2004 is the sixth Year that the Australian (formerly Queensland) Secondary Schools Digital Design Challenge has been conducted, where secondary schools throughout Australia are invited to participate which encourages and rewards students in the creation, fostering, and promotion of new and original ways of thinking that challenge the conventional.

This paper will look at many aspects of the competition, in order to give guidance and direction to educators, including the viewing of the past award winners, this years National winning designs, the design briefs given, design professionals feedback on these designs, and the analyses of data gathered from six years of participating schools, students and judges. This presentation includes the:

• Effective design techniques and processes used by the students;
• Transitional changes of teaching techniques and graphics software over the past 6 years, and why teachers have migrated to these teaching approaches and specific software programs;
• Analyses by the design professionals who judge the competition on how design teaching processes can be improved for students to become more effective at conceptualising and ideation using digital technology as a tool;
• Analyses of the ongoing benefits and outcomes of the competition; giving equal opportunity, recognition, encouragement, networking, and rewarding students, educators and schools;
• Seven stages of design learning.

School students compete for design honours

In the last five Years computers have been the weapon of choice for more than 1,200 students from 70 Queensland high schools vying for design honours. In 2004 the competition has gone national, with The Australian Secondary Schools Digital Design Challenge being contested on the 22 July, with the awards ceremony being held on the 27 August at Griffith University, South Bank Campus, Brisbane. As a National competition, the digital design challenge aims to build a rich network of local, state and national links, to encourage and reward students in the specialist skills of digital design.

A competition website has been designed to be used as a teaching resource for students and teachers at http://www.griffith.edu.au/qca/challenge This website is used as a teaching resource containing student’s designs, judges feedback, design lecturer’s and leading industry written materials for school's and student's to use as an evolving and non-static resource which will have ongoing community benefits.

Competition description

The Australian Secondary Schools Digital Design Challenge has six categories, of which schools can enter one or more of these categories, with a team of up to two students. Each category will encourage, evaluate and reward students in the specialist skills of computer design. Each student team will undertake a design challenge typical of the real field of the design industry. Students will be required to think critically, innovatively and purposefully in conceptualising, modelling and generating their design, using any software they wish.

Students are evaluated on how they articulate and communicate their ideas. This evaluation will be based upon industry expectations and requirements that have become a necessity in the field of design. Students are presented with a design brief and are assessed on the development and realisation of a solution. Students are given a three hour time frame to complete the challenge, with the design briefs designed to encourage and stretch the boundaries of their imagination. This brief is given to the students at the start of their time limit. The competition will incorporate intelligent and innovative design as part of the base criteria. Students can do any
amount of sketching and planning with pencil and paper first. Students then complete the design exercise using their computer.

The six categories are:
- Graphic Design (open to all year levels)
- 3 Dimensional Design (open to all year levels)
- Architectural Design (open to all year levels)
- Web Page Design (open to all year levels)
- Junior Graphic Design (open to Years 8-10)
- Junior 3 Dimensional Design (open to Years 8-10)

A seventh category, Digital Animation (open to all year levels) will be added to the competition in 2005.

The design challenge in 2003 was to provide winning designs for a solar powered walkway light, an information display shelter for National Parks, a gym, and logos for a ‘CityCat’ Ferry and Microsoft’s 2nd Generation Gaming console. The 2002 competing students designed a watch, company logo/signage, extreme sport logos with accompanying names, a three-dimensional model of a furniture piece, and floor plans for a two-bedroom beach house.

The rules

The digital design challenge rules are:
- Schools competing outside the Brisbane region electronically submit their students work via attached emails or post their files for judging;
- Competing schools are required to supply their own computers with installed software;
- A participating school is not required to enter every category;
- A school can only enter one team per category;
- Each team can only use one computer;
- Each team consists of a maximum number of 2 students;
- No student or team can participate in more than one category;
- All winning students work will be published in journals, magazines and website, with recognition given to the students and schools. A student consent form is signed for this to happen;
- The competition is ‘open book’ where students can bring in their own notes, teacher handouts and software manuals;
- Students can have loaded on their computer individually designed template files, extra textures, libraries, clip art and images that can be used in the competition, and used in any way;
- Teachers can only assist students in hardware technical issues, such as fixing any hardware/software problems that might occur, and how to save and export their design files. They cannot give any assistance in the design, software functionality, critiquing their work, etc;
- Students can discuss any topic they wish, within their own team;
- Students can use stationery such as paper, pens and pencils to assist in their designs. These sketches are not submitted;
- Students can go to the amenities, eat or drink at any time, with no extra time being allocated to the students for doing this;
- An academic staff members must be present at all times while the Challenge is being completed;
- The competition is free to enter for all schools.

The outcomes

The competition outcomes include the:
- Encouragement and rewarding of secondary students for academic excellence in the field of design and technology;
- Recognition given to educators and schools leading in technology and design curriculum development.
Teachers use this acknowledgement to increase the funding for their departments, to increase their department’s student numbers and profile, while Principals benefit by enhancing the prestige of the school and gain greater community publicity and awareness of their activities;
- Giving of encouragement, focus and direction to talented students into relevant, technology driven career paths;
- Raising the awareness of educators of the future careers technology offers their students;
- Stimulating the networking and sharing of ideas amongst technology and design educators; including projects, activities, learning experiences, course content, design and construction techniques, and software and hardware selection and issues;
• Giving of feedback from design professionals, used as a teaching resource;
• Stimulating the thinking, and creation of the next generation of learning with technology;
• Making aware the postgraduate technology courses available to educators.

**Judging**

There are no correct or incorrect answers, but it is important that students convey their design in the allocated time. The task requested of the students is designed to test their design ability, not their computer skills, even though they require the technical computer skills to convey their design/s on the computer. The submitted solution does not have to be fully completed. Judging is assessed from viewing the files on the computer monitor. Qualified judges are allocated to each Challenge category who are members of the Design Institute of Australia. These judges include Design lecturing staff and leading Australian designers. All judges assess a category similar to their industry design or lecturing background. Students are assessed on the development and realisation of a solution. The judges will assess the student’s ability to create a solution and demonstrate practical skills in conceptualising and illustrating the brief, and present it as a completed product. There are three criteria used in judging the students’ ability, with the first two being weighted the most.

They are:
• Demonstrated creativity / innovation / problem solving of the design;
• Demonstrated technical skills in illustrating their design;
• Presentation, overall visual impact of the design including colour scheme, layout, positioning, appearance, and image quality.

All participating schools and students receive a university certificate. In each of the six categories a 1st, 2nd, 3rd, 4th, and Honourable Achievement certificate awards are presented to the students who demonstrate exceptional creative design and technical ability. The awards also include the best achieving school and overall best design in the competition.

At the official Awards Ceremony, student’s designs are displayed for discussion and feedback from the judges. The guest speakers, mostly renowned Australian cutting-edge designers, give presentations on their design ideas, projects, strategic thinking, and current international and national design practices.

**The strategic priorities in teaching, learning and research**

This competition engages the community by providing a medium in which secondary students can test their ability against their peers. Because students are able to participate in the Challenge remotely as well as on campus, students from all socio-economic backgrounds are given an equal opportunity. The students recognise their common interests and the benefits of working together as a team are easily recognisable. The Challenge creates an awareness of team responsibilities as well as the benefits.

This ongoing event benefits the community, by allowing students, from all socio-economic groups, from single sex and co-educational private and public schools, from remote and regional areas to participate on the same basis as those participating at conventional city schools.

The 2004 challenge briefs were connected to the Year of the Built Environment, which is an initiative supported by the Federal Government, to raise awareness of the environment in which we live and work. In providing solutions to the problems solved, students will learn how to be part of sustaining a community that creates and communicates knowledge. Australia has many niche areas gaining reputations in environmentally sustainable design, and the participating students are ideally situated to become acutely aware of the importance of this for their future lifestyle.

This project provides a valuable partnership with the State governments, via the education departments, by increasing the exposure to students to the demands of a ‘smart nation’ with creative needs. The digital environment in which the students compete is one of the government’s lynchpins, and the density of digitally related creative industries in Australia is indicative of the importance of this field to the economy of each State. Creative activities originate from innovation and ideas, and the students learn from their participation that these are essential elements for a winning solution.
The Government’s ‘Creativity is Big Business’ platform emphasis’s the need to educate the future workforce to better understand the changing skills demanded for the creative industries. Students who participate in such events as the digital design challenge will be better equipped for this role in the future.

This competition bodes well for the transition of these students to study at universities, and then onto career paths in the community, by rewarding gifted students and encouraging these students to continue with their talents into such careers as information technology, multimedia, engineering, architecture, design and technology education.

**Design learning: To be effective and progressive**

Design is a complex discipline and design learning is also. Therefore it is essential to welcome a broad range of approaches that may help in a later synthesis to give a rich and rounded understanding of design learning from a variety of perspectives.

Design practice, philosophy and research have all begun to touch on the richness and complexity of what is going on when people are designing. Yet, this heightened awareness is not always present in the minds of students. The students’ preconceptions of the role of a designer often have a strong influence on their learning approach. According to Reid and Davies (Reid, Davies 2001), conceptions held by students and teachers alike vary as to the nature of what they think design, and design learning is, and these preconceptions affect the way students learn: Their approach to learning is, to a large degree determined by their conception of learning.

In terms of design learning there are two points worth noting. The first is the relationship between the design students’ preconceptions of designers’ roles and the effect these have on their learning and the latter is the value of helping design students acquire an understanding of how to reinterpret their design tasks in their own terms and how to use this reinterpretation to generate a sense of intrinsic meaning. Marton and Saljö (Marton, Saljö 1976a, Marton, Saljö 1976b) identified that a student’s learning is significantly effected by their previous learning situations and experience, which in turn effects their learning approaches; whether ‘deep’ or ‘surface’ learning. These different learning approaches are reflected as discernible differences in the quality of the learning outcome. An example they give, by using a specific text as their frame of analysis, they found that the surface learner tends to be more interested in the sign of the text and what can be memorised, as opposed to the deep learner who is more interested in what is signified by the text and how they find meaning in the text and then relates this to other learning.

Marton and Booth (Marton, Booth 1997) found that these characteristics of deep and surface learning are not fixed for the individual student. A deep learner can adopt a surface or strategic (marks orientated) learning approach, according to the learning situation they find themselves in. This may be for lack of intrinsic meaning or expediency, but for a surface learner to acquire a deeper approach often demands a personal shift in their understanding or meaning; for them to make a model of the learning task or situation. These findings are confirmed in Prosser and Trigwell’s (Prosser, Trigwell 2002) study of university students, using the same investigative techniques and philosophy as Marton and Booth.

For Marton and Booth, the world as experienced by the learner is reflected as an internal relationship between the learner and the world. This internal relationship or “awareness”, changes according to the way learners experience different learning situations, contexts and renewed perceptions of their life world. This awareness is also an expression of a student’s appreciation of the interaction between the “what” or content of their learning and the “how” or the way in which they learn.

In essence and reflected by Kristensen (Kristensen, Tore 1999), an effective progressive teaching program in design:

- Builds a body of generalised knowledge;
- Improves student problem solving capacity;
- Generalises knowledge into new areas;
- Identifies value creation and cost effects;
- Explains differences in design strategies and their risks or benefits;
- Generates learning on the individual level;
- Generates collective learning;
- Generates meta-learning – shape a wider range of learning options for the field as a whole; often, but not always including learning about how to learn.
One benefit of a rich learning cycle within a competition is the competitive advantage it creates. When collective learning that takes place in a competitive context, it can become a form of meta-learning for those students located within organisational or network boundaries. Students will learn from the wider range of learning options within the competition group. While some teaching and learning generates knowledge for the subject field, teaching and learning is not required to do so. Most teaching and learning takes place in the clinical or local context. Many studio activities in education and in professional practice involve significant teaching and learning without reaching beyond the local context to generate meta-learning.

Events such as the digital design challenge affect many of the educators and administrators who will change their philosophy on classroom teaching and processes of design learning in order to develop creativity and innovation through the design and technology experience. Technology education itself is about taking risks, and we may have to try several ways of teaching before we know what will work best.

The positive steps required to developing creativity and innovations through the design and technology experience are:

- Ensure that all program ideas are grounded in the realities of today's marketplace;
- Make sure that all programs are focused in the future;
- Create a learning environment that embraces cross-disciplinary learning;
- In-service faculty members in cross-disciplinary team dynamics;
- Create one common language of innovation spanning all disciplines;
- Become a model for how departments evolve and function;
- Link research and teaching practice effectively;
- Ensure that your approach to technology education serves all the stakeholders that you serve;
- Make sure that you deliver your promises to your students;
- Develop a focus on educating and training future student and staff leaders.

**A progressive research/learning model**

I believe that all learning is the same, it just occurs in different contexts to serve different purposes and has different histories for those involved. When one thinks of designing furniture or architecture it is the domain of application that circumscribes learning not modes of learning. In design there is of course the emphasis on artifactual creation (e.g. product, industrial, furniture design, etc.) and the limitations imposed by that intent; for instance design is most often about creating useful artifacts or environments, but as Burnette (Burnette 1997) has phrased it, "I would like to think that design is created in the same light as poetry, music or even a sentence".

Design learning involves learning to initiate, guide and manage intention; learning to access and develop relevant information; learning to develop and analyse conjectural models; learning to interactively resolve and communicate responses to situations; learning to act on proposed responses efficiently; learning to assess success in terms of intention; and learning to acquire and adapt knowledge for future use.

I also feel that design learning is related to the seven modes of thought that are the basis of Dr Charles Burnette’s theory of design thinking. Design learning is role related and pertains to being holistic, autobiographical, cultural and concerned with learning about learning.

There is also a correlated teaching/learning model by Schank and Cleary (Schank, Cleary 1995). This articulation of “teaching architectures” of design related teaching, parallels to an extent that of Burnette’s theory of design thinking. Briefly summarised, this research model includes: Scaffold (Learning through Coaching); Researching (Learning by Defining); Exploring (Learning through relating); Communicating (Learning through expressive interaction); Producing (Learning by Doing); Assessing (Incidental learning and valuing), and Storytelling (Case based learning).

**The seven stages of design learning**

Dr Charles Burnette’s (Burnette 1994) description of Design Learning’s seven modes of thought, are the basis of my theory of design thinking. This model appeals to me since it corresponds extremely well with the stages that I have experienced personally as a teacher, a designer and as a lecture of graphic, 3D, and interior design. Design learning involves learning to initiate, guide and manage intention; learning to access and develop relevant information; learning to develop and analyse conjectural models; learning to interactively resolve and communicate responses to situations; learning to act on proposed responses efficiently; learning to assess success in terms of intention; and learning to acquire and adapt knowledge for future use.
The first mode of thought deals with learning to understand the context and the situation that usually leads to trying to get clarity from a very complex set of signals and processes to provide the essence of a direction. This kind of learning, like many others, does go through several iterations but at the end of these multiple cycles the level of conviction and sense of purpose is usually very high in the task and the purpose that it represents.

The second deals with access to information to many classes of information types which includes published and reported facts, field based observations and self initiated experiments that are contextually mediated to fill gaps in the current information. Students have drawn from all kinds of disciplines the tools and techniques perfected within these disciplines over the years of specialised investigations.

The third deals with analysis of conjectural models and the tools to conduct such analysis. The hypothesis that drives design investigation is in the form of advanced scenarios of parts or the whole of the student situation at levels of observation and visualisation of the need and the consequences that are being investigated by the student. This too moves through numerous iterations till a selection of a few alternate courses of action that can be taken to the next level of investment, be it models, experiments or prototypes in part or whole. This also applies to the pre-cognitive diagrams, doodles and fuzzy sketches that are the preliminary visualisations created in many cases intuitively by the student for themselves in the search for possible configurations and relationships of the various attributes of the solution in a search that resolves the many contradictions that exist in all design tasks. We can call this an analytical exploration of the design situation using visual tools and processes that generate external models rather than numerical or verbal expressions; although in some cases even these would be used in combination with the visual.

The fourth kind of learning deals with the typical nature of design that involves a number of participants who need to be convinced as the work progresses. This calls for many interactions with numerous stakeholders such as fellow classmates, industry visitors, guest speakers and teachers. These interactions are both critical and necessary for the task to progress to the next logical level of action. The learning involved is in communication, in seeking collaborations and in understanding the responses with empathy to the situation and the needs and feelings of the identified users.

This leads to the fifth kind of learning to accept and process the feedback into constructive actions which brings about a great change in the individual themselves. Some of this feedback could be cultural or outside their insight or accepted frame of comfort. There are many instances of the student embarking on a new path outside the scope of the current task based on the insights and convictions derived from these learning experiences.

The sixth form of learning is in decision making choices from out of the numerous alternatives of parts and wholes that are the result of progressive visualisations and experimentations conducted in the progress of the design task. The definition of the task itself is open to review and many times the investigations and design investments have veered of into an entirely new direction as a result of this kind of review which is quite normal in a design situation that is complex and previously less explored.

The seventh deals with the constant self development that we see students do in their search for new and interesting bits of knowledge that would be of value in the future. This pertaining to some not yet anticipated task usually within the frame of interest paths that each student traverses over time of continued learning to cope with the new and the unexpected in their usual study, with areas overlapping in their multiple interest paths.

**Conclusion**

As many design education theorists have stated (Schank 1997, 2002), (Reid, Davies 2001), (Burnette 1994) there is no direct connection between designing skills and teaching skills. This being obvious as we cannot teach what we do not know. There are skills and attributes applicable in design that can be applied in teaching, such as the organisation and responsiveness to the needs of the client. Equally, there are attributes that may be negative in the teaching concept, with the demand for exactness and lack of tolerance. For this reason, in a large sample we may find the association between “design” and “teaching” skills to be positive, negative or zero, but within an individual we may see links.

Teaching may be didactic or inspirational, with this knowledge being directly and consciously passed on by the teacher. An inspirational teacher motivates the students to learn, and is delighted when the students report back something which the teacher did not know.

It also seems that most research agrees that a good practicing designer does not make a good design teacher/educator, even though a good teacher obviously needs experience in the topic. In Vygotskyan
framework/terms (Vygotsky 1980), how could the teacher otherwise open the student's zone of proximal development? But given that design teaching is a practice in its own rights, other local skills, ways of relating to students and concepts to see the world through are obviously needed. Therefore a capable practicing designer would not necessarily make a capable design teacher.

Many practicing designers can probably help students with levels of their practice, but in order to be a good teacher/educator one needs to reflect and assess how the students are learning and preferably the students learn also how to reflect upon their learning. When they do, they are equipped with a powerful tool, for seeing their own knowledge and expertise and more importantly, seeing the limits of it, so that they continue to purposefully learn throughout their professional life.
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Data analyses of digital design challenges (1999-2004) [findings are still being processed, and will be concluded shortly]
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<td>3rd. Inventor 11%</td>
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<tr>
<td></td>
<td>3rd. Artlantis 11%</td>
</tr>
<tr>
<td><strong>Junior 3D Design</strong></td>
<td>1st. ProDesktop 29%</td>
</tr>
<tr>
<td></td>
<td>2nd. 3DS Max 26%</td>
</tr>
<tr>
<td></td>
<td>3rd. Vectorworks 14%</td>
</tr>
<tr>
<td></td>
<td>4th. Artlantis 10%</td>
</tr>
<tr>
<td><strong>Architectural Design</strong></td>
<td>1st. AutoCAD 35%</td>
</tr>
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<td></td>
<td>2nd. ArchiCAD 18%</td>
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<tr>
<td></td>
<td>2nd. Vectorworks 18%</td>
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<tr>
<td></td>
<td>4th. ProDesktop 12%</td>
</tr>
<tr>
<td><strong>Web Page Design</strong></td>
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</tr>
</tbody>
</table>

Note:
(1) To win an award the students must have achieved a 1st, 2nd, 3rd, 4th, or Honourable Achievement in one of the categories.
(2) Country school is a wide term referring to a school that is not in the states major city, e.g. Brisbane.
(3) Within many schools, students use different software from junior to senior school; therefore both the junior and open design categories have separate listed software.
(4) The majority of schools that used Vectorworks and ArchiCAD also used Artlantis rendering software to achieve high quality rendered images.

Other software used by schools in each Design category:
Graphic Design: Paint Shop Pro, Illustrator, PowerPoint, Cadsman,
Junior Graphic Design: Illustrator, 3DS Max, Inventor, PowerPoint
3D Design: Vectorworks, AutoCAD, Rhino, MicroStation, Maya
Junior 3D Design: Inventor, Solidworks, MicroStation, IntelliDraw, Cadsman, PhotoShop
Architecture Design: Artlantis, 3DS Max, MicroStation, 3D Home Architect, Creative Designer, AutoSketch
Web Page Design:-