

# MagLab – An Intelligent Management Learning Environment

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Abstract: In this paper, the perceived difficulty for students learning purely through auditory and visual means, such as via the standard lecture format, is highlighted through a literature review of learning styles and methods, and a solution based upon interactive computer case-based learning is proposed through a new and continuously evolving simulation environment called *Management Laboratory*, or simply *MagLab*. The software was developed using the open-source, high-level scripting language Tcl/Tk and it was designed to run under both Unix/Linux and Windows. An insight into the characteristics of MagLab brings out its many capabilities and strong points of simplicity, user friendliness, intelligence and extensibility.

## 1 INTRODUCTION

This paper describes the development of a student-centred teaching and learning methodology within the field of Management Science. It is important that learners acquire knowledge and experience in the contextualized use of analytical management techniques since these have a broad specification. Furthermore, theories to do with different styles of learning are very well rehearsed in this day and age and the development of interactive packages to assist students with their learning is highly relevant when these are considered. As described by (Lepi, 2012), it is important to keep in mind that learners broadly learn via an auditory, visual or kinaesthetic style of learning. Whilst it is the case that most learners may use an amalgamation of all three styles, there is nevertheless much evidence to suggest that learners do tend to have a preferred style of learning. Traditional lectures may capture the interest of an auditory-based learner, albeit with some limitations based upon the length of time an individual can concentrate. The addition of graphics and visual aids such as ‘Power-point’ can be used to help assist the visually stimulated learner. However,

it is generally the case that unless an activity is very practical and/or laboratory based, many learning sessions do not provide the kinaesthetic learner with many opportunities. This paper seeks to address the problem learners have in accessing, understanding and using material in the field of Management Science by developing a learner-centred, interactive, computer-based package. The interactive package described here integrates different styles of learning and gives the student every opportunity to progress at his or her own rate. Allowing students to proceed at their own rate is highly important (West, 2013). Learners tend to acquire knowledge and confidence in material at different rates and the interactive package described in this paper fully recognizes this important fact.

## 2 RELATED WORK

The plethora of management tools currently available presents an overwhelming choice to users of various needs. Commonplace is tools developed for specific markets, like OR/MS (Hillier, 2014) used in

academia and MPSIII (Ketrion, 2011) used in the commercial market.

Both markets present packages that support a specific group of techniques, for example a package offering support for Linear Programming (e.g., MPSIII) typically will not support Game Theory. This forces users, who wish to explore a range or combination of techniques for solving a problem, to require access to a number of different software packages and acquire the ability to operate them.

Predominantly, packages are provided by different vendors and operation is targeted to audiences with specific needs. This has led to reduced *conformity of operation* among packages due to the varying design criteria used by each vendor. These criteria could affect elements as the GUI (graphical user interface), input and control method (files, mouse and keyboard), operating platform (UNIX, Windows, MacOS) and the balance of theoretical and practical focus.

In the area of *learning environments*, for academic purposes, the available packages are commonly linked to specific platforms and support an accompanying course or book, resulting in limited tools heavily related to the material covered therein. Conversely, packages aimed at the commercial market tend to offer *solution tools*, neglecting the provision of theoretical revision or offer exploration of new techniques through education, preventing the development of additional skills by the employee.

### 3 MAGLAB - INNOVATIVE FEATURES

A contemporary discussion of interactive learning systems with respect to modern theories of education (Schank, 2010) lists the following five different teaching architectures: (i) **simulation-based learning by doing**, (ii) incidental learning, (iii) learning by reflection, (iv) **case-based teaching**, and (v) learning by exploring.

In this work, the focus is on the first and fourth of these teaching architectures. Simulation-based learning by doing is critical when the subject matter is experiential at heart. Emphasis is made on learning by doing and preparing the student for the challenges that might be faced with real world problems. Case-based teaching is described as being a useful addition to that of learning by doing – sometimes students will realize that in order to progress in their ‘doing’, they

need further knowledge. This can be achieved through the use of case studies. While isolated facts may be difficult to remember, if knowledge is presented in the form of a story or particular case, it is generally integrated better into memory.

MagLab is an intelligent *interactive learning environment*, which provides a wide ranging theoretical content, backed with calculation tools that can be used as problem solvers, implemented in an expandable and integrate-able fashion. The integration framework allows for the masking of the underlying application and applied theory by a highly intuitive and usable interface. An example of the MagLab interface can be seen in figure 1.0, which demonstrates the use of MagLab as a *learning or reference tool*.

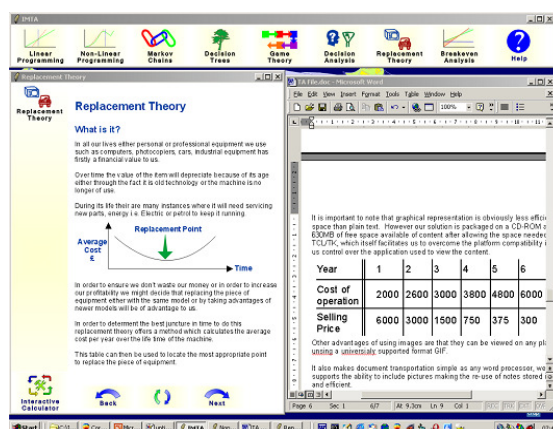


Figure 1: MagLab environment providing theoretical assistance to a user while they are developing a document in a word processor – in this example relating to a Replacement decision.

The environment uses common MOTIF interface components such as *navigational anchor bars* (top of the screen) and *icons*, which remove language barriers and facilitate navigation between sections. Theory content and calculator tools as well as interactive exercises are provided in independent *windows* (“Theory window”, on the left in figure 1) assembling an interactive learning environment, where users can study theory, step through methods, review examples and answer questions through independent high level scripts. The *independent window* environment facilitates the use of other applications such as word processors or spread-sheets in conjunction with MagLab, assisting users through their learning or decision making process; an innovative convenience against other packages. MagLab uses the high level scripting language Tcl/Tk

(standing for **Tool Command Language/Tool Kit**) ([www.tcl.tk/software/tcltk/](http://www.tcl.tk/software/tcltk/)), which provides support for powerful GUIs (graphical user interfaces). Tcl is a very simple but powerful and dynamic language that allows implementation of complex programs and functions with very few lines of code (Flynt, 2012). The Tcl scripts call on the Tcl core to provide their functionality.

The use of Tcl/Tk gives MagLab an advantage over existing packages by providing true cross platform compatibility, requiring only a Tcl/Tk interpreter per platform and removing the need for code recompilation. The interpreter is *royalty free*, which removes licensing issues (traditionally found with cross-platform applications) and allows MagLab to be provided in a run-from-disk format with no installation required. So, a student, for example, could use the Unix/Linux version of MagLab for work in the university laboratory and the Windows version for work at home. Also, desktop Tcl/Tk programs may run almost unaltered on the Android Platform (AndroWish, 2014).

Tcl provides network and internet access through TCP/IP, allowing provision for online content and updates for collaborative or distance learning, as figure 2 illustrates.

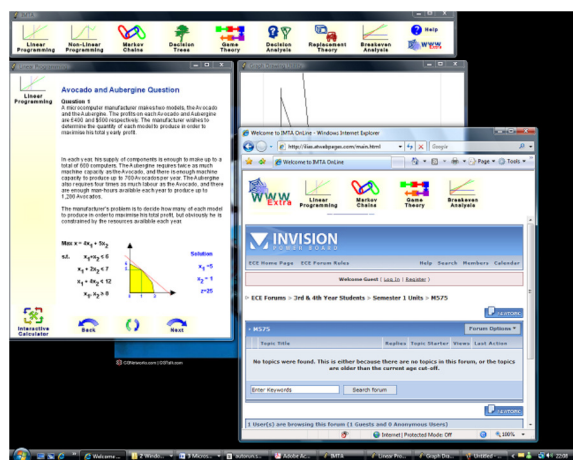


Figure 2: Software running along with IE in windows

Online forums and online chat are easily implemented on a web site and no alterations need to be made on the software since it already provides a link to the web. Also perception tests can be developed on the server's side for accessing purposes. Web features can be additionally used for the support of the software with updates and technical support as well as providing extra online content.

Other features of Tcl allow third party applications to be 'glued' on to MagLab allowing integration of powerful third party routines in *Interactive Calculators*. These calculators provide users with real tools to be used in problem solving at the workplace or experimentation to support learning.

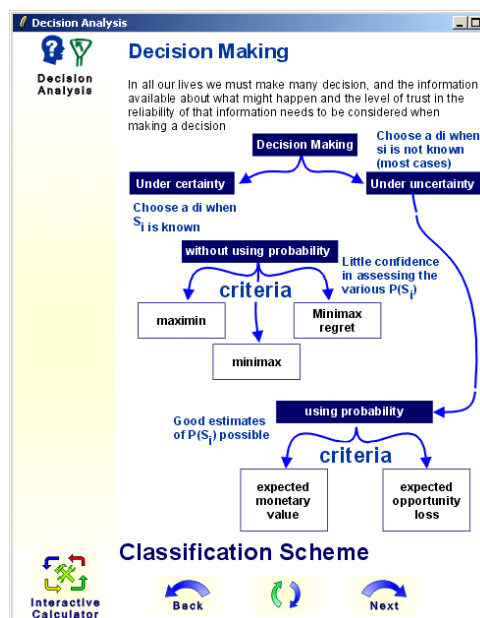


Figure 3: Interactive decision making environment provides assistance on the selection of theoretical techniques without the need for prior knowledge, assisting the learning process.

MagLab implements *intelligent learning* through the use of *wizards* in order to simplify and de-skill the selection and use of appropriate analytical management techniques. This simplification enhances the learning process and reduces the prerequisite theoretical knowledge required by the user, making techniques available to a wider audience and providing a greater understanding in the application of techniques, as figure 3 illustrates.

## 4 CONCLUSIONS

The outstanding capabilities of the Tcl/Tk in creating GUIs were used in order to build a really fine tool for academic education: MagLab. It can be efficiently used for educational purposes as part of either an introductory or a more advanced course in Management Analytics. It is very easy to use MagLab

and little time is required for its learning. The great variety of functions and options it includes, together with the detailed help topics provided directly by the interface of the tool, promote extremely the learning process and make working with MagLab both productive and enjoyable. The development of MagLab continues and more functions, techniques and algorithms are included, so that it becomes a really professional management tool.

## ACKNOWLEDGEMENTS

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