1. Introduction

Exposing people to positive experiences with science and technology from an early age can build confidence, enthusiasm and skills for further exploration and learning. This philosophy was behind the development of many workshops and science shows at the Edinburgh International Science Festival. The Festival is a showcase of science and technology made accessible to general public audiences from young to old, generalist to specialists.

Realising that few people, especially children, had the opportunity to experience the satisfaction of building an electronic gadget from basic components, MadLab was developed – a hands-on electronics workshop. Under guidance of experienced staff, participants learn to solder electronic components onto specially designed circuit boards. These boards, and their corresponding instruction sheets, have evolved into an easy-to-use format for large groups (i.e. school classes).

There are currently over forty MadLab kits - the simplest being MadEyes (Flashing Lights), the most complicated a programmable robot, which is able to find its way around a maze.

*The excitement of MadLab is learning how to use a soldering iron, and actually being able to make and take home a working electronic circuit.*

Since 1987 MadLab workshops have flourished and now feature at science festivals around the world. To date over 80,000 MadLab kits have been built in more than a dozen countries. In Australia, MadLab appears annually at the Australian Science Festival (Canberra), Ultimo Science Festival and ScienceExposed (both Sydney) and other venues and schools around the Country. MadLab has featured on television science shows Scope and Totally Wild.
2. MadLab: the teaching tool

2.1. Physics

“Increase students’ understanding of the applications and uses of physics, the implications of physics for society and the environment, and current issues, research and developments in physics” (HSC Physics Stage 6 Syllabus; Option – The Age of Silicon).

2.2. A Positive & Safe Experience

The first principle of MadLab is to ensure every participant has a positive experience in the workshop. This is generated by providing appropriate projects to match the skill level of participants, which ensures satisfactory completion of a working project in the given time.

Direction of the workshop from the workshop supervisor ensures that all participants are progressing at the appropriate pace with additional guidance provided (often with trained assistants) as required.

Additional support is provided to assist individuals identify components, place components into the PCB or use the soldering irons.

Safety is an important learning component, which is taught by example in MadLab workshops. Equipment is well maintained, cables are taped down and appropriate lighting/ventilation levels are provided. The wearing of safety goggles while using the irons and cutters is a requirement and participants are asked to remain seated and be aware of those working around them while in the workshop. Correct use of all tools is explained prior to any use.

2.3. A Rough Guide to Electronics: resource for educators

MadLab provides an on-line beginner's guide to electronics. The short course leads participants from basic ideas about electronics right up to an understanding of how a simple kit actually works.

The notes explain what electrons are and what they do; what the different types of electronic components are and how they work; and how components connect together to make a complete circuit.

Useful things like the resistor colour code and how to read a circuit diagram are also provided. NB this is electronics without mathematics.

The rough guide answers some of the most common questions about electronics:

- What are a.c. and d.c. ?
- What is Ohm's Law?
- What is the difference between current and voltage?
- What exactly does a transistor do?

Notes are available from www.madlab.org/electrnx/electrnx.html

- Lesson 1 The Basics
- Lesson 2 Resistors
- Lesson 3 Capacitors
2.2. Comprehending and Following Procedures

MadLab instruction sheets are available as PDF downloads from the web site. The instructions for all kits are in a consistent format and language with procedures being similar across the range of kits. This enables participants to quickly learn the ‘style’ and progress from basic to more complex projects with ease.

Observations of participants provides support for the notion that learning takes place rapidly, such that second-timers will generally complete similar projects up to twice as fast as their first attempt.

Key learning outcomes include:

- Components are identified by their shape and markings (e.g. resistors are sausage-like with legs extending each end, they have 4-colour banding to indicate their value.

- Components are fitted into the printed circuit board (PCB) as indicated (e.g. R1 component goes to R1 on the circuit board)

- Components must be fitted the correct way around (if applicable), e.g. light emitting diodes have a minus side indicated by the shorter leg, corresponding with the flat line near one hole on the PCB.

- Soldering only takes place on the reverse (metal) side of the PCB. Solder wire (an alloy of tin and lead) is melted by the soldering iron (which also heats the destination point) to leave an ‘electrical glue’ between the PCB and each component.

3. Lifelong Learning

MadLab is more than just the kits. Whether you use trained MadLab staff or run workshops yourself, there is continued learning and support for those wishing to do more.

3.1. Problem Corner

For workshop presenters and individuals – you are not alone! If you have any questions about your MadLab kit, or needs any assistance in trouble-shooting, you can download a Guide to Troubleshooting, or email your questions to MadLab HQ. This is a great resource for those taking on more ambitious projects.

Dear MadLab,

When I touch the back of my Mad Music Machine the tunes play much faster. Is
Your Mad Music Machine contains a computer chip, which has a master clock controlling the speed of the program. The clock uses a capacitor, and when you touch the board your body changes the capacitance. This happens because your fingers bridge across the legs of the capacitor and this increases the speed of the clock. Thus the chip runs faster and the music plays quicker.

Dear MadLab,
How long will the battery for my Flashing Lights last? Can I make it last longer? The Flashing Lights circuit draws about 20mA on a fresh battery. An ordinary zinc chloride battery should last up to 3 days and an alkaline battery twice as long. It's difficult to calculate the exact time because the circuit will work down to 3 volts where the current drawn is only 5mA.
To make the circuit more energy efficient you can use ultrabright LEDs in place of normal LEDs. Change R1 & R4 to 4k7, R2 & R3 to 220k, and C1 & C2 to 1uF. The lights will flash in exactly the same way as before and will be just as bright but they will use only 1.6mA and the battery will last more than 10 times longer.

3.2. Club Mad: on-line community

ClubMad is for people interested in keeping in touch with MadLab news and developments. Enthusiasts can subscribe to ClubMad to receive periodic emails about new kits, special offers, workshops and other information of interest.

To be added to the emailing list:
Send a blank email to madlab_clubmad-subscribe@yahoogroups.com
OR join via the Yahoo! Groups ClubMad homepage.
Note: to subsequently unsubscribe to the group, send a blank email to madlab_clubmad-unsubscribe@yahoogroups.com

4. What Now?

Enjoy this MadLab workshop and consider how you might influence enthusiastic students to consider further studies in science & technology.

Recent reports have celebrated a 10 percent increase in engineering enrolments at RMIT in Melbourne and Curtin University in Perth. Meanwhile, figures from the University of Technology, Sydney (UTS) indicate a constant increase in engineering enrolments since 2000, and a record high in science enrolments since 2002.

According to Peter Taylor, Chief Executive of Engineers Australia, even this year’s enrolment increases might not be enough to satisfy the widely touted skills shortage in the Australian technology industry...
“The Australian Council of Deans of Science believes that the lack of transparency of career paths involving science, the uninspiring experience that many students have of science in school, the view that science is limited to lab work, the 'geek' image and similar factors are largely responsible for the drift from science.”

UNSW’s Faculty of Engineering aligns itself with potential students through programs such as ProgComp, which is a computer programming competition for high school students, and Robotics Workshops for primary and secondary school teachers and students.

“What is needed is something that can put the idea of science and engineering in front of kids and parents.” UNSW Dean of Engineering Dianne Wiley.

IT News 29 Jan 2008

5. Want to run your own workshop?

To run MadLab workshops you will need the following:

5.1 Workshop staff

Technical background not required, but good with people (or class), and ability to calmly problem-solve. MadLab Australia and CSIRO Education Centres have experienced people who can train teachers or run sessions.

5.2 Venue

Well lit and ventilated. Daylight, though not direct sunlight, is preferable. Sturdy, stable, and clean work surfaces for kit construction, with sturdy and stable chairs or stools.

5.3 Equipment

Soldering iron (low-voltage soldering irons and silicone rubber cables are recommended)
Soldering iron stand
Safety goggles
We recommend a circuit breaker be connected between the mains electricity supply and all electrical equipment.

5.4 Communal equipment

Reels of solder (250g of 0.8mm diameter tin/lead is good)
Wire cutters and wire strippers
Solder suckers

6. Useful Links

MadLab www.madlab.org
Science Foundation for Physics www.physics.usyd.edu.au/foundation/
Ultimo Science Festival www.ultimosciencefestival.com/usf08/
National Science Week  www.scienceweek.info.au/
Advanced Engineering Capability Network  www.engineeringcapability.net/

NOTES: