ITGS - A blueprint for a Social Informatics Course in Pre-university Education

Richard Taylor

International Baccalaureate, Cardiff, United Kingdom
richard.taylor@ibo.org

Abstract. The continual development of information and communication technologies in contemporary society has led to a constantly evolving inter-relationship between human beings and these technologies. Within the university sector there is a wide range of courses which examine this inter-relationship, but such courses are largely absent from the pre-university sector. One pre-university course that attempts to examine this inter-relationship is the Information Technology in a Global Society (ITGS) course which is part of the International Baccalaureate (IB) Diploma Programme. This position paper examines whether this course may be seen as a blueprint for the development of other similar courses in the pre-university sector, and how such courses will be able to accurately reflect the constantly evolving inter-relationship between human beings and information and communication technologies.

Keywords: digital capability, digital literacy, digital wisdom[1], Information Communication Technology (ICT[2]), Information Technology in a Global Society (ITGS), International Baccalaureate (IB) Diploma Programme[3], stakeholder analysis, social informatics

1 Introduction

The introduction of information and communication technologies into schools in the 1980s was followed by the development of related courses. One area of curriculum development was in Computer Science, which was, and still is to a great extent, largely based on programming; a second was linked to the application of new software packages such as Microsoft Office™ and became known as ICT. Over the subsequent two decades the development of information and communication technologies has

[1] Digital wisdom and digital capability in this paper may be viewed as synonyms. Both relate to an interpretation of the term "media wisdom" that encompasses; technical competence, creativity, analysis and reflection (Martens 2011).

[2] Information and Communication Technology is a subject in secondary education. This is different to information and communication technologies, the use of digital devices to store, send and receive information, which is not abbreviated throughout the paper.

[3] International Baccalaureate Diploma Program is a pre-university course for 16-19 year old students. More information can be obtained from www.ibo.org

adfa, p. 1, 2011.

occurred at a much faster rate than the curriculum development of both ICT and Computer Science, thus leading to courses that may be seen as anachronistic and largely irrelevant in today's technological landscape. This is illustrated in the decline in the numbers of students that follow these courses, see Table 1.

Table 1. Candidate registrations of UK ICT related pre-university courses (2007 – 2011).

ICT related Course	Registered candidates (2007)	Registered candidates (2011)	Change 2007 - 2011
GCE in ICT	10968	9133	-17%
GCE in Computing	4683	3606	-23%

Source: Shut down and restart [8].

Seminal papers by Wing (Computational Thinking, 2006) and McBride (Death of Computing, 2007) questioned the nature of Computer Science resulting in the revision of the International Baccalaureate Computer Science course and the development of the United States Advanced Placement (AP) Computer Science Principles course. In these courses computational thinking is placed at the heart rather than programming. As the assessment of students4 in either course will not take place until at least May 2014, the effects of this paradigm shift have yet to be seen.

In ICT the decline in student numbers has continued unabated. However, in contrast to Computer Science, there not been a similar discussion questioning the nature of the subject. This has resulted in the absence of a coherent strategy to provide a subject that is appropriate in the current technological landscape. Changes to technology have occurred far more rapidly than the ability of exam boards[5] to keep pace and have resulted in ICT lagging behind the technologies it studies (or effectively playing 'catch-up'), something that is similar to what occurs in legal and regulatory fields. ICT has also struggled due to a lack of a clear identity and, indeed, many policy makers and school managers regularly use Computer Science and ICT as synonyms.

2 The International Baccalaureate ITGS course

In the early 1990s a group of teachers and the IB Subject Manager, Ruth Baber, realised that in addition to the Computer Science course there was demand for a course that focussed on the inter-relationship between human beings and the emerging information and communication technologies. As a result, the ITGS course was "born".

[4] Assessment refers to the first year that students are examined in these courses. The IB Computer Science course will be taught from August 2012. Pilot studies for the new AP course started in 2011.Registration for the assessment does not need to be completed until November 2013, so the effects on student uptake will not be apparent until then.

[5] Exam boards are responsible for the development and assessment of courses for public examinations.

Since these early days, the course has undergone three curriculum reviews[6] but struggled to find an appropriate position within the IB Diploma Hexagon[7]. The current version of the course is within Group 3 (Individuals and Societies) and has been taught in schools worldwide since August 2010.

ITGS focuses on stakeholder analysis. The 'ITGS triangle' (see figure 1) is at the heart of the course. Within this framework, scenarios based on the inter-relationship between human beings and information and communication technologies are based on three strands; social/ethical significance, application to specified scenarios, and IT systems. They are taught in an integrated and iterative manner.

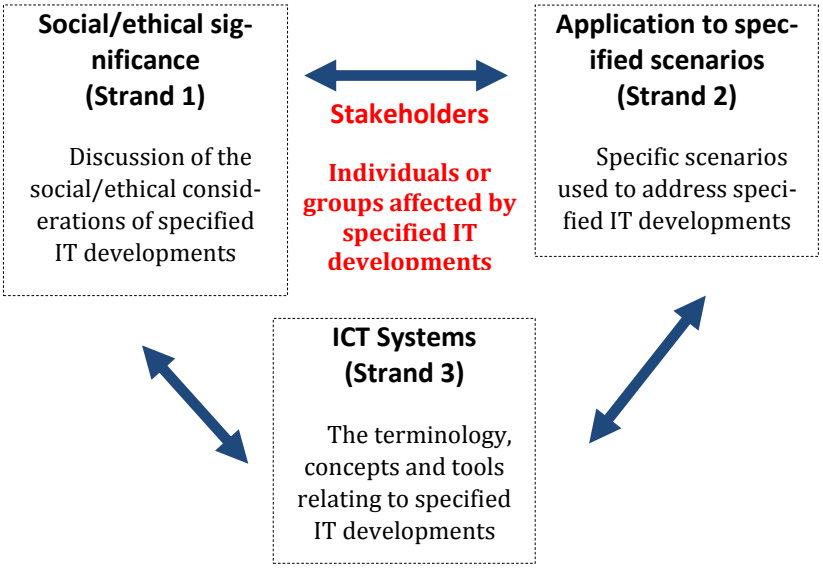

Fig. 1. The integrated stakeholder focussed approach outlined in the ITGS Guide[8] [7].

Teachers may choose any of the three strands as a starting point.

The level of technical knowledge required by students of the course is confined to the general principles that underpin the technology. In summative assessment[9] only

[6] The IB Curriculum Review is carried out over a 7 year cycle. This leads to the development and implementation of a new course.

[7] Subjects are categorised into six groups (Studies in language and literature, Language acquisition, Individuals and Societies, Experimental sciences (including Computer Science), Mathematics, The arts), see http://www.ibo.org/diploma/curriculum/ and must take a subject from each.

[8] ITGS Guide (Specification), a document that indicates the scope of the ITGS course for teachers

[9] Summative assessment is assessment that takes place at a given time, for example, at the end of a course.

lower order command terms[10] such as describe, identify, state and outline are used. Therefore a student should be able demonstrate knowledge of a specified technology or provide an overview of a process by identifying the key steps. For example, an ITGS student would be able to identify the steps that a biometric authorisation device would use in the authorisation of an employee to enter a building. In a Computer Science curriculum, instead, it may be necessary to suggest possible algorithms that could be used to determine whether the image captured matches the image in the database.

An equivalent course does not exist in programmes such as the AP Program, Victoria Certificate of Education (VCE) and French Baccalaureate, and the course is significantly different to other IT related courses, such as United Kingdom (UK) A-Levels. In ITGS students are required to apply their knowledge to a wide range of scenarios leading to substantiated opinions being developed that are underpinned by the proficient use of both technical and social/ethical vocabulary whereas in other IT related courses the discussion of social/ethical issues is usually more superficial.

As ITGS may be considered as "low content, high context[11]" compared to other subjects, many senior managers in school and external organisations have not appreciated the transferable and higher order skills such as application, formulation, synthesis and evaluation that are required to successfully follow this course. This is not just an issue for ITGS, both in terms of its perceived rigour, as it is one of the few IB subjects that the Russell Group[12] does not recognise as being sufficiently academic or acting as a facilitating subject, but also for other ICT related courses.

3 Reflections of the Current ITGS Course

There is a widespread belief that once students opt for ITGS they find it a relevant, stimulating and challenging course. Many past students have referred to it as the subject that was the least use for university entrance, but the one that had the most relevance in later life. However, getting this message across to school senior managers, potential students and their parents has proved problematic.

As part of the ongoing curriculum review process for ITGS, which will result in a new course being introduced for the May 2019 examination session, a prototype questionnaire was tested using 64 students from a Florida High School in the US. This school was chosen as the ITGS teacher had been involved in the previous curriculum review and because it provided easy access to a large number of students, something that is not always possible as, in many schools, ITGS classes may have fewer than 10 students.

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[10] Command terms provide an indication of the depth of response required and are based on Bloom's Taxonomy.

[11] "low content, high context" refers to courses that rely on the application of a smaller body of knowledge to a wide range of scenarios or contexts – an applied course. This is in contrast to a "high content, low context" course where a narrow in-depth field of study occurs based on specified content – a theoretical course.

[12] The Russell Group represents 20 leading UK universities

The main findings from the research indicated in Table 2 below, were most positive. There was a general satisfaction with the nature of the course with none of the 13 questions producing an average response below the no opinion score (3). The students felt most strongly that there was an appropriate balance between the three strands of the subject, a mean response of 4.47 (individual responses ranged from 1 to 5). The feedback obtained about each of the strands indicated a reasonable level of satisfaction, although not as much as the overall structure of the course. Comments such as" I feel like there is too much content in the course. I think it is slightly unreasonable to expect students to remember and understand such an extensive list of vocabulary, and then be able to apply them to such a large range of IT subjects and problems" suggest that an appropriate balance between the content and scenarios has yet to be reached.

Table 2. Summary of findings of questionnaire completed by St Petersburg High School.

Question	**Ave response[13]**	**Standard error**
The ITGS course provides sufficient opportunities to address the attributes of the Learner Profile[14]	4.11	0.09
There is a correct balance between Social/ethical significance, application to specified scenarios and IT systems	4.47	0.08
The range of social/ethical considerations (Strand 1) is appropriate	4.19	0.07
The range of specified scenarios (Strand 2) is appropriate	3.90	0.08
The range or depth of technical knowledge required for IT systems (Strand 3) is appropriate	4.08	0.09
The Project[15] has the right amount of technical difficulty for the subject	4.17	0.09

Sample size = 64

These findings suggest there is a need to amend the nature and/or content of each of the strands. As part of the current curriculum review in 2011 preliminary feedback was obtained from Bradshaw who commented "IT Systems is presented only as an ever increasingly long list of hardware and software that is only ever partially complete, impossible to keep up to date and, of most concern, of variable levels of 'difficulty' for the students" as well as McBride who noted "change is inevitable and the

[13] The questionnaire was based on a 5 point Likert scale (1 – Strongly disagree, 5 – strongly agree)

[14] Learner profile – a set of attributes such as inquirers, thinkers, principled that provide the basis of an IB student

[15] Project – the internally assessed work (coursework) that is created by students in consultation with a named client. This provides the opportunity for a student to showcase their practical skills.

subject matter is volatile. Who can know what the world will be like in 2017? How will technology change? What will be the issues faced in terms of society and ethics? And there is a dynamic population of stakeholders".

The Project, an activity that requires students to develop an original product in consultation with a specified client using a simplified project management approach, forms the internal assessment16 (coursework). The students feel it is appropriate for the course as well as being a part of the course that teachers and students enjoyed. It also allows them to demonstrate their practical IT skills (digital literacy). Currently it is the only place within the IB Diploma, as the existing Computer Science course concentrates on programming, where students could carry out this type of activity.

In the medium term it is highly likely that this component of the ITGS course will need to undergo significant change to a more in-depth evaluation of the socio-technical systems that emerge. The development of the Web as a social machine will require a reduction in emphasis on the skills required to develop products and a more in-depth understanding of the inter-relationship between human beings and information and communication technologies. With the more explicit focus on stakeholder analysis and the ITGS student acting in the role of an intermediary between policy makers and developers within a project management framework, a new internal assessment will need to be developed. This change will also be possible as the assessment of student work may include the students completing their examinations in a digital environment which will allow digital literacy to be assessed through this medium. Furthermore, developments in software allowing students to be able to create highly complex products simply by following on screen menus and the internal assessment of the Computer Science course which is similar to the current Project will render the Project redundant.

4 Possible Constraints in Introducing a Pre-university Social Informatics Course

There are a number of major obstacles that may exist to the development a new ICT course based on Social Informatics. The stigma of ICT, whereby many universities are unwilling to accept students from a course that is ICT related is particularly problematic. One method of resolving this may be to replace ICT as the name of the subject with Social Informatics. However, Social Informatics is a term that has not been used and is likely to not be understood by senior managers and teachers in secondary education or by parents so may simply be a case of replacing a 'tarnished' subject with an unknown one.

Currently, ICT does not have the support of high profile backers, in a way that Computer Science does. Eric Schmidt, the Chairman of Google, commented that the "IT curriculum focuses on teaching how to use software, but it doesn't teach people how it's made" [4]. This could result in the 'technology related' part of the curriculum

[16] Internally assessed work – the student completes the work under the supervision of the ITGS which then marks it. The work is then externally moderated.

becoming based on the assumption of the student as a potential developer of information and communication technologies rather than as a user. The potential risks that are associated with an overemphasis of the opinions of special interest groups "they give too much emphasis to the special pleading of particular institutions and industries (universities and software companies, for example), or frame the need for better teaching in purely economic terms as being good for "UK plc" [6] should also be recognised.

Senior managers in schools still view ICT, Computer Science and Digital Literacy as synonyms. Therefore, before the introduction of any Social Informatics course, these distinctions need to be made explicit. Furthermore, the provision of appropriate professional development for teachers who may lack the confidence to be able to teach the subject will be necessary.

5 Leading the Way in Social Informatics

Despite the number of obstacles facing the subject of ICT, the continued emergence of new information and communication technologies makes a case for an appropriate secondary education course more and more compelling [1].

The methodology described previously is similar to that outlined by Duquenoy et al in the paper presented at the 2010 Ethicomp conference. In this paper, the integrated stakeholder focussed approach developed in ITGS is likened to climbing stairs with the students starting with the context and progressing to recommendations for modification to the proposed IT system or alternative solutions. The diagram below shows a revised version of the linear approach proposed (context – stakeholders – ethics – reflexivity[3]) with an iterative approach.

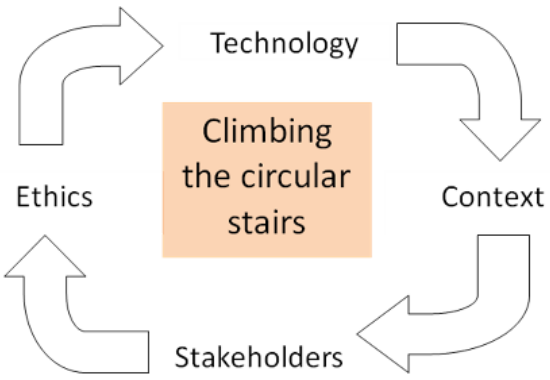

Fig. 2. A model for climbing circular stairs.

The role of stakeholder analysis in a Social Informatics course is critical to the development of the student understanding the social/ethical issues that lie beyond the technologies themselves. It was noted that "many students have had no exposure to

the ethical issues that are associated with information and communication technologies, so a bottom up approach is required" [3]. Furthermore Gotterbarn and Clear comment that, "many IT related courses which tend to be high-content, low context" [5] which has led to IT tools being developed at the expense of an understanding of the effects of their use.

The development of Social Informatics courses would place digital wisdom[17], or "digital capability" [1] at the heart of the course. This would require the student to be able to appreciate the implications of the introduction of new technologies and clearly goes beyond digital literacy, a concept championed by the Royal Society[18] and the state of California[19], which may be defined as the ability to use IT tools appropriately. The 2012 ITTE position paper, "the future of ICT in education", argues that "whilst 'Digital Literacy' is well established, it is a broad and often ill-defined concept incorporating a range of associated literacies (media literacy, information literacy, visual literacy, etc.). In addition, as has been highlighted by The Royal Society (2012), Digital Literacy does not readily lend itself to being taught – it constitutes a passive state, rather than the application of digital technologies"[1].

Any Social Informatics course would also need to ensure it addresses the new disciplines that are associated with the emerging technologies. "The movement towards ubiquitous computing is based on interaction and convergence. Here, convergence means a move towards a common content. Interaction means that technology interacts with the social world with values and beliefs" [2].

In recent years, the growth of ubiquitous computing and 'the Cloud' where information is constantly available has led to the most significant changes in the nature of human existence since the Industrial Revolution. The understanding of the constantly ever evolving inter-relationship between human beings and information and communication technologies may be seen as a new discipline that future citizens should have at least an awareness of.

In this 'new world' home and work will become increasingly blurred and the ability to successfully exist in the digital world will rely less on the 'traditional skills' associated with digital literacy and more on those associated with digital wisdom. A parallel may be drawn between the changes that took place in employment where traditional skills developed in primary and secondary industries were replaced by those in tertiary and quaternary industries. Therefore if schools are to provide students with the skills to exist in the emerging technical environments, the study of these skills needs to be far more prominent than they currently are. The issue may fundamentally be about where within the secondary school curriculum this wisdom can be developed, rather than whether it should.

It is critical, therefore, that any course that attempts to reflect these changes is able to adapt at the same speed. This will need a significant rewriting of ICT courses to provide a programme of study that can be as 'future proof' as possible. This would

[17] The Association for IT in Teacher Education (ITTE) uses the term digital capability in a similar context

[18] Shut down or restart (Royal Society 2012)

[19] Digital Literacy pathways (2010), www.ictliteracy.info/rf.pdf/Digital%20LiteracyMaster_July_2010.pdf

include the re-organisation of subject matter, through curriculum development, to fit into new categories that allow the course to evolve with the technology. The scenarios for discussion that emerge could be supported by teacher resources through wikis, such as ITGSopedia[20]. This collective intelligence of teachers and students would ensure the provision of contemporary and appropriate resources that does not have the lag time associated with textbooks.

The study of ethics needs far greater emphasis with an explicit framework, as well as providing a level of recognised academic content that may occur implicitly at present. The uses of models such as the culturally negotiated ethical triangle by authors such as Orams provide a basis for the consideration of ethical decisions within the cycles of stakeholder analysis. With more and more resources being put into 'the Cloud', the ethical issues associated with the remote management of individuals' data will increase in importance. One suggestion for an ethical framework could be based on the ACTIVE[21] framework being developed by McBride et al.

For the introduction of any new subject, professional development would be necessary for secondary school teachers. The skills required to teach this course are closer to those held by social scientists than those from a traditional IT background. However, many of the values, such as those espoused in the IB Learner Profile (inquirers, open-minded, reflective etc.) are as important as subject knowledge for they provide students with the transferable skills and competencies that characterise this type of course. Many teacher training organisations have developed programmes to enhance the skill of digital literacy of their employees or citizens, yet have not provided the opportunities to enable teachers to develop the discursive skills necessary.

6 Conclusions – ICT the Way Forward

Despite the decline in numbers and the uncertainty about what constitutes ICT, groups such as the ITTE see "that education and training in digital technologies is fundamental to all aspects of education in the 21st century" [1]. The current debate may lead to a revision of the courses that are offered based on body of knowledge is appropriate for ICT/Social Informatics and Computer Science as well as the degree of overlap (as both subjects have the requirement for technical knowledge and the social/ethical issues arise from the development and use of technology). Once students make decisions about which subjects they wish to study, it is both possible and desirable that separate courses in Computer Science and a revised ICT can successfully co-exist, as they will appeal to different students.

One possibility for the new ICT could be modelled on an updated version of ITGS, with the stakeholder at the centre, a strengthened focus on ethics, a refining of the specified scenarios and a redesign of IT systems with the main headings such as Overview of the Web, Web Technologies, Data management, and Socio-technical

[20] http://itgsopedia.wikispaces.com/

[21] ACTIVE - Anonymity, Community, Transparency, Identity, Value, Empathy. A framework being developed by McBride et al.

systems. However the redevelopment of ICT, with a possible renaming, will require creating a new brand that is seen as relevant and academically rigorous to ensure its survival in an increasingly competitive marketplace.

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References

1. Association for IT in Teacher Education (ITTE): Position Paper: The future of ICT in education (2012)
2. Bradley,G: Social and Community Informatics - Humans on the Net. Routledge, London, New York (2006)
3. Duquenoy, P., Martens, B., Patrignani, N.: Embedding Ethics in European Information & Communication Technology Curricula. Ethicomp (2010)
4. Gigaom, Eric Schmidt challenges teachers: get with the program: http://gigaom.com/2011/08/29/eric-schmidt-challenges-teachers-get-with-the-program/ (accessed 21 March 2012)
5. Gotterbarn D., Clear, T.: Using SoDIS™ as a Risk Analysis Process: A Teaching Perspective (2003) http://www.acs.org.au/documents/public/crpit/CRPITV30Gotterbarn.pdf (last accessed on 29th April 2012)
6. Guardian: A manifesto for teaching computer science in the 21st century: http://www.guardian.co.uk/education/2012/mar/31/manifesto-teaching-ict-education-minister?CMP=twt_fd (accessed 2 April 2012)
7. International Baccalaureate Organisation, www.ibo.org
8. Furber, S.: Shut down or restart. The Royal Society (2012) http://royalsociety.org/education/policy/computing-in-schools/report/ (last accessed on 29th April 2012)