‘Happiness’: Can Pervasive Computing Assist Students to Achieve Success?

Adriana Wilde
Electronics and Computer Science
University of Southampton
Southampton SO17 1BJ
United Kingdom
agw106@ecs.soton.ac.uk

Ed Zaluska
Electronics and Computer Science
University of Southampton
Southampton SO17 1BJ
United Kingdom
ejz@ecs.soton.ac.uk

Hugh Davis
Centre for Innovation and Technology in Education
University of Southampton
Southampton SO17 1BJ
United Kingdom
hcd@soton.ac.uk

UbiComp '13 Adjunct, Sept 8-12, 2013, Zurich, Switzerland.
ACM 978-1-4503-2139-6/13/09...$15.00.

Abstract
Computing is traditionally used in higher education with fairly static configurations (fixed equipment, location and access times), but a range of powerful, sensor-rich, mobile devices are now widely available. Furthermore, the majority of current university students are highly digitally-literate, therefore the adoption of mobile technology to facilitate their learning is an interesting potential development. Such a shift, besides providing enhanced access to learning resources, could offer a greater understanding of student behaviour which could then be used to help students, e.g. by prompting them into adopting behaviour likely to increase their chances of academic success. We have explored the existing use of context-aware technologies in education, and we will study the behaviour of higher-education students in order to inform a behavioural intervention in future studies.

Author Keywords
Happiness; Higher Education; students; behavioural intervention; pervasive computing

ACM Classification Keywords
H.5.m [Information interfaces and presentation]: Miscellaneous; J.4 [Computer Applications]: Social and Behavioural Sciences.; K.3.m [Computers and Education]: Miscellaneous

Introduction

Development in microelectronics and mobile technologies has accelerated the growth of pervasive computing, as the combination of inexpensive processing power, sensing capabilities and connectivity now facilitates the adoption of sensor-rich mobile devices (such as smartphones). Using pervasive computing, tailored services from many applications can be offered to users based on their current context. An application area of increasing interest is education, however much of the interest has focused on the delivery of learning resources [8] and the provision of virtual learning environments rather than identifying *what successful students do*. We are interested in modelling the behaviour of successful students by focusing on measuring 'happiness', on the assumption that it is a contributing factor and also a proxy for future success: not only success makes us happy, but a positive outlook attracts success [9]. In this research we will use smartphone data to infer a behaviour model of higher-education students. Our research hypothesis is that an intervention in students' behaviour to increase their happiness could impact positively on their academic success. In particular, using mobile technologies to facilitate such an intervention is an interesting proposition. Such technologies have the potential for a greater understanding of student behaviour: we set out to identify what successful students do, and then use this knowledge to help students, by prompting them into adopting behaviours identified as likely to increase their chances of academic success. Furthermore, this study could inform our general understanding of human behaviour with regards to potential links to well-being, happiness and success.

Happiness and Success in Education

The measure of academic success does not reside only in achieving high grades (although there might be a correlation). Even if it were, any intervention after the grades were available could only have a limited impact. Ongoing observations on the general well-being of students are more appropriate for a timely intervention, especially considering the unprecedented access to a range of technologies that have the potential to help interpret student behaviour and improve their learning experience.

One valid approach to understanding student behaviour uses technology to gather data about activities from which the general well-being of successful students can be inferred. A second step then uses these findings to inform students. The technology available for collecting activity data is not only becoming more diverse and powerful but it is also becoming widely available. Indeed, the greater affordability of smartphones and Internet access not only means that all students *can* access learning materials anytime and anywhere (which does not necessarily mean that they do) but also, more than ever before, we can learn more about student habits and context.

The application of pervasive computing in the area of education exploits both the opportunity of the ubiquity of devices and the increased user interest in technology. There is existing research in this direction but it is mainly focused on the use of pervasive technologies, as follows: to use the student context to inform the learning activity design [7];to provide digital augmentation to enrich the learning experience of the students [10]; to increase access to content and annotation capabilities while supporting peer-to-peer learning [12]; and, to increase interaction by broadening discourse in the classroom [6] or by playing mobile learning games.These approaches tend to focus on the technology, and do not address the use of contextual information in order to predict or even understand student behaviour. To address this shortcoming, we will consider

Figure 1: The Hitachi Business Microscope (HBM) [1]

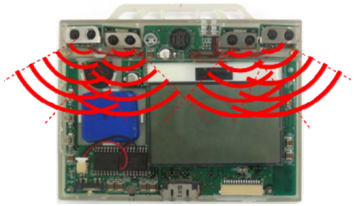

Figure 2: The HBM has infrarred sensors, a tri-axial accelerometer, a microphone and other sensors [1]

context aware computing methods and techniques that have been applied successfully in the areas of healthcare, assisted living and social networking, and apply them to higher education. Many researchers have worked on the acquisition of context in general (e.g.[4]) and on the discrimination of human activity in particular, and these findings are also relevant.

'Sensing' human behaviour
Information about human behaviour can be gathered via sensors, as with the Hitachi's Business Microscope (HBM) [13], shown in Figures 1 and 2. The HBM is a smart badge that has been used in research mainly within organisations [1, 5, 14]. Given the wide availability of smartphones, we are interested in measuring certain behaviour characteristic variables from smartphone data, as well as using traditional questionnaires in order to study the correlation amongst the measured values of behaviour characteristic variables and personality traits. The focus is on higher education students, and the data hence collected could be used to discriminate behaviour with a similar approach to that used in activity recognition.

Objective for attending the Doctoral School

Although published papers reveal the existence of robust, large datasets from which human behaviour is inferred [2, 3, 11], these are not easily accessible. Adriana's main objective for attending the School is to receive advice on the difficult problem of gathering the data required for this study and possibly facilitate collaborations with research groups which have built datasets which could be used in the next phase of this research.

Conclusions

Students in higher education today have had unprecedented access to digital technology, which suggests that they might welcome its use to better achieve goals of academic success, or their proxies, general well-being and happiness. Furthermore, the knowledge that human behaviour is highly predictable, given what we may know of our history and that of our peers, is a driver in this research, as well as the use of "nudges" to guide and enable choice towards effective behavioural interventions.

We have identified a new area of research not yet well explored which is combining contextual information (to be gathered via smartphones) with educational analytics in order to understand students' behaviour and then to use this analysis to prompt students into positive behaviours to increase their chances of academic success. We then formulated two specific research questions: "how to infer the interests, motives and behaviours of successful students" and "how could pervasive computing improve students' learning experience", proposing in particular to raise behavioural self-awareness via a personalised smartphone app, and to provide information about what successful students in their community do.

The implications of this research, whilst at present limited to students at one university, are wide and deep, as any findings will help advancing our understanding of human behaviour in general.

Biographical sketch

Adriana received a B.CompSc.(Hons) degree from the Universidad Central de Venezuela, a PGCE(PCET) from the University of Southampton (UK) and a MSc in Computer Science by the Universities of Berne, Fribourg and Neuchâtel (Switzerland). Since 29 Sep 2011, she has been working on her PhD in Electronics and Computer Science (ECS) at the University of Southampton, with an estimated completion date of 28 Sept 2016. She has been

awarded a Mayflower scholarship from ECS under which she has teaching and examining duties in undergraduate and Master courses to fund her research. Her supervisors are Ed Zaluska and Hugh Davis.

References

[1] Ara, K., Akitomi, T., Sato, N., Tsuji, S., Hayakawa, M., Wakisaka, Y., Ohkubo, N., Otsuka, R., Beniyama, F., Moriwaki, N., et al. Healthcare of an organization: using wearable sensors and feedback system for energizing workers. In *Proceedings of the 16th Asia and South Pacific Design Automation Conference*, IEEE Press (2011), 567–572.

[2] Böhmer, M., Hecht, B., Schöning, J., Krüger, A., and Bauer, G. Falling asleep with angry birds, facebook and kindle: a large scale study on mobile application usage. In *Proceedings of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services*, ACM (2011), 47–56.

[3] De Domenico, M., Lima, A., and Musolesi, M. Interdependence and Predictability of Human Mobility and Social Interactions. In *The Nokia Mobile Data Challenge Workshop (collocated with PERVASIVE)* (June 2012).

[4] dos Santos, A. G., Cardoso, J. a. M., Ferreira, D. R., Diniz, P. C., and Chaínho, P. Providing User Context for Mobile and Social Networking Applications. *Pervasive and Mobile Computing 6*, 3 (2010), 324–341.

[5] Eguez Guevara, J., Onishi, R., Umemuro, H., Yano, K., and Ara, K. Personality and mental health assessment: A sensor-based behavior analysis. In *ACHI 2011, The Fourth International Conference on Advances in Computer-Human Interactions* (2011), 22–27.

[6] Griswold, W. G., Shanahan, P., Brown, S. W., Boyer, R., Ratto, M., Shapiro, R., and Truong, T. M. ActiveCampus: Experiments in Community-Oriented Ubiquitous Computing. *Computer 37*, 10 (2004), 73–81.

[7] Hwang, G.-J., and Tsai, C.-C. Research Trends in Mobile and Ubiquitous Learning: A Review of Publications in Selected Journals from 2001 to 2010. *British Journal of Educational Technology 42*, 4 (2011), E65–E70.

[8] Laine, T. H., and Joy, M. Survey on context-aware pervasive learning environments. *International Journal of Interactive Mobile Technologies 3*, 1 (2009), 70–76.

[9] Lyubomirsky, S., King, L., and Diener, E. The benefits of frequent positive affect: does happiness lead to success? *Psychological bulletin 131*, 6 (2005), 803.

[10] Rogers, Y., Price, S., Randell, C., Fraser, D. S., Weal, M., and Fitzpatrick, G. Ubi-Learning Integrates Indoor and Outdoor Experiences. *Communications of the ACM 48*, 1 (2005), 55–59.

[11] Vázquez, A., Oliveira, J. a. G. O., Dezsö, Z., Goh, K.-I., Kondor, I., and Barabási, A.-L. Modeling bursts and heavy tails in human dynamics. *Physical Review E 73*, 3 (2008), 036127.

[12] Yang, S. J. Context Aware Ubiquitous Learning Environments for Peer-to-Peer Collaborative Learning. *Journal of Educational Technology and Society 9*, 1 (2006), 188.

[13] Yano, K. The science of human interaction and teaching. *Mind, Brain, and Education 7*, 1 (2013), 19–29.

[14] Yano, K., Lyubomirsky, S., and Chancellor, J. Sensing happiness. *Spectrum, IEEE 49*, 12 (2012), 32–37.