

# **NEST – A New Web Based Teaching Tool for Engineering Surveying**

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**Key words:** Education, Engineering Surveying

## **SUMMARY**

The University of Nottingham has been involved with developing Computer Aided Learning packages for over 16 years. SurCAL, AshCAL and TrimCAL were packages developed at the University of Nottingham in the period 1993 to 1999. These packages helped demonstrate the use of specific pieces of equipment to large audiences.

The demonstration of such equipment is vital for surveyors and engineers to learn how to survey as well as how to operate such equipment effectively. However, when teaching to large classes, such as the 150 per year at Nottingham, this becomes either a very large and tedious exercise to teach them from zero experience, or the amount of time given to such an exercise is reduced.

Previous experiences in developing and implementing computer aided learning tools to introduce students to virtual instruments proved very successful, in that students were familiar with the equipment before having their first practical class. These CAL packages had many advantages, including the fact that students could learn at their own pace, and re-visit sections they may not have understood the first time around.

Recently, a project at the University of Nottingham developed a new generation of teaching material, based over the internet, using photos, animation, interaction and text to teach students the basic operations of specific surveying equipment.

The following paper details this software, including first hand experiences in implementing it with a class of 150 first year civil engineering degree students.

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## **1. INTRODUCTION**

Computer Aided Learning (CAL) was the keyword used in the mid 1990s to describe software developed to teach students. The University of Nottingham had several initiatives to push this idea forward, developing a suite of teaching material, using software called authorware. The versions developed were PC based, and used animation, text and photographs to teach. Three surveying focused packages were developed, which were SurCAL, AshCAL and TrimCAL. These were used for many years to teach students how to operate various pieces of surveying equipment, but over time the equipment were updated, and also the look and feel of the CAL software became old fashioned. To this effect a project was undertaken during the Summer of 2009, whereby an undergraduate student was employed to develop a new suite of web based teaching material, based on the current equipment used at the University of Nottingham.

## **2. COMPUTER AIDED LEARNING; BACKGROUND**

Three CAL packages were developed at the University of Nottingham in the mid 1990s to allow self teaching of students [Smith and Roberts, 1996], [Smith and Roberts, 1997]. The idea was to use CAL material as an addition to lectures, practical classes, field courses, books and other such material, The advantage of the CAL packages included the ability to allow students to learn at their own pace, as well as to be able to access the material outside of the lectures. During this period, the size of the civil engineering classes were about 80 students, which meant that there had to be many practical classes, and the demonstration of how to operate a specific piece of equipment at the front of such a large class was difficult. The use of such CAL packages was a good way to allow many students to see how the equipment worked, both in their own time and using a projector at the front of the class. Figure 1 illustrates a screen shot from the SurCAL (Surveying Computer Aided Learning) package, using simplified animation to demonstrate how the footscrews are used to level the plate bubble on a Wild T1 theodolite.

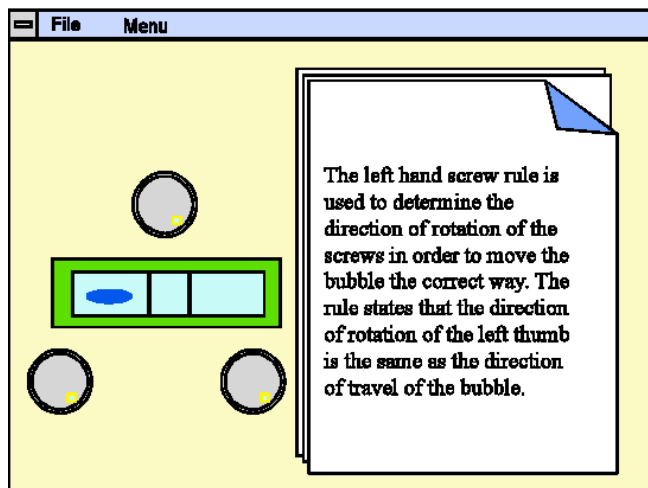


Figure 1. A screen shot from SurCAL, showing the use of animation to teach

The use of photographs were used, in addition to the animation and drawings, and allowed the students to scrutinize and learn about the equipment, Figure 2 illustrates such an example for the SurCAL package.

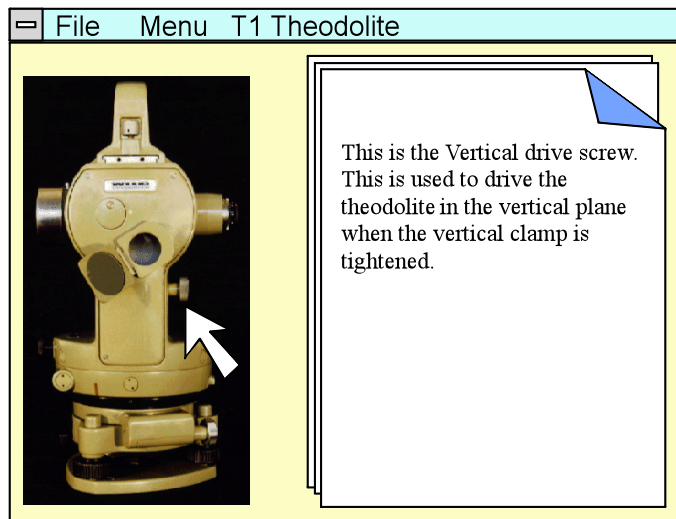


Figure 2. The Wild T1 in SurCAL

Various sections were developed that taught the students the various concepts of surveying as well as how to operate the equipment. The overall idea was to allow a large group of students to gain some experience of the equipment before actually touching one. This meant that the practical classes and field-courses were more productive. Once the various elements were taught, this was then all brought together with an animated demonstration of measuring angles, and how to book and reduce the results, Figure 3.

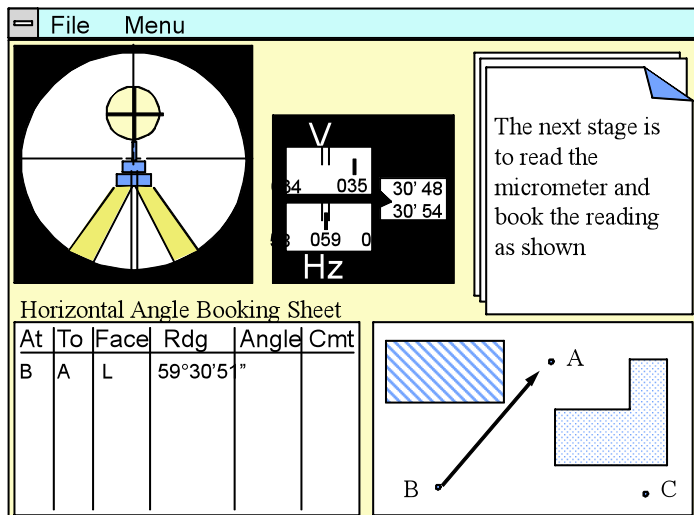


Figure 3, the use of animaton to illustrate measuring and reducing angles

Further to this, the SurCAL package also included sections that taught about levelling, through animation, drawings and text. Figure 4 illustrates a screen shot showing the student how to take a levelling reading from a staff. In addition to this, a section was developed to teach students how to operate a GAK1 gyrotheodolite attachment.

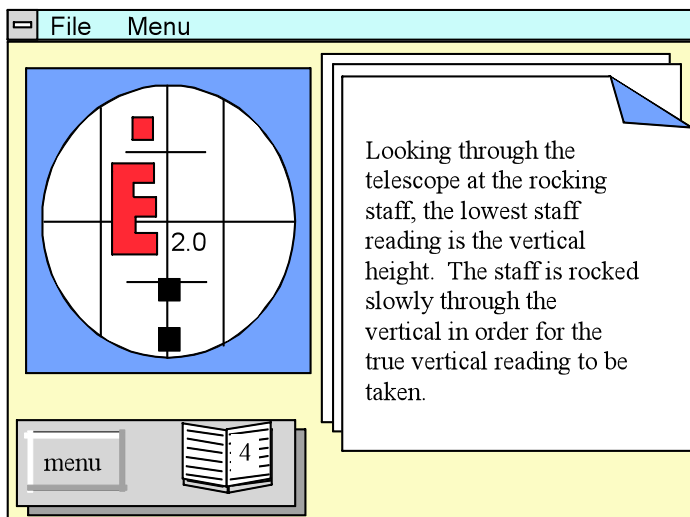


Figure 4. The use of SurCAL to teach levelling.

The use of such CAL packages was seen to be very advantageous. It was possible to monitor the students' usernames, and also monitor the time they accessed the packages as well as the duration for each section. It was seen that most students accessed the packages, and also they used the packages in particular the night before a practical class, as well as the examinations [Roberts and Smith, 1996].

Following SurCAL, two other packages were developed, namely TrimCAL (Trimble CAL) and AshCAL (Ashtech CAL). These packages were developed to teach the use of the

Trimble 4000 SSE and the Ashtech Z-XII GPS receivers, Figures 5 and 6 illustrate the two packages respectively.

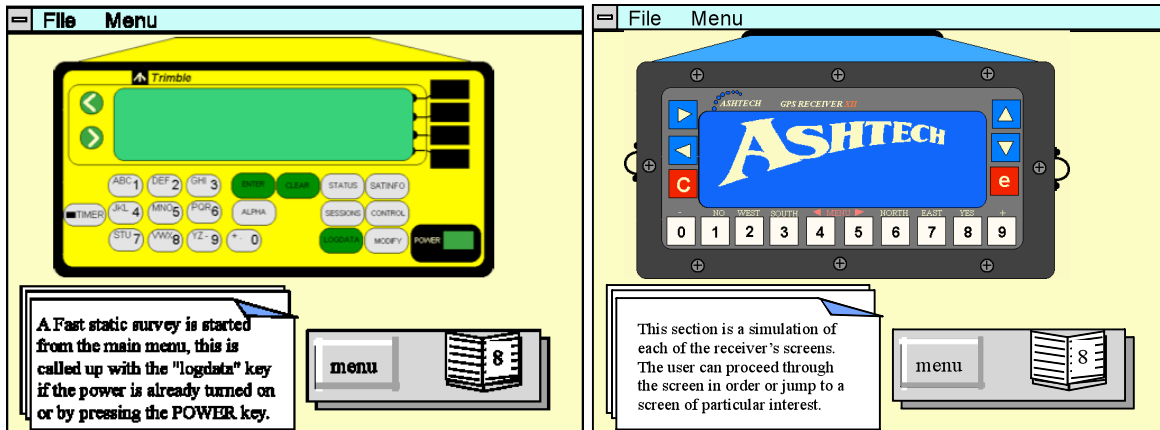


Figure 5 (left). A screen shot from TrimCAL.  
Figure 6 (right) A screen shot from AshCAL

These packages were easier to represent a realistic simulation, as the static GPS receivers were easier to animate compared to movable theodolite.

### 3. NEST

During the Summer of 2009, a project was undertaken to develop a web based package, to incorporate some of the ideas developed through the CAL packages, but also incorporating the advantages of web based e-learning, as well as the advances in technologies, and also to teach the students how to operate the new surveying equipment. The result is a package called NEST (Nottingham Engineering Surveying Teaching). Figure 7 and Figure 8 illustrate screen shots from NEST. Figure 7 illustrates a typical screen, teaching the students how to use a tribrach, whilst Figure 8 illustrates the use of animation to teach the student how to level a pond bubble using the foot-screws.

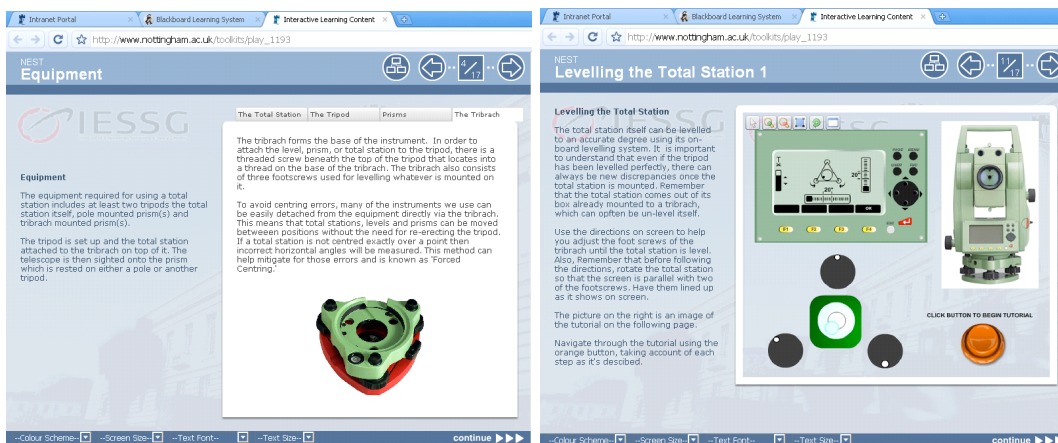


Figure 7 (left). A screen shot from NEST  
Figure 8 (right) NEST teaching the student how to use the footscrews to level a bubble.

The software is written using a template software called Toolkits and some individual pages using Xerty. Flash interactive is used for developing videos and cartoons. The results is similar to an interactive powerpoint presentation. The students access this material over the internet, and is made accessible through WebCT, which is used to help teach. Again, as well as teaching the students how to operate modern day total stations, such as the Lecia TC405, the package illustrates the use of modern day automatic levels, Figure 9. Figure 9 illustrates how the student can click on various parts of the instrument and receive an explanation of its use, and how they are taught how to read the staff, through animation.

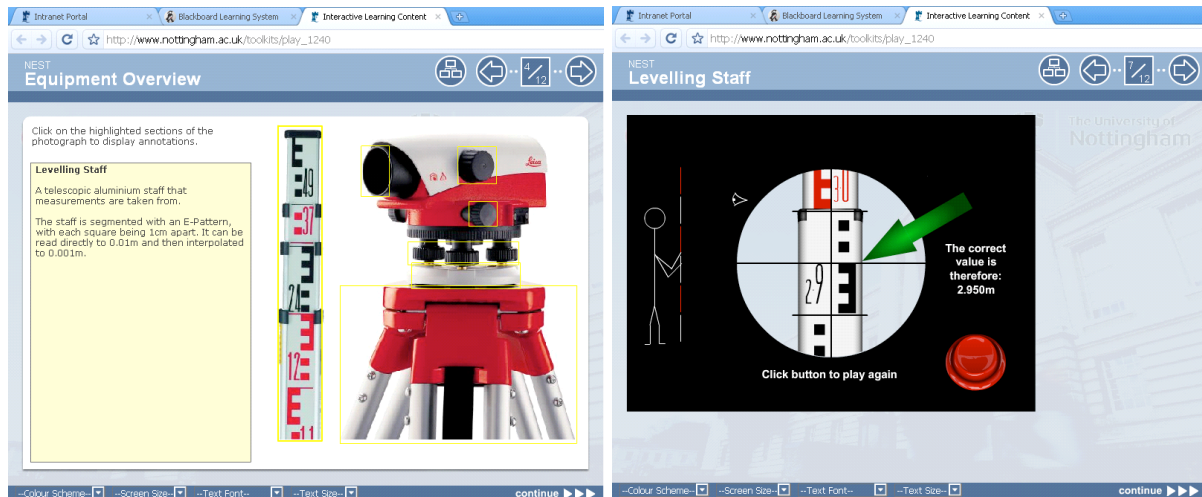


Figure 9. NEST illustrating the use of an automatic level.

Again, all the concepts are taught in individual tutorials, then the concepts are brought together through a tutorial allowing the students to view and learn through animation how to measure and reduce angles, Figure 10.

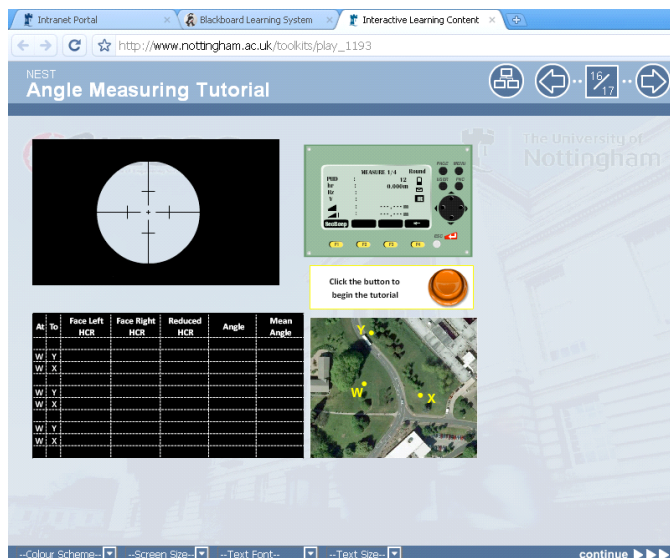


Figure 10. Animated angle measurements, and angle reduction in NEST

NEST is currently being used for the first time to help teach a group of 150 first year undergraduate civil engineering students. Once this has been used, the students will be surveyed for their reactions to the package. NEST is also to be made generally available on the University of Nottingham's web page, and the use of open source development is being investigated.

#### **4. CONCLUSIONS**

The use of e-learning through CAL packages in the 1990s illustrated that such material can help the effective teaching of various disciplines, including surveying. New software has been developed, NEST, which brings together the CAL principles, but incorporating into a web based delivery system.

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## BIOGRAPHICAL NOTES

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