

Abstract

This article explains a new approach to the teaching of electronics. While on the face of things it might be easy to dismiss this as just another kit, early indications suggest that it is extremely easy to use, offers all students success and promotes understanding in what has traditionally been a difficult subject area.

The design and technology curriculum in Northern Ireland differs somewhat from that of the rest of the UK. Central to the teaching of technology are the principles of energy and control. There has been a dramatic increase in the resources and time made available to this area and nowhere more so than in electronics. For all this, it still remains the subject area which teachers find most difficult to deliver and students find most difficult to understand. We all know it is important that students understand electronic principles but why is it that so many students still have great difficulty in grasping the basic concepts necessary to make any real progress in this area?

The teaching of electronics is fraught with many difficulties that are not encountered in other areas of the technology curriculum. Electrons flowing, or not, is much more difficult to explain than, say, air flowing in a flow regulator or the workings of a cam and follower. The inability to see anything flow or move has always been a problem in the delivery of electronics. Systems approaches are very good at what they do, teaching input process and output, but fall far short of giving explanations and the reason why things work.

Snaptronix adopts a middle ground to the teaching of electronics. It is not a systems approach, encouraging students to handle discrete components and to understand the correct use of a MultiMate. Yet it is not designed to be cumbersome, allowing users to quickly assemble circuits and in the process learning the theory of what it is they are doing. Using this approach it is much more likely that if problems are encountered in manufacturing a circuit at a later stage then students will be more capable of discovering the problem for themselves. With some discrete systems far too much time is lost explaining the arrangement of a

fairly complex system and then the lesson degenerates to a simple following of instructions, often leading to the incorrect assembly of circuits. This can prove a frustrating and unrewarding experience and it is little surprise that many students become frustrated and don't reach their potential in this area, choosing to drop the subject at the first available opportunity. The Snaptronix system is very much student-centred, giving students every opportunity to handle and identify discrete components, model circuits and try to discover how the circuit operates. It has often been noted that it is teachers and technicians who do the fault finding and the 'learning' as students are often ill-equipped to do this exercise for themselves. But then again they will only be able to fault find if they understand the circuit and how it operates in the first instance.

Snaptronix is a board-based system with the central aim of teaching and explaining basic electronics. Central to making progress at Key Stages 3/4 is understanding the potential divider – it is this concept more than any other that will determine whether students will make any progress in this area. Using the system above it is possible to insert resistors of various sizes, and measure the potential division across each with a MultiMate. From this it is simpler to explain the turn on voltage for a transistor. We can see from the board that the circuit layout is much more representative of what students might expect to see in any book. The terminal blocks make it very easy for students to model the circuit and all students are going to be guaranteed some degree of success. The system allows a hands-on approach ensuring that students becomes familiar with both handling components and are encouraged to use the appropriate vocabulary. The above exercise is supported by written material and it is suggested that students place various sizes of resistors in the positions marked RES(1) and RES(2), measure the voltage and record it. He can then turn the switch to the base of the transistor and establish if the LED stays off or comes on. From this we can build up a pattern of when the LED comes on and when it stays off.

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The second example shows the use of the student board to teach the theory of how an LDR switches a transistor in darkness. The students assemble the circuit and are able to take voltage readings in both daylight and darkness. Again this practical is easily set up and students can be taught that the changing resistance results in a voltage change which causes the transistor to switch and brings on the LED. Again the multimeter is used by students to establish voltages, putting them at an advantage if they should go on to manufacture a circuit and it doesn't work.

The second aspect to the Snaptronix system is the computer interface board. Resembling the student board in every respect, but with the added facility of being able to interface to a computer, this enhances the teaching of the principles involved. The computer captures voltages in real time and places them on a screen. In other words from the previous diagram the computer will measure the voltage across the resistor and LED in turn and indicate the state of the transistor. The circuit can be explained on screen and then students can go off and build the same on their own board. The charge of a capacitor, for example, has become a very simple and straightforward procedure with the added advantage that students can now see the capacitor fill on screen and discharge can be illustrated instantaneously. On screen it is possible to see LDR effect, thermistor behaviour, moisture detection, timing effects and the actions of a 555 timer. By placing a resistor and capacitor on the board it is possible to track all pins and note their behaviour in real time as the timer is triggered and the capacitor fills.

Snaptronix – a school's perspective

St. Cecilia's is an all girls secondary school based in Derry which uses Snaptronix on a regular basis and as such is well placed to comment on the value of the system to the teaching of electronics in the classroom.

- The simplistic nature of the design of the boards makes them useful for all levels of student to set up and then model simple circuits. This eliminates the need for students to perform the difficult task of handling the much more difficult

concept of breadboard. It is not necessary to spend long periods of time explaining the arrangement of breadboard and saves valuable teaching time in that circuits can be modelled in a fraction of the time.

- All the students are working on a 5v regulator and this is especially useful as the voltage readings of all the groups should correlate when a practical exercise has been set involving the use of the multimeter. The system also has the advantage that the lessons involve several practical activities which all the students can easily carry out. The students know when they have succeeded in their exercises.
- Support material in the accompanying booklet use simple language and concepts that teachers (and students) can relate to and understand.
- The interactive nature of the material in the booklet means that it can be used within the classroom by the students as they carry out their tasks. The package also is useful in that it in some cases it can be used as a source of homework to test student understanding.

In common with all teachers we as a department have found the biggest restraint in teaching to be time and we have found this pre-prepared package which promotes practical activity, encourages understanding and suggest practical projects and homework to be most useful. We can now start to concentrate on the teaching of the key concepts of electronics which is the aim of the exercise. This aspect is helped considerably by the use of the computer interface which allows students to see the change in voltage as they happen in real time in the case of an LDR as an example. The graphs and charts are especially useful.

In conclusion, Snaptronix has made the teaching of basic electronics principles much easier. It allows students to do much more for themselves than many other systems and hopefully this will improve their chances of understanding the underlying principles. Students enjoy using the boards

and are much more in control of their learning experiences. From a teacher perspective it allows much more time to be spent constructing circuits and helping those members of the class that need it most.

Conclusion

In summary the following advantages are to be had for students and teachers :

Students

- Snaptronix places students in the centre of the learning process
- Practical experiences with hands-on exercises
- Encouraged to handle and identify discrete components within practical activity
- Taught the correct user of the multimeter in measuring voltage and resistance
- Gaining practical experience will facilitate in the understanding of the subject.

Teachers

- A huge saving on time by way of preparation
- More time to help those members of the class who may need extra help
- Differentiated material which can be edited to suit class and individual needs
- The computer interface allows the teacher to demonstrate electronic principles on screen in real time
- Practical circuits suggested and explained
- Advice and support available
- Homework and class exercises provided.

Support material

- A computer interface which takes real time voltage readings and illustrates on screen (Capacitor charge)
- Full set of coloured and illustrated notes made available in hard copy and on disk
- An interactive CD which takes the user through the package and using voice over explains the concepts in real time as they happen on the interface board
- CD contains a number of suggested circuits and shows the user how to fault find any problems.

The range currently consists of a potential divider board and the 555 monostable board.

It is intended that the 555 astable and the operational amplifier will be available within the next few months. This will then offer a set of boards to cover the full range of electronic circuits from first year to the top end of the GCSE syllabus. The system has been fully tested and evaluated and early indications are that this is an easy to use system offering the potential for student learning and understanding.

For further information visit our website: <http://www.soft.net.uk/techsci> or E-mail mlynch@techsci.softnet.co.uk.