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Understanding novice programmers: their perceptions and motivations

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This paper presents the initial findings of an ongoing research program eliciting a basic understanding of students undertaking a first year programming course at the University of Ballarat, with a particular focus on their motivations and aspirations. This paper also provides a brief history of the course within its institutional setting including the different strategies that have been implemented over the last decade, an overview of the overarching study that is currently being undertaken, a discussion of some of the initial results, as well as a short discussion further research that is currently being undertaken. Results from the initial study indicate that students are positive coming into our courses but can become disillusioned as the course progresses. The research path forward will also be presented along with the discussion of these initial findings.

Keywords: Novice programming, motivation, perceptions

Introduction

Programming is a proven difficult topic to learn and teach and there is a great wealth of research attesting to this (Bergin, Reilly, & Traynor, 2005; Bonar & Soloway, 1983; Lewandowski, Gutschow, McCartney, Sanders, & Shinners-Kennedy, 2005; Lister et al., 2004). In spite of the effort dedicated to understanding and resolving this problem, IT programs and courses, including our own, are still suffering high attrition, failure and dropout rates (Ramalingam, LaBelle, & Wiedenbeck, 2004; Roberts, McGill, & Hyland, 2012). This situation is made even more perplexing by the perceived shortage of IT professionals in the work force (Barnes, Powell, Chaffin, & Lipford, 2008).

Like many others educational institutions, we have been experiencing on going challenges delivering introductory programming courses to commencing first year students (Bonar & Soloway, 1983; Lewandowski et al., 2005; Lister et al., 2004; Nagappan et al., 2003). In order to better understand the perceptions, motivations, aspirations and concerns the students have when they undertake our degree we planned and deployed a series of surveys throughout the first 2012 semester of a first year programming course. We endeavoured to discover if the students have any pre-existing programming knowledge, what motivates the students to undertake the course, and whether their motivations fluctuate during the lifespan of the course.

This paper provides a brief overview of the history of our programs and the first programming course that most of our students are required to undertake, and discusses some findings of interest from the first exploratory survey that was conducted prior to the students' first programming class. The students' responses to the various questions were in general very positive indicating that, at this initial stage, many of them perceived programming to be both achievable and relevant to their career goals.

Background

The University of Ballarat (UB) is a small, regional university located approximately 100 km northwest of Melbourne, Australia. UB draws a range of domestic students mainly from Western Victoria, and they tend to have a wide variety of backgrounds and abilities. Many of our students come from circumstances that fit them into one of our so-called "equity groups" which indicate disadvantage – for example, many come from sparsely populated areas that have limited access to certain resources such as broadband Internet, or at times may be the first on their families to attempt tertiary education. Some have not had great success in their secondary studies, may come from low socio-economic backgrounds and in turn face many challenges in undertaking tertiary study (Devlin, 2010; University of Ballarat, 2011). A further complication that we are currently facing is the emergence of a demand driven intake which has resulted in a far wider range of students that has been

encountered by UB to instruct, support and assess.

ITECH1000 Programming 1, SITEs CS1 course, is a core course within many UB degrees including the Associate Degree, all the undergraduate IT degrees delivered by SITE, the Bachelor of Mathematical Sciences, in most of our conversion Masters degrees and the course is also offered by most of our partners. Students enter our degrees through a variety of means including students with ATAR scores, direct entry, students articulating from TAFE, students who have completed our Foundation Access Studies Program (FAST), mature aged students, along with international students from a variety of countries and educational backgrounds. This diverse, mix of students has made the shaping and delivery of courses to be a continually challenging and evolving process within SITE.

Since 2001 ITECH1000 has undergone a significant number of structural and pedagogical changes following the trends of many other universities and lines of research (Barnes et al., 2008; Koffman & Wolz, 1999; Smith & Boyd, 2001). During this time the school also developed a number of partnerships with private providers; as a consequence, the programming course underwent further changes to internationalise the content of the courses and to accommodate a wider variety of commencing student types. The course also had to be developed in such a way that it could be delivered as a standalone package to enable partner lecturers to deliver the material successfully and without further development. Adding to this momentum of change was the school adopted policy of providing students with early feedback within all first year courses. This process of early intervention enabled students who were struggling with the course to be given an opportunity to seek personalised assistance early and in turn raise their chances of successful course completion.

Like many other universities we also utilised a number of other evolving and differing approaches to aid student learning. These approaches have included, but are not limited to, the use pair-programming within the laboratories (Nagappan et al., 2003), using exercises to challenge high-achieving students who were becoming disengaged, using robots to enable program visualization (Wu, Tseng, & Huang, 2008), and implementing a Peer Assisted Study Scheme (PASS) to provide further assistance to students (Devey & Carbone, 2011). Nonetheless students continue to have difficulties.

It has become apparent that we now need to focus on the demographics, needs, motivations and expectations of the students involved. The first step towards this new approach was to develop an understanding of the backgrounds, motivations and perceptions of the new students entering the course. We also intend to study how these factors change for the student during the lifespan of the course.

The Study

The purpose of the main study was to develop an understanding of the students undertaking the first programming course in our IT degrees, focusing on the motivations and perceptions of these students. A series of exploratory surveys were planned over the semester including prior to the students first lecture, the mid-point of the semester (week 6 of 12), and in the final week of learning (week 12).

This paper focuses on the data collected prior to the first lecture in week 1 of the first 2012 semester and contained a series of questions covering demographic data, perceptions of programming, issues regarding the commencement of programming, prior programming experience, students' thoughts regarding how they would approach the course, and the final result the student expects to obtain for the course.

Further data was collected throughout the semester to provide a comparison with the students' initial responses, focusing on their perceptions of success or failure within the course, how their view of what programming is changes and where they will seek assistance. This data is continuing to be gathered and analysed for future publications and presentations. In the following section we provide a description of the participants of the survey, an overview of the initial data that has been collected and how the data has been analysed.

Results

Participants and Data Collection

The participants are fifty eight (N=58) students who were enrolled in ITECH1000 Programming 1 which, as outlined earlier, is the first programming course taught within a number of degree programs at the University of Ballarat and is generally a core, unavoidable course for most enrolled students. The course may also be taken as an elective by other students at the University but in general this is a rare occurrence. The data collected was

analysed using Minitab. Descriptive analysis was conducted using Pearson Chi-squared tests and basic thematic analysis was used to model trends.

Participants – Demographics

The majority of the students who participated in the study were under twenty (20) years of age (72.4%). The cohort was predominantly male (82.8%) and there were only small number of international students who took part in the initial survey (13.8%). Over half of the students entering the course have had some form of prior programming experience (58.6%). The languages previously used by the students varied. Most of the previous experience was completed within a formal school setting, however, a small percentage (8.3%) were self-taught.

We also asked the students why they were undertaking the degree. Most of the students indicated that they were enrolled as they wanted to become an IT professional, with second most common response was that they enjoy working with computers. Surprisingly and encouragingly there were indications that the surveyed cohort had entered our degree and introductory courses with a very solid pre-understanding of the concept and meaning of programming. The students generally expressed a detailed view of what programming meant in terms of: different languages that could be used; automation of processes; the building of applications to solve problems and a multi-industry view point of use. Although interestingly a small number of students who answered this question seemed to confuse scripting with programming. Even more surprising was the consistently solid understanding of what programming entailed. These themes include the likes of: having to apply different languages; continual learning; testing and debugging; and the use of multiple platforms.

None of the students who completed the survey expected to fail the course, with the majority of the students expecting to receive a final grade of HD (33.3%) or D (42.11%). Only four of the respondents expected to receive a final grade of P (7.0%). Due to the low numbers of respondents who indicated that they would receive a C or P grading (N<9), the data for these two categories was combined for the purposes of the analysis.

Expected Results

A Pearson Chi-square test was run to investigate whether there is a relationship between gender and expected final grade. The results indicate that there was not a significant relationship between the gender and expected final grade (see Table1: Gender and Expected Result).

Table 1: Gender and Expected Result

	M	F	All
HD	15	5	20
	70.00	55.56	34.48
D	22	2	24
	44.90	22.22	41.38
C/P	12	2	14
	24.49	22.22	24.14
All	49	9	58
	100.00	100.00	100.00

A Pearson Chi-square test was also run to investigate whether there was a relationship between prior programming experience and expected final grade. The results indicate that there was a significant relationship between the prior programming experience and expected final grade. By examining the table below overall students with prior experience expect to get a higher grade and those without experience lower, this is evidenced by 71.43% of the students with no prior experience expecting to get a C/P grade (Chi-square = 6.920, DF = 2, p-value = 0.031; see Table2: Prior Programming Experience and Expected Grade).

Table 2: Prior Programming Experience and Expected Grade

	Yes	No	All
HD	14	6	20
	70.00	30.00	100.00
D	16	9	24
	66.67	33.33	100
C/P	4	10	14
	28.57	71.43	100.00

All	34	24	58
	58.62	41.38	100.00

Future Directions and Conclusion

We wish to draw what conclusions we can about first year student motivations and pre-existing programming knowledge in order to better prepare materials and shape pedagogical practise. Our ultimate aim is to improve student performance (i.e. grades) without adversely affecting learning outcomes or diluting course content. We especially want to reduce the number of failures and dropouts which are so problematic to a small teaching institution in a competitive environment. We have anecdotal evidence that some students in the past have changed degrees or have dropped out of tertiary study based upon not being able to successfully pass the introductory programming course on their first attempt.

Once we have completed the whole series surveys we will match it up with other sources of data such as attendance records (at labs and lectures), and final grades. We will examine the access of Moodle (our electronic repository for materials) to see whether students are finding more flexible ways to learn the material. We will also examine any exit interviews provided by students who do drop out although these are not always available.

We then expect to expand our studies to our partner institutions who are also concerned about failure and dropout rates. These students differ in demographics from those at our Mt Helen campus in that they are mainly international students. We would expect these students to have a different set if backgrounds, concerns and motivations from those of our domestic students. We will also conduct surveys with our Programming 2 (CS2) students and students in more advanced courses to how motivations have changed during the course of their degrees.

This initial survey into various perceptions, motivations and concerns of students commencing our CS1 course (Programming 1) was an exploratory survey conducted in response to concerns of high failure and dropout rates of students in these early core courses. We found students, in general, have very positive attitudes towards their new course, expect to do very well and have a firm entering understanding about what programming means and entails. Many of them had very explicit ideas of what careers they wished to pursue once they finish their degree which indicates an intrinsic motivation towards their studies. Follow up studies will attempt to elicit if and when these motivations change and will be used to find possible remedies for this problem.

References

Barnes, T., Powell, E., Chaffin, A., & Lipford, H. (2008). *Game2Learn: Improving the motivation of CS1 students*. Miami, Florida: ACM.

Bergin, S., Reilly, R., & Traynor, D. (2005). *Examining the role of self-regulated learning on introductory programming performance*. Seattle, WA, USA: ACM.

Bonar, J., & Soloway, E. (1983). Uncovering principles of novice programming. *Proceedings of the 10th ACM SIGACT-SIGPLAN Symposium on Principles of Programming Languages,* Austin, Texas. 10-13. doi: 10.1145/567067.567069

Devey, A., & Carbone, A. (2011). Helping first year novice programming students PASS. *Thirteenth Australasian Computing Education Conference (ACE2011),* Perth, Australia.

Devlin, M. (2010). Non-traditional university student achievement: Theory, policy and practice in Australia. *Keynote Address Delivered at the 13th Pacific Rim First Year in Higher Education Conference,* Adelaide, Australia. *, June 27-30*

Koffman, E., & Wolz, U. (1999). CS1 using java language features gently. *SIGCSE Bull., 31*(3), 40-43. doi: 10.1145/384267.305845

Lewandowski, G., Gutschow, A., McCartney, R., Sanders, K., & Shinners-Kennedy, D. (2005). What novice programmers don't know. *Proceedings of the First International Workshop on Computing Education Research,* Seattle, WA, USA. 1-12. doi: 10.1145/1089786.1089787

Lister, R., Adams, E. S., Fitzgerald, S., Fone, W., Hamer, J., Lindholm, M., . . . Thomas, L. (2004). A multi-national study of reading and tracing skills in novice programmers. *SIGCSE Bull., 36*(4), 119-150. doi: 10.1145/1041624.1041673

Nagappan, N., Williams, L., Ferzli, M., Wiebe, E., Yang, K., Miller, C., & Balik, S. (2003). Improving the CS1 experience with pair programming. *SIGCSE Bull., 35*(1), 359-362. doi: 10.1145/792548.612006

Ramalingam, V., LaBelle, D., & Wiedenbeck, S. (2004). *Self-efficacy and mental models in learning to program*. Leeds, United Kingdom: ACM.

Roberts, M. R. H., McGill, T. J., & Hyland, P. N. (2012). Attrition from australian ICT degrees – why women leave. *Proceedings of the Fourteenth Australasian Computing Education Conference (ACE2012)*, Melbourne, Australia.

Smith, P. A., & Boyd, G. (2001). Introducing OO concepts from a class user perspective. *J.Comput.Sci.Coll., 17*(2), 152-158.

University of Ballarat. (2011). *2012 charter.* (No. October 2011). http://www.ballarat.edu.au/__data/assets/pdf_file/0016/35602/UB_Charter_2012.pdf: University of Ballarat.

Wu, C., Tseng, I., & Huang, S. (2008). In Mittermeir R., Syslo M.(Eds.), *Visualization of program behaviors: Physical robots versus robot simulators* Springer Berlin / Heidelberg. doi: 10.1007/978-3-540-69924-8_5

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