



QSITE

educators of today, creating tomorrow

QSITE Response to STEM Discussion Paper

The Queensland Society for Information Technology in Education (QSITE) is the peak state teacher professional association in Queensland supporting teachers' use of information and communication technologies in the education. This document represents QSITE's response to the Science, Technology, Engineering and Maths (STEM) Discussion paper released by the Queensland Government through the Department of Education, Training and the Arts.

The QSITE response does not offer answers to all questions in the discussion paper. Rather, it refers to those aspects relating to information technology (IT) and/or information and communication technology (ICT). A multiple acronym IT/ICT has been adopted in this response to cover reference in the discussion paper to these technologies.

The response is organised in four sections: QSITE's role in STEM education; Defining IT/ICT in terms of current and preferred future practice; Issues; and, Priorities. It has been prepared for QSITE by its newly formed Advocacy Group and is based on the findings of a specially-designed online survey of QSITE members. Further correspondence is to be directed to Mr John Oxley, the President of QSITE who may be contacted by email at OxleyJ@mbc.qld.edu.au.

- **QSITE's role in STEM education**

QSITE welcomes the STEM initiative, particularly in relation to information technology (IT) and information and communication technology (ICT), and the opportunity provided to comment upon the government's discussion paper. Information technologies are essential in developments, simulation, knowledge modelling and construction in the desirable learnings related to all STEM areas. QSITE advocates both integration and specialisation with the former supporting the notion of general community literacy and the latter playing a critical role in addressing predicted skills shortages in the IT industry. This belief has been corroborated through the findings of a specially-conducted survey (see *Issues* in this response).

We believe that, although we are in another transition stage where computing technologies are embedded into the curriculum and school procedures, the question of IT/ICT education being compulsory is no longer as crucial or relevant as it used to be. IT/ICT in school is a given. The problem is that school experiences are not equal and still need guidance and support.

QSITE has provided such support, for over 25 years, through its annual conferences, publications, professional development opportunities and the collegiality demonstrated through its online communities. QSITE has also actively supported student participation in IT/ICT through its annual Web Challenge and targeted activities for girls.

- **Defining IT/ICT in terms of current and preferred future practice**

QSITE has identified shortcomings in the STEM discussion paper in relation to its representation of IT/ICT (refer to STEM Q 1.1). The association is concerned about the definitions implied through allusions to IT/ICT and its inconsistent use of terminology. Our adoption of the multiple IT/ICT acronym in this response is due partly to the inconsistency of language in the discussion paper. We believe that these allusions are limiting and are not indicative of the current convergence of technologies or the policy or practice of Queensland schooling.

It is also difficult to ascertain where IT/ICT “fits.” There are instances where IT/ICT is used to exemplify or illustrate particular points e.g. fall in tertiary enrolments, and others where it is omitted, e.g. the data on pp. 45-46 related to the teaching workforce. A clearer vision of what is meant by IT and ICT is required as is a clearer positioning of these technologies within the STEM initiative.

There is also disparity in the use of the broad term, Technology. In some instances, this is used interchangeably with IT/ICT when, clearly, it is more aligned to engineering and the application of tools and crafts (see Section 1.2). IT/ICT also appears as a subset of engineering (see Section 1.2), which while having some resonance in the naming of disciplines, viz. software engineering, seemingly excludes the positioning of IT in particular as a discrete discipline and industry. This usage is, furthermore, contradictory with the defining of IT, from the ABS fields of research, as being information, computing and communication sciences (see Section 1.3). While clearly integral in the contemporary practice of these areas, IT/ICT is also a discrete discipline and industry.

We believe that an accurate and rigorous definition of IT/ICT is a critical preliminary step in formulating practical plans of action. The definition will need to encapsulate the duality of purpose in IT/ICT which is described through this response but may be summarised as being both integrated and a specialist field within STEM education.

- **Issues**

In order to accurately represent the views of its membership, the QSITE Advocacy Group has recently conducted an online survey. This section presents a summary of their responses to eight targeted questions based on topics from the STEM discussion paper which, if not specifically related to IT/ICT, were adapted for this purpose. The related STEM questions (in order of the following text) are: 4.1, 4.2, 1.3, 5.2, 5.5, 5.6, 6.7, and 3.3. Quoted text in this section has been taken directly from survey responses.

Do you believe that IT/ICT should be compulsory in schools? What are the arguments for and against making the study of IT/ICT compulsory in (a) Years 1 to 10, and (b) Years 11 and 12? [Based on STEM Q 4.1]

All respondents agreed that IT/ICT should be compulsory in schools with the overall goal being that “by the time students reach Years 11 and 12, they should be competent users, able to adapt to new technologies and be aware of the social consequences of these technologies.” Respondents argued for both integration of IT/ICT across the curriculum and isolation of IT/ICT within specialist subjects at senior secondary level. The views expressed may be summarised as:

- the importance of IT/ICT as a “necessary life skill” and as “a general literacy of the modern world.”

- the lynchpin role of IT/ICT in an integrated curriculum as “a way of learning rather than a body of skills” which develops “higher-order thinking skills” and “encourages collaborative learning.” This was quite specifically described as “a tool to be exploited in teaching practice rather than a set of content to be covered at different levels.”
- the critical need for specialisation in Years 11 and 12 for students “to be ready and able to either enter further education facilities or start work when they leave school.” Year 10 was described as a potential “transition to specialisation” or the juncture at which VET Certificates could be undertaken.
- the need for comprehensive worthwhile ethical IT/ICT experiences for students scaffolded by qualified teachers rather than students being “left to ... [pick] up the required knowledge somewhere.” These experiences would complement computer technology use at home and elsewhere and “guide ... exploration, help [students] identify dangers and fallacies and effectively use the technology at their disposal.” It would expose student to differing platforms and operating systems.

What approaches could be employed to enrich primary school STEM learning experiences?

Note: Based on STEM Q 4.1

The consensus of opinion was that primary school experiences in IT/ICT should be (a) broadly based across platforms and applications, and (b) integrated across the curriculum so that “a whole picture is developed rather than seeing things in isolated pockets.”

While primary school learning experiences need to be authentic and to be “hands-on,” they also need the rigour described by one respondent as allowing students to “understand that with some IT/ICT skills they are learning, ... [while] they may have a comprehensive understanding and application for that level, they ... should expect to learn more. Embedding the concept of life long learning as this area is an area of rapid change.”

Primary school experiences need to be scaffolded by informed practitioners with one respondent suggesting that:.

- *Connecting kids with real world expertise through online content, collaborations and communities. Teachers also need proven recipes of practice to make this realistic (e.g. Virtual Field Trips, Raps) and PD and tools to support these practices. Syllabus documents need to make explicit reference to these practices as an expectation for schools.*

The need for additional teacher training (pre-service, in-service and mentoring) and support (through human resources e.g. regional training teams and realistic funding) was also identified. These included:

- *More training for teachers and more realistic funding of resources for schools There is a huge gap between the expectations and the deliverable with the current funding and human resources.*
- *Development of extensive support networks for staff. Teachers need to understand the pedagogical implications for using IT/ICT, not only skills.*
- *Focused PD opportunities that do not promote a read and regurgitate type of education and where IT/ICT is integral to the learning process.*

What strategies could be implemented in junior secondary schooling to promote the uptake of STEM subjects in post-compulsory years? Note: Based on STEM Q 4.2

One survey respondent offered:

Is Junior Secondary too late? Children form ideas of what they want to be at a very early age and are influenced by media and the people around them. We need to provide young children with role models and get STEM into the media somehow to make it trendy.

Another, critically, offered that junior secondary learning experiences should offer:

Graduated levels of difficulty, basing work on student's success, allowing fun and incorporating fun and challenge together in the school work program. Allowing a diverse range of learning experiences including experiential learning in a constructivist context. Success in learning is one of the most critical factors. Teacher skills are another factor. Students will not enrol if they consider a teacher to be lacking skills either in IT/ICT or in pedagogy.

The strategies suggested for implementation in junior secondary schooling reiterated some of the points previously raised and offered others relating to:

- *pedagogy appropriate to the age and interests of junior secondary students*
- *authenticity and rigour of student learning experiences with a shift to more problem-oriented tasks*
- *a need to focus on relevance and 'real-world' practices which: attracts all students; provide a "taste" of senior subjects; understand obsolescence and change; create and opportunities for "hands-on" learning.*
- *integration of IT across the junior secondary curriculum*
- *maintenance of equipment to allow a focus on learning and more equitable access to technology*
- *teacher preparation and development*
- *the need to regularly review, renew and update teaching practice*
- *actively advocating and "selling" IT/ICT and STEM studies*

To what extent do you believe that IT/ICT (within a STEM education and skills plan) should be dual-purposed, that is, focussing on enhanced literacies for the whole population as well as preparing young people for careers in specialist fields? Note: Based on STEM Q 1.3

In response to STEM Q1.3, survey respondents were asked to rate the following IT/ICT use in schools in terms of each being (i) not needed; (ii) elective; (iii) important (compulsory); and (iv) critical (compulsory). An inapplicable (N/A) rating was also provided.

- a. Standalone IT/ICT skills
- b. Integrated IT/ICT skills
- c. Extended IT/ICT skills
- d. Computer Science studies
- e. Multimedia skills Games development
- f. IT as application (e.g. bio-informatics)

| | Not needed | Elective | Important (compulsory) | Critical (compulsory) | N/A |
|---|------------|------------|------------------------|-----------------------|----------|
| Standalone IT/ICT skills | 0.0% (0) | 30.0% (6) | 45.0% (9) | 25.0% (5) | 0.0% (0) |
| Integrated IT/ICT skills | 0.0% (0) | 0.0% (0) | 30.0% (6) | 70.0% (14) | 0.0% (0) |
| Extended IT/ICT skills | 0.0% (0) | 65.0% (13) | 30.0% (6) | 5.0% (1) | 0.0% (0) |
| Computer Science studies | 10.0% (2) | 80.0% (16) | 5.0% (1) | 5.0% (1) | 0.0% (0) |
| Multimedia skills | 5.0% (1) | 50.0% (10) | 35.0% (7) | 10.0% (2) | 0.0% (0) |
| Games development | 20.0% (4) | 70.0% (14) | 5.0% (1) | 5.0% (1) | 0.0% (0) |
| IT as application(e.g. bio-informatics) | 5.0% (1) | 70.0% (14) | 20.0% (4) | 5.0% (1) | 0.0% (0) |

In summary, it can be seen that:

- The majority (65%) view standalone IT/ICT skills as **compulsory** but more *important* (45%) than *critical* (25%).
- All respondents view integrated IT/ICT skills as being **compulsory** with the majority rating this as *critical* (70%)
- Extended IT/ICT skills; Computer science studies; multimedia skills; games development and applied IT were predominantly rated as being **elective** rather than compulsory studies.

This finding corroborates the duality of purpose expressed previously where IT/ICT was seen as both the lynchpin to integration and the basis for critical specialisation.

Respondents were also asked about the compatibility of general and specialist approaches to IT/ICT education. There were a range of responses with no dominant view but it was clear that these were seen as two separate and discrete areas with one respondent arguing that “there is room for both, just don’t confuse one with the other.” The response to the question of compatibility thus further corroborates the argument for both integration and specialisation. The key to this response lies in the “and” conjunction indicating that there is a clear but interdependent role for both approaches.

There has been a fall in numbers of students enrolling in elective IT/ICT subjects at senior secondary and tertiary levels. Female participation, initially low, is also falling. What explanations could be offered for this situation? Note: Based on STEM Q 5.2/5.5

The responses to this survey question represent a wide range of opinions. These may be categorised within the interconnected topics of pedagogy and course design, subject image, industry knowledge and opportunities. The comments are here presented in full but grouped to enhance understanding.

Pedagogy and course design

- Boring curriculum. Trend towards picking the 'easy' option. Inexperienced teachers.
- The narrow curriculum approach. Traditional work that appeals to boys more than girls
- Honestly (as a female) I believe this is because the most commonly offered senior subject IPT is dry and boring, often taught by dry and boring male teachers. ITS is slowly being taken up and offers the opportunity to engage students in new, exciting, and current activities that offer practical experience regardless of whether the student decides to do pure IT at university, or something entirely different.
- Not extending the students - "We did this Word assignment 5 years ago - we can still do it now" - So we need teachers to keep ahead of the trend.
- Inappropriate testing. The focus on skills rather than integration.
- It was originally a novelty - now has become 'normal'. Is not exciting and new.
- The course work offered is no more than that which can be achieved on the home computer. The software is all the same - boring. These are the reasons usually given when a student is asked.
- Poor experiences at school with IT/ICT subjects where hardware fails or teachers lack ability to effectively integrate IT/ICT into courses. Lack of access to IT/ICT at school. Too hard. Too nerdy. Students not making informed decision when selecting programs. Perceptions that the IT/ICT industry is not growing.
- The extent to which IT/ICT subjects are seen as not being connected to real life learning needs of students. Is there also a decline in young people's use of technology in the same period? Or of girls use of technology in their own lives? If not, then the fault probably lies with the design of the courses/curriculum.

Subject image

- IT /ICT seen as geek subjects narrowly focussed on programming and systems. More needs to be done on promoting IT as a career out there in the community. Much on the way the Chartered Accountants have in the media. Show the possibilities of having an IT career rather than the Stereotypes.
- Seen as geeky – i.e. might be beyond their capabilities. Girls like to succeed at their subjects - they don't want to risk failing or being seen as unable to do the subject. Girls will often work better in an all girls group - difficult to do in state schools numbers.
- Emphasis on programming drives females away as does emphasis on hardware. Females will not enrol in a subject in which they feel that they will be put down. Many have difficulty in distinguishing that a bombastic, opinionated male student may in fact be absolutely wrong. They will not thrive in this environment and tend to change classes. They need success. They need to understand how IT/ICT can be integrated at a tertiary level, i.e. IT and some other base level degree can often lead to very interesting, challenging and pioneering jobs.
- A recent study indicated that girls don't see the importance in these subjects for their future. I think this comes from conditioning in the family and from society - this is still not seen as a "valued" area for girls to go into in terms of their future.
- IT/ICT subjects not seen as female friendly. Programming orientated and so more to the male liking. Perceptions that ICTs are difficult. Lack of knowledge of the content of IT/ICT courses offered.
- Games based on violence. Not showing creative side of IT - Media and advertising -shows the 'geek' side. Non IT people espouse that it is Aspergers' type people only who are attracted to IT. Not showing collaborative side of IT. Teachers not developing classroom experiences based on the students' real world.

Industry knowledge and opportunities

- No definite career paths and little knowledge of the IT industry.
- I think that generally in schools we have a low opinion of IT or no concept of IT as an industry. Teachers and Administrators all too often think that integration is the same as the actual IT industry; they undervalue and estimate and IT industry as a whole. I think that this poor perception of IT shows through and makes it extremely difficult for students to consider IT as a real option. When people make statements like "the create web pages in Year 3" the implication that follows is that this is an easy task that anyone can do. It devalues the industry. Children in Year 3 also write poems and play football but we still seem to recognise that there are levels and that there is a professional level. I don't think the same exists for IT.
- IT jobs are not paying the big money that they used to in the 90's Supply and demand - just part of a cycle, as students enrolling drop, eventually students with IT skills will be in demand and wages will go up.
- Masculine image and lack of role models.
- Lack of awareness of opportunities available. Also often linked to the "nerd" concept rather than one of an effective communicator.

What types of targeted interventions do you think might assist to increase student participation in IT/ICT - particularly those students who are currently under-represented (female, Indigenous, low SES, rural)? Note: Based on STEM Q 5.6

As expected with a contentious issue, there were some strong comments made in regard to this question with some contradictory suggestions made. The targeted interventions suggested included:

- small groups so that students receive individual, just-in-time instruction as required.
- after school/lunchtime classes for specific groups of students e.g. female only classes.
- focussed sessions and programs e.g. Girls & ICTs events, Gidgits
- IT/ICT 'buddies'
- parental involvement
- work placement
- scholarships
- improved curriculum e.g. developing projects that require students to explore the IT/ICT needed to enhance or complete their work, and real-world focused IT/ICT experiences. Topics that engage and interest non-IT geeks.
- programs of study directly aimed at the needs in this area
- access to IT/ICT in authentic, engaging contexts across all curriculum areas.
- teacher re-invigoration
- professional conversations re what works and why
- a very 'upfront' advertising campaign ... Elicit media assistance in portraying the 'whole' population of IT users and creators.

The following comments, somewhat contrary to these suggestions, were made. These generally argue that overall change will be inclusive and thus solve issues of exclusion and under-representation. The overall view is encapsulated in the comment that, "*we need to go beyond random acts of innovation and have a state or Australian wide approach which is promoted to parents, teachers and students.*"

- *Educate the community, parents, and staff. When adults start portraying IT as a valid worthwhile industry then maybe students will.*

- *Provide the facilities and reliability of systems, i.e. Broadband. Show a purpose (real life) for IT so it is seen as being a productive area.*
- *Targeted interventions fail. They fail because they hype one-dimensional approaches to trying to stimulate "interest" for a given group. This sort of intervention inevitably pings off another "group" and then we start wondering why that other group is pinged off or disinterested. So - NONE - develop a well rounded, interesting approach and offer it to all.*
- *Where IT/ICT is used as an integral tool for learning in rich, connected contexts, I suspect nobody asks "are kids learning enough ICTs?" Look at the example of Yarrabah SS (Digital Dreaming - Jason Evert¹) and there is a model of kids and communities engaging in learning about ICTs ... because they need it for real purposes.*
- *I think the days of the girls' "add on" activities at the teachers' expense in terms of time and extra-curricular effort are over. These have been very valuable to the girls who attended but they do not change the numbers, and they are often "one-offs." I have heard of all girls' classes being effective but this is not always practical. I think someone needs to be appointed fulltime to address these issues and be given a budget to work with schools to develop intervention strategies based on research.*

1. see <http://www.abc.net.au/stateline/qld/content/2006/s2050869.htm> for more information on this innovative project

What strategies could assist to attract specialist IT/ICT teachers into the profession, and particularly to take up positions in rural or remote settings? Note: Based on STEM Q 6.7

This question, as with the previous, was also contentious and again drew some specific strategies as well as more polemic expression. The strategies suggested may be summarised as:

- increased pay and conditions (including housing for those in rural/remote settings)
- scholarships, bonuses and incentives
- provision of IT/ICT facilities e.g. satellite Internet, wireless computing, specialist hardware and software
- assistance with HECS fees (as these are higher for IT subjects than for Education subjects)
- high standard professional development for current teachers with appropriate scheduling for rural and remote teachers
- Visible [support] networks
- Target the 40+ yo IT specialist that are being "thrown away" by the IT Industry i.e. promote the Diploma of Education to the IT industry.

Longer comments included:

- *Raise profile of teaching in general so that it competes equally with the private sector in business. So that it becomes a viable alternative to business.*
- *Stop talking about students as "digital natives." It makes adults appear amateurish and puts students on a pedestal (some are definitely very gifted but many are not). I think we need more people who really are IT trained. I suspect that there really aren't many really trained IT teachers around; there's a belief that anyone can do it. This encourages mediocrity. IT teachers seem to spend many hours continually updating their skills. There's no acknowledgement that this is necessary.*
- *21st century curriculum needs to challenge specialist not by asking them to give up or water down their domains but by establishing a rich, real-world curriculum and asking them to be part of building rigour and substance.*

- *Value the teaching profession. Give the students excellent, high quality, academically rigorous courses at school. Teachers who take up rural and remote teaching positions must be fully supported. This does not only mean with IT/ICT. They need to have decent accommodation and working conditions. They must have the opportunity for promotion and movement in and out of remote areas.*
- *Don't use them as technicians. Higher pay, good access to up to date and plentiful resources and ongoing training. IT/ICT specialist teachers become very disenchanted when they are being used to keep struggling computers and networks going.*
- *Perhaps you can target older workers who are in unstable positions, and the concept of stability/permanence may attract them, but only if they can do a one year highly practical (in terms of pedagogical practice) post grad qualification. They may not feel the benefit of studying for a longer period of time and often have very demanding financial commitments which may preclude study.*

What implications will national trends have on IT/ICT in Queensland schools? Note the changes already wrought by the National Statements of Learning (ICT) on the QCAR reporting. What effect might a national IT curriculum have? Note: Based on STEM Q 3.3

There was a range of views expressed concerning the implications of national trends on IT/ICT in Queensland. It was firstly acknowledged that national trends “impact on the way of working of all teachers.” Some were very positive about a change from state to national oversight believing that this might “give ... access to a wider range of possibilities through sharing with a larger personnel and resource base.” The majority believed that while a national IT curriculum could provide a uniform platform or baseline, it may have the unintended consequence of limiting teacher professionalism and rich locally targeted student experiences. This is encapsulated in the statement that:

It SHOULD provide a common core curriculum across all states which could be useful in terms of identifying minimum IT/ICT infrastructure, hardware and software requirements across the state. It could also prevent teachers from being innovative and provide a curriculum that doesn't keep up with developments.

Further caveats were added which, consonant with other remarks made in response to the survey, that a ‘content’ focussed curriculum would not be of value in IT/ICT, largely because of the continuous changes in the technology and also because of the dynamic hands-on nature of the discipline. A comment which summed this up was:

What we need is a national 21st century curriculum - IT/ICT should be a set of tools to support practices within that, and to the extent IT/ICT is a specialist knowledge domain rather than a set of technological resources, it should contribute rigour and expertise to a rich, connected curriculum.

Some concerns were raised. These included the belief that:

- national standardisation may “not necessarily meet the needs of specialist communities and groups. Some areas will improve in standard, others fall.”
- “computing skills may be 'lost' amongst other subjects. ... IT needs to be integrated into other subjects, but students need a strong basic knowledge of IT skills.”

- “it will probably have a skills focus as agendas are unleashed”
- “it might just make it all one great big white-washed, boring facade.”
- “it may change it to being shaped like the HSC with external exams - a mistake in my humble opinion. It is truly important to build in flexibility to respond to the needs of the student, the community and the changing demands of the workforce. If we follow the path of a nationally determined, rigid syllabus, our subject will be lost.”

Priorities

QSITE is pleased to be part of the Department of Education, Training and the Art’s consideration of the future – the next 10 years – of STEM. In conclusion, the survey asked respondents to comment on how we might plan for an unknown future and where do we want IT/ICT to be at that time. These have outlined what we believe to be the priorities for a 100-year STEM Plan (STEM Q 1.3). These are:

- IT/ICT, in both general and specialist modes, holding a respected and valued place in the curriculum;
- Both existing specialised disciplines remaining and other learning integrated, (especially in regards to IT/ICT) as appropriate. STEM and IT/ICT literacy have much overlap but each has its own rigour. The whole population should have access to STEM areas for enriching general knowledge through ICT;
- Education in primary and secondary settings could be more enriched with STEM tools and teaching that leverages off mobile learning tools such as tablets, laptops, data loggers and interactions with online simulations and modelling, knowledge construction and presentation tools;
- “healthy” student enrolments and diverse representation in specialist studies and industry with a flow of students into IT careers;
- IT/ICT curriculum would be flexible; reflective of its times; will have moved with trends and developments in technology design and use; engaging for young people in real and authentic learning experiences, underpinned by the rigour of knowledge disciplines and specialisations; questions the value of new technologies; allows students to adapt and transfer knowledge to an unknown future.
- Learning with IT/ICT would be collaborative; having moved “beyond a skills-based approach, and look at IT/ICT as a vehicle to teach/learn collaboration, flexibility, and adaptation to change.
- IT/ICT in schools will be well-resourced and taught by appropriately qualified teachers.
- Positive teacher attitudes to educating and re-educating and “continually changing and adapting

A final remark which draws value from current practice and extrapolates it into the future is:

- *It has to be flexible, responsive, and as forward thinking as possible. Rigidity and structure will kill it. You need to achieve your standards through your assessment criteria/monitoring/verification rather than through specific subject related specifications in the syllabus. You also need to have some IT structure to underpin smaller or remote/rural schools so that they can access similar facilities/standards/programs.*