requirements.

Programming – while it is essential that all ICT personnel have some ability to program, it is only one of the many important skills required. Biggers et al. [12] found that, although the primary reason students gave for leaving was allegedly a loss of interest, the underlying explanation was often related to the undesirability of a programming-only career.

One difference between students who complete and students who leave is their motivation to study [6, 14]. Providing evidence that the course can result in a secure, satisfying, and financially rewarding career can influence the decision to continue [14, 15]. Smith et al. [8] found that a lack of academic success is also a major factor in the decision to withdraw and ICT students who pass subjects were more likely to continue. A lack of student engagement in ICT courses was also found to be a leading cause of course attrition, particularly for first-year students [5, 16]. This was often a result of poor course design: poor quality teaching, feedback, or course structure [7, 10, 13, 14, 16–19], poorly related practical work to professional practice [10, 13, 14, 17–19], and low levels of interaction with peers and staff [6, 12–14, 18, 20].

3 The UTAS Situation

The University of Tasmania (UTAS) is responsible for developing competent graduates for a broad local ICT industry. In 2014, the Tasmanian ICT sector employed over 4500 people and generated industry value add of around $640 million, representing less than 1.6% of the Australian ICT sector's total [21]. The Tasmanian ICT sector had been constrained by skills shortages for a decade [21].

As had been the case for ICT courses nationally, the student numbers had stagnated, and the attrition rates were high, as shown in Table 1. As Tasmania is an island state with a small population, there is a very limited domestic market of tertiary applicants. There was reliance on international student enrolments, but these were in decline – down to 22% in 2012 [4]. 11% of the students were enrolled in the Bachelor of Information Systems (BIS), while the rest were in the Bachelor of Computing (BComp). The attrition rate in the UTAS ICT courses prior to 2013 was 57%, much higher than the national ICT course average of 43% in 2012 [1].

Table 1 Student data for the BComp/BIS

	2010	2011	2012	2013
Commencing students	131	137	135	167
Domestic student ratio	73%	69%	78%	78%
Attrition rate	55%	54%	63%	74%