Implementing the LASO model: development of a pilot online course at the Faculty of Engineering and Technology, University of Botswana

The Authors

Philip Uys, *Deputy Director at the Centre for Academic Development, in the Faculty of Engineering and Technology, University of Botswana, Gaborone, Botswana*

Cheddi Kiravu, *Lecturer in the Faculty of Engineering and Technology, University of Botswana, Gaborone, Botswana*

John Mothibi, *Lecturer in the Faculty of Engineering and Technology, University of Botswana, Gaborone, Botswana*

Abstract

This paper reports on the process of developing a blended online engineering course at the Faculty of Engineering and Technology of the University of Botswana. It presents the actual development process in terms of its management, the University's preferred pedagogical approach to student-centred learning and the consequent technological choices and deployment. In that regard, the paper will demonstrate the development of the Electrical principles course (EEB211) focusing attention on what was done, how and what result was achieved. This paper will be a useful reference for all those staff expected to develop their online courses alongside their normal face-to-face lectures.

Introduction

The University of Botswana (UB) has progressively moved from a vision to incorporate information and communication technologies (ICTs) in its programmes through the commitment of resources to a stage where eLearning pilot projects across its faculties are now transiting into a UB-wide eLearning Programme. Among the pitfalls that seem to inhibit an enthusiastic adoption of eLearning by faculty members, perhaps the uncertainty of the pedagogical principles involved (Diaz, 2001) and/or the educational technologies used (Luck, 2001) stand out most prominently. This paper shall review the milestones in the process of an online course development focusing attention on the technological choices made and their incorporation to implement the student-centred engineering course, EEB211.

The first part of the paper shall review the UB's vision and its consequent implications on the organisation and management of eLearning. This will be followed by a brief discussion of the LASO model (Uys, 2001) for technological transformation that was adopted to drive the eLearning initiative. Then a detailed discussion of the eLearning pilots will follow with EEB211 as a particular case for review. Just before the conclusions, the results of EEB211 will be presented in the form of illustrative figures highlighting some key aspects of the course.

UB's quest for academic excellence

The UB vision is to become a leading academic institution of learning (UB Annual reports, 2001, 2002, and 2003, available at: www.ub.bw/about/vision.html). Central in its quest for excellence

is the realisation that ICTs can innovate learning, as documented by Newby *et al.* (1996). The prominent role played by ICTs is underpinned in an extract from UB's mission statement, thus:

- develop student-centred, intellectually stimulating and technologically advanced teaching, learning and research environment;
- extend access to higher education through the utilisation of ICTs within the framework of life-long and open learning; and
- enhance the teaching, learning and research environment through the provision of proactive styles of leadership and management and efficient, effective and quality-driven institutional support services.

At the UB, eLearning is defined as the appropriate organisation of ICTs for advancing student-oriented, active, open, collaborative and life-long teaching-learning processes – a definition that embraces blended learning so that students can profit from the appropriate mix of teaching and learning strategies to minimise the constraints that may be posed by limited resources.

UB's centres of academic activity and its affiliated colleges and health centres are situated at distances of at least 60km away from the main campus. Given this distribution, the UB stands to benefit from eLearning in that eLearning promises (Uys, 2002) to:

- provide flexibility within University's semesterised programmes;
- increase the success rate and quality of student's learning through increased, formative feedback, repeatability, ability to track own achievements/failures, modern curriculum, extended connectivity, effective organisation and handling of large classrooms, remedial support and student-staff intercommunication, student-centred collaborative learning;
- increase access to education because of its cost effectiveness in expanding distant education;
- slacken the administrative and teaching pressures on academic staff;
- create a repository of intellectual educational capital;
- provide for capacity building and competitiveness to UB against the threat of national and international virtual and private institutes vying for the same pool of students; and
- create and support new research opportunities and prepare students for effective participation in the workplace and the wider information society.

The management of eLearning at the UB

In consonance with its mission statement, "to enhance the teaching, learning and research environment through the provision of proactive styles of leadership and management and efficient, effective and quality-driven institutional support services", the UB has entrusted the management of eLearning to the Educational Technology Unit (EduTech) within the University's Centre for Academic Development. EduTech foresees its role in the first place as that of "spearheading through research, teaching and service provision the appropriate use of educational technologies by the academic staff and students of UB and its affiliated institutions". EduTech therefore has carried out and continues to implement the following functions:

- promoted and communicated the effective use of educational technology through seminars and demonstrations;
- provided educational technology equipment and services to faculties through its distributed eCentre philosophy;
- provided academic staff training in all aspects of educational technology awareness, adoption and development;
- initiated pilot projects to roll-out the inception of ICTs for staff teaching and student's learning;
- contributed to consultancies and debate on eLearning in the Botswana context; and
- encouraged staff research on applications of educational technology in tertiary education.

Though EduTech has a limited staff comprising of an instructional designer, a graphic designer and an online media expert and a few support technicians, it has managed eLearning progressively from its initial phase as a project, to now, a programme. The instructional designer sees to the pedagogical requirements that suit a student-centred content delivery. The graphic designer is responsible for the technical layout of the course content for online delivery, while the media expert is responsible for the integration of different media into an online course. At the time of writing this paper, especially during the pilot phases, the roles are diffused, with some staff going beyond their call of duty and providing canvassing support to the other. The following sections will describe how EduTech has used the LASO model of technological transformation (Uys, 2001) to manage the infusion of eLearning at UB.

The LASO philosophy

The management of EduTech chose a "Leadership, Academic and Student Ownership and Readiness (LASO)" model as shown in Figure 1 as its strategy for effecting technological transformation at the UB.

The LASO model for technological transformation is one where management provides for the requisite vision, direction, organisation, focus and control over the resources needed and thereby empowers the staff for action and ownership of the transformation. In the process, the confluence of leadership and ownership creates a spill-over of the transformation from within the institution outwards to the wider community. The model also includes an inside-out dimension as it attempts to address the affective domain such as fears and motivation of staff and students. The model effectively therefore is a top-down, bottom-up and inside-out strategy, much akin to the bottom-up action through top-down investment mentioned in "Learning technology mentors" (McNaught and Kennedy, 2000). In terms of the UB, the vision and leadership emanate from EduTech and the University of Botswana Educational Technology and eLearning committee (UBel) down to the staff and students. The development effort then creates an implosion from within the UB institution to the wider Botswana community.

Encapsulated in the LASO model is the idea of cause and effect applicable to a technological transformation and their interaction to bring about the desired change. At the UB, the change started with a vision by the EduTech Leadership and its commitment to fulfilling the conditions for that vision. EduTech was vested with formulating the strategic framework for integrating ICTs in the UB programmes. In it, the necessary reward structures for staff engaged in eLearning

were incorporated, albeit not yet implemented. As a result, a phased planning of the activities was established encompassing a needs analysis, a strategic plan, and the selection of the suitable learning management system (LMS) amongst Web Communication Tools (WebCT®) or Blackboard. The UB ended opting in favour of WebCT.

As pointed out in other literature ([Marcinkiewicz, 2001](#)) the Leadership's commitment to the vision and its ownership was a pivotal precondition necessary for the integration of ICTs into the UB programmes. The vision was made to trickle down to the staff and students for ownership and readiness. This entailed the formation and management of eLearning interest workgroups, training teams, the umbrella advisory committee – UBel, and addressing other pertinent issues on eLearning. Among these issues were training schedules for WebCT and eLearning pedagogy, the boosting of library resources, addressing student access issues, the acquisition and deployment of ICT equipment including the Smart classroom, the formation of eLearning support centres and the design, allocation and management of eLearning research pilots including their funding.

After the successful completion of the eLearning pilots, it was envisaged that UB would be poised to transform itself from within by rolling-out eLearning as a programme across its faculties, based on the results of the implementations of the eLearning pilots – a stage in which the UB finds itself now.

The eLearning pilots

The eLearning pilots were designed to "test-drive" the eLearning initiative with a view to finding out how, what kind of, and where eLearning best works for the UB. The pilots would provide best practice and positive role-models with which staff would identify as they confront the issues and advantages of eLearning while designing their online courses in respective areas of speciality.

Nine pilots were awarded, representing the UB faculties, the UB library and the Centre for Continuing Education. The award of the pilots to individuals was the prerogative of EduTech in consultation with UBel but was based on a strict point-score system of criteria developed by EduTech. As part of these criteria, it was desirable, for example, that the pilot would be linked to academic areas that might become strategic roll-out areas later. EEB211 was selected to ascertain the suitability of WebCT for online delivery of engineering-related courses.

One requirement of the LASO philosophy is that the development process would be a team effort where consortiums of members from multi-disciplinary backgrounds collaborate in the development of the pilot. In the case of EEB211, the team members were the content expert, a library representative, a representative from IT, an instructional designer, an online media developer and a graphic designer – the latter three being staff from EduTech. In the following sections, the development of EEB211 will be highlighted from the perspective of the content expert while acknowledging the inputs of the other team members.

Development of EEB211

Any planning for an online course must be preceded by the appreciation of the implicit pedagogical issues in order to develop the course around sound educational principles. For this, the EduTech offers the necessary staff advice and coaching through general and, where demanded, personalised training, development and implementation support ensuring that staff are familiar with and confident in the use of ICTs and allied skills needed for eLearning. The planning of EEB211 was under the following subheadings:

- Selection of the pertinent pedagogical approaches.
- Selection of the online content.
- Plan for communication, assessment, collaboration.
- Selection of technologies to implement the online content.
- Implementation of the selected technologies.
- Uploading content to WebCT.

We next present brief discussions of each of the categories considered in the planning of EEB211.

Selection of the pertinent pedagogical approaches

The selection of pedagogical approaches was dictated by the realisation, that the UB fosters student-centred learning through a discovery learning approach. Therefore we explored how constructivism, resource-based learning, anchored instruction and situated learning could render the learning activities in EEB211 student-centred. Specifically, we achieved our goal through targeted, individualised, interactive learning activities that were presented in a conversational style whether through brief outlined narratives or through the use of graphical user interfaces (GUIs) in the self-assessment exercises.

Selection of the online content

We recognised that, thanks to blended learning at the UB, some of our content could be provided face-to-face. That meant that only the content or an aspect of a learning content whose learning was likely to be innovated by the online option was worth considering for development. By conducting an "innovation-hunt" for each section or aspect of the course, we were able to discover all the syllabus sections that formed the potential content for online development.

The innovation to learning EEB211 derived from the ability:

- of conducting online simulations thus provided learners with the ability to visualise complex electrical phenomena;
- for learners to hyperlink to different learning resources related to the same content thus widening their learning horizons;
- for learners to interactively engage in self-assessment exercises designed with feedback prompts thereby dispensing away with the limited exercises regularly given to students on handouts; as well as
- to foster collaborative learning among learners through discussion groups.

Selection of the requisite educational technologies

Many disciplines, notably engineering and science-related ones, require students to analyse, visualise, design, experiment with what-if scenarios and perform computations.

There was an ardent desire to test each of these requirements in a WebCT-based electrical engineering course. As such the choices on the appropriate educational technologies for EEB211 were dictated by the extent to which the requirements above would be met. In EEB211, the technologies employed to achieve interactive features were Java programming, JavaScripting, HTML programming. Beyond these, a program for basic graphics was required, although we recommend Macromedia Flash® to be an extremely practical program for generating scalable and easily-editable graphics.

Additionally, where interactivity involved server-side programming, it helped to have a test-server. Depending on the technology adopted, server-side programming may use Java Server Pages (JSP) if Java is selected as the programming language or Active Server Pages (ASP) if either JavaScripting or VBScripting is used. PHP is also a common technology.

In our case, the fully-functional test-server, the Internet Information Services Server (IIS) that comes bundled with Windows 2000 or Windows XP was installed and configured in the local machine for running and testing the.ASP files.

Java programming and the Internet

We realised that the implementations of the simulations was going to be in the form of Java applets. An applet is a small Java application (in the sense of a droplet being a small drop) that requires a Java-enabled Web browser for it to run. The original sense of "smallness" is in the meantime outdated, as Java applets, can span many pages of programming code. There are repositories of useful educational Java applets, notably for instance under the URL, www.gamelan.com In most cases when a need for an applet arises, the content expert would resort to an Internet search using such search engines as Google (www.google.com) or Ask_Jeeves (www.Ask_Jeeeves.cm) and one or more keywords including the applet keyword.

Java applets are platform-independent applications that can be widely distributed through attachments to HyperText MarkUp (HTML) pages via the applet tag and can therefore be delivered for educational applications via the Web. The integration of programs with the Web browsers is possible via mini programs called Plug-ins for Netscape or ActiveXControls for the Internet explorer. Thus Plug-ins and activeXcontrols extend the capabilities of Web browsers.

Since the development a Java educational application is time-consuming, the recourse is to obtain existing simulations from the Internet. Any investment on the development of a learning object in terms of time and personnel is only warranted if development work is either organised around consortia (Cairncross and Mannion, 1999) or when it cannot be outsourced. In EEB211, all the Java simulations but one, were derived from the Internet. The analogue electrical multimeter simulation was designed and implemented from scratch at a trade-off in terms the

time invested for its development. The other interactive GUIs for the self-test exercises were generated using JavaScript programming.

JavaScripting and the Internet

Besides Java, JavaScript offers excellent features for rendering content interactive. JavaScript has a programming syntax almost identical to and probably less demanding than Java. In EEB211, JavaScripting was used to design the GUIs used in the self-test exercises. There were seven major self-test engines, each with eight questions graded in terms of the level of difficulty of the individual questions. After completing all the exercises in sequence, a student is guaranteed to have mastered the skills called for in a particular module. In addition, there is also a hyperlink to a random self-test engine, which students are advised to attempt, only after going through all the course modules. The random self-test engine comprises 50 randomised questions from any course topic.

Results – a guided tour of salient features of EEB211

Figures 2 through 6 illustrate some of the salient features of EEB211. Figure 2 and Figure 3 show learning objects developed for the course, whereas Figure 4, Figure 5 and Figure 6 display typical learning objects that learners in EEB211 can link to and access.

Conclusions

This paper has demonstrated the milestones and results of an interactive WebCT course developed to showcase desirable features typical in engineering or science-related disciplines. These features are general visualisations, simulations, and the ability for students to do computational analysis and to carry out virtual experimentations, as well as test what-if scenarios. In addition, the paper showed the possibility of designing student assessment exercises that are interactive and provide immediate feedback.

The paper gave insightful hints into the programming languages, Java and JavaScript that were used to program the main learning object GUIs, through which learner interactivity was achieved. Whereas their design and implementations have been demonstrated, the paper cautions that such an exercise may not normally be necessary due to the substantial development time and the limited programming language skills that many an ordinary course developers possesses. The best way out in any case is to search for, identify and collate learning objects directly from the Internet and to incorporate them into courses.

Despite the fact that today, many features can be incorporated via HTML tags to enable a true multimedia online experience, three things still need to happen: For the UB, every effort must be made to minimise network outages. Frequent network outages are frustrating. They make students uneasy and may nurture in them traits of mob psychology. The latter may in turn create a collective apathy towards the very promises that eLearning was meant to provide.

Second, the debate on bandwidth may be premature at this stage. However it is easy to foresee a situation when bandwidth becomes an overriding issue. Already now, the downloading of
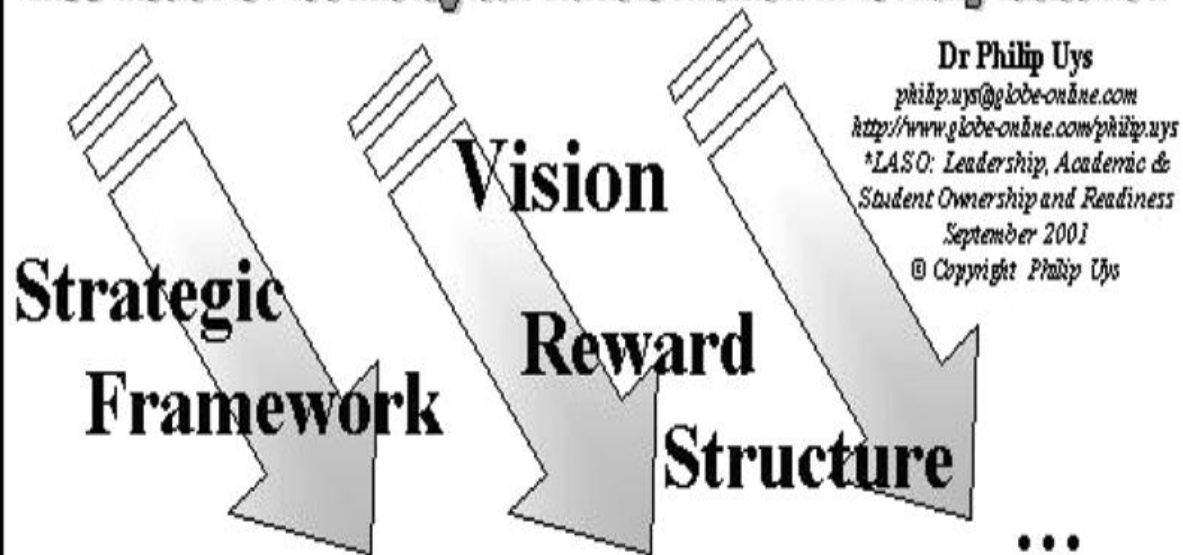
learning objects like applets took a very long time. This was worse, as noted also in the British consultation report on *Superhighways for Education – The Way Forward* (DFEE, 1995), during the day time when apparently, most of North America, with its high Internet connectivity of 115 times more than Africa in 2001 (representing an Internet per population ratio of 690:6 (Kellerman, 2002, p. 179)) is awake and surfing the net. The UB shall therefore need to invest in the eLearning infrastructures to demonstrate its commitment to its eLearning vision and a will to own it.

Third, the LASO model was found to be a helpful guide in the implementation of eLearning in this instance and could guide similar developments within and external to the University.

Finally, in engineering and science-related disciplines, the requirement for analytical and computational rigour is paramount. It would be desirable to have an online course where it is possible to run time-tested engineering applications like MATLAB® or OrCAD® directly from within the Web browsers. At the moment, this is not possible because it requires extending the capabilities of current Web browsers through plug-ins and/or ActiveXControls. Some work, with notable results, has already been done in this regard at the Ruhr University Germany (Mueller, 1997) where a MATLAB plug-in for Netscape 4.0 has been implemented. However, both its progress and documentation are sketchy. It seems therefore, that increased promises of online engineering courses in future shall depend on the ability of engineering educators to develop wide-ranging plug-ins for integrating into the Web those applications that we have come to respect as being educative.

*LASO Model for Technological Transformation in Tertiary Education

Dr Philip Uys
philip.uys@globe-online.com
http://www.globe-online.com/philip.uys
*LASO: Leadership, Academic &
Student Ownership and Readiness
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Vision

Strategic

Reward

Framework

Structure

. . .

LEADERSHIP

TECHNOLOGICAL TRANSFORMATION

ACADEMIC AND STUDENT OWNERSHIP & READINESS

Workgroups

Pilots

Teams
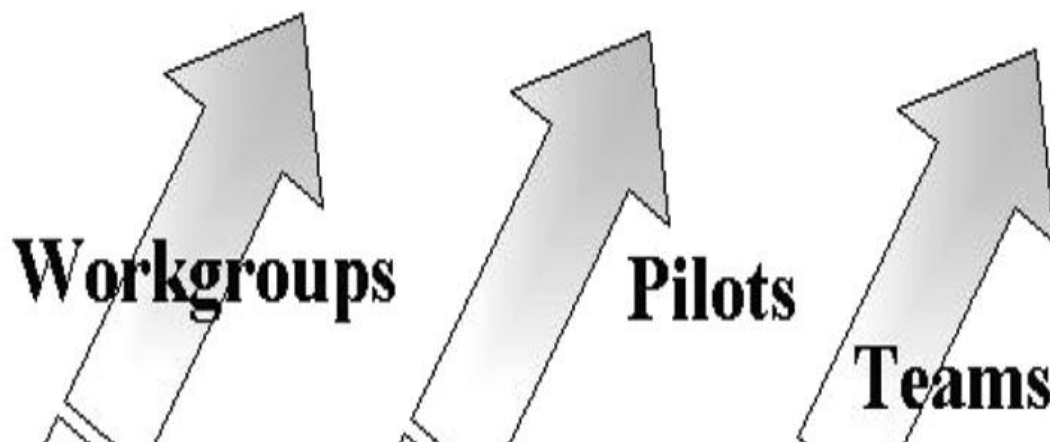
Figure 1 The LASO technological transformation model
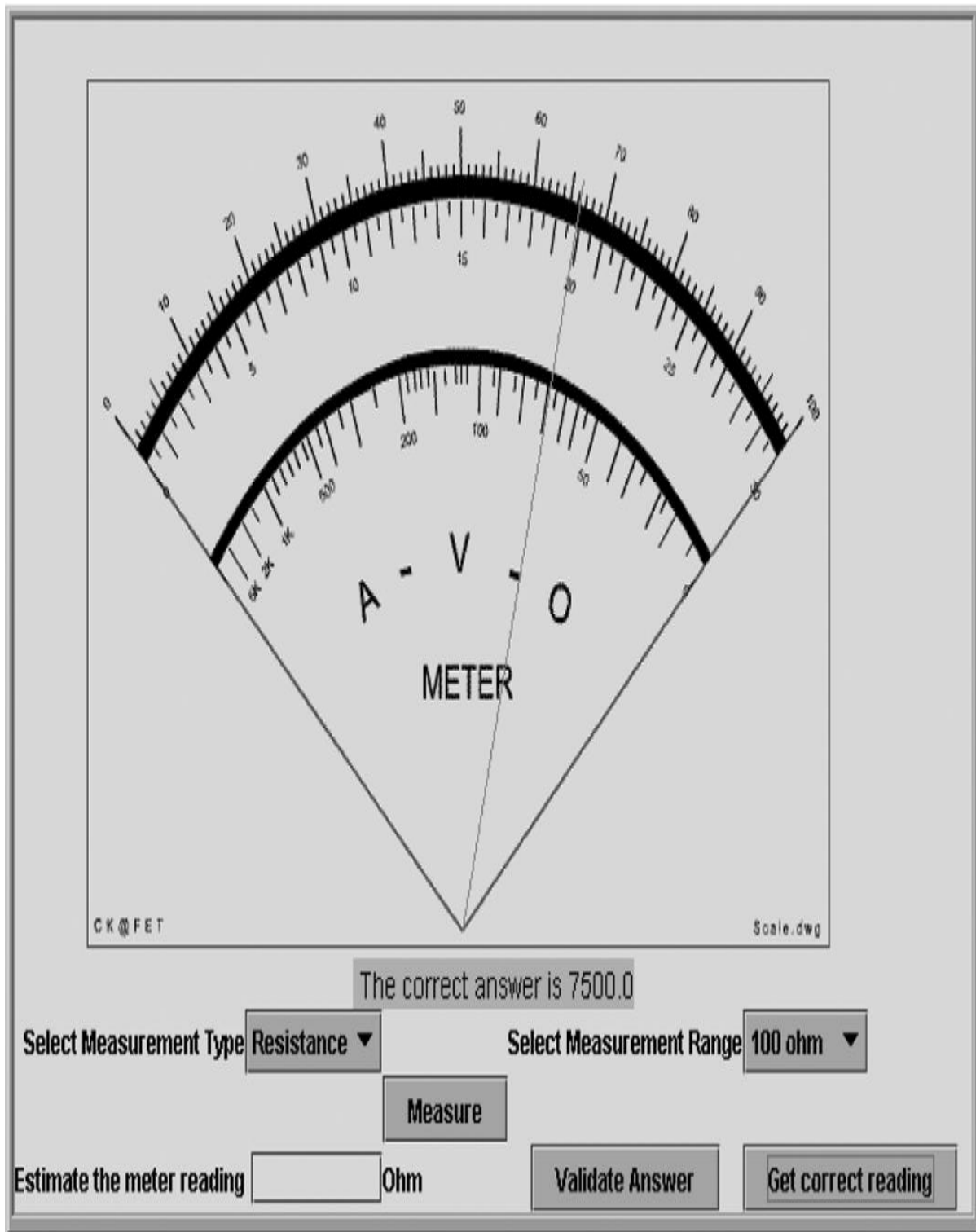
Figure 2 Simulating virtual electrical resistance measurements

Fig. 8
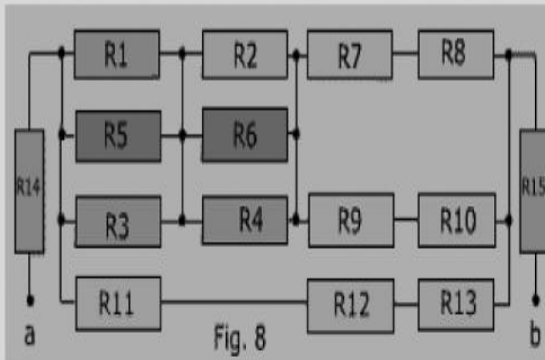
• Fill in arbitrary resistance values below,
• Identify those resistances or sets of resistances connected in series and/or in parallel
• Write down a single expression that combines the resistances identified in step above
• Evaluate your expression starting from the innermost bracket
• Enter the result you get in the answer field below

Microsoft Internet Explorer ☒

⚠ Well done!!

[OK]

Enter the resistance values here.

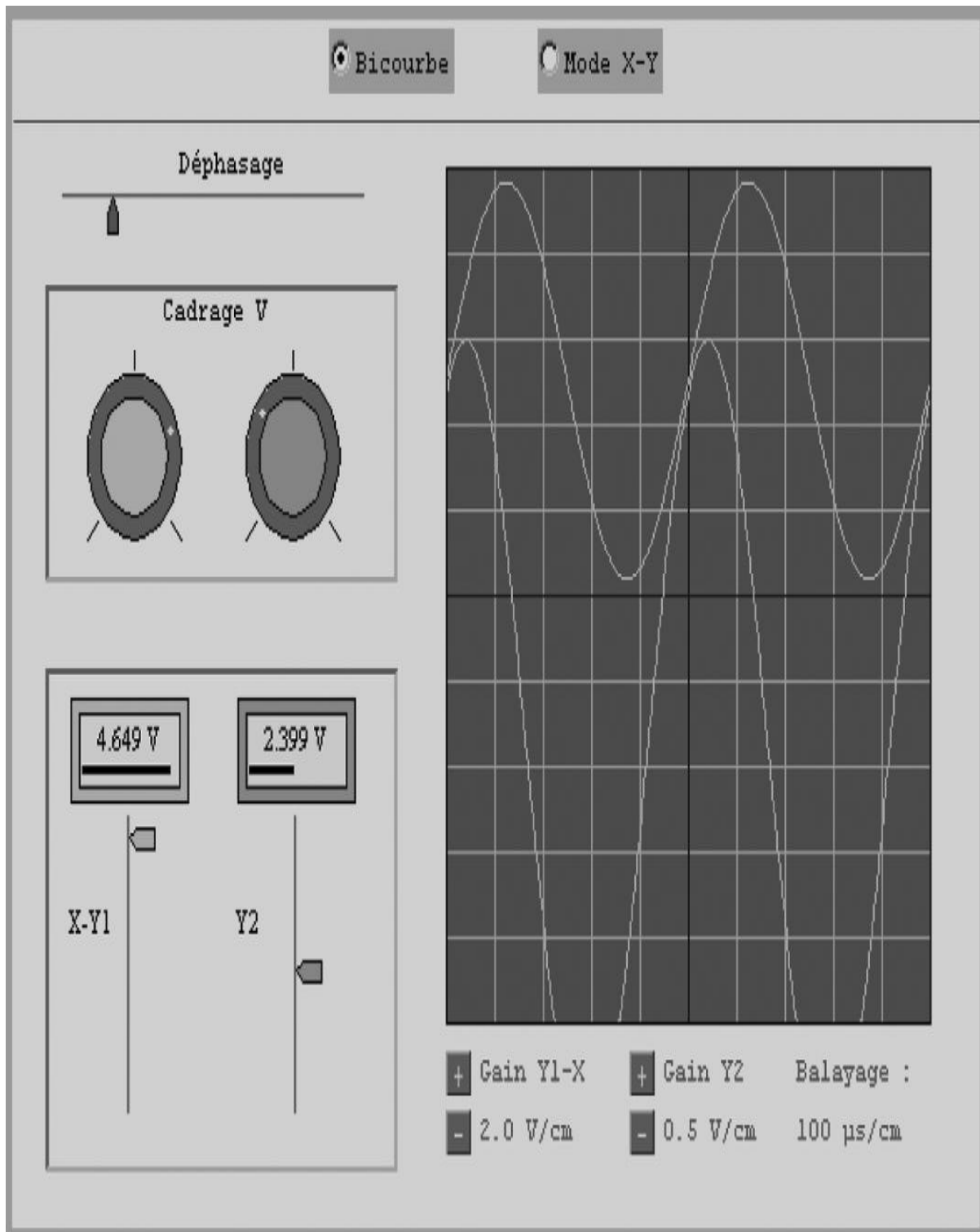| R1 | 1 | R2 | 2 | R3 | 3 | R4 | 4 |
R5	5	R6	6	R7	7	R8	8
R9	9	R10	10	R11	11	R12	12
R13	13	R14	14	R15	15		

Enter the answer Here [36.9] Then click 'Check Answer' to Validate Your Answer

[CHECK ANSWER]   [CORRECT ANSWER]   [N E X T]

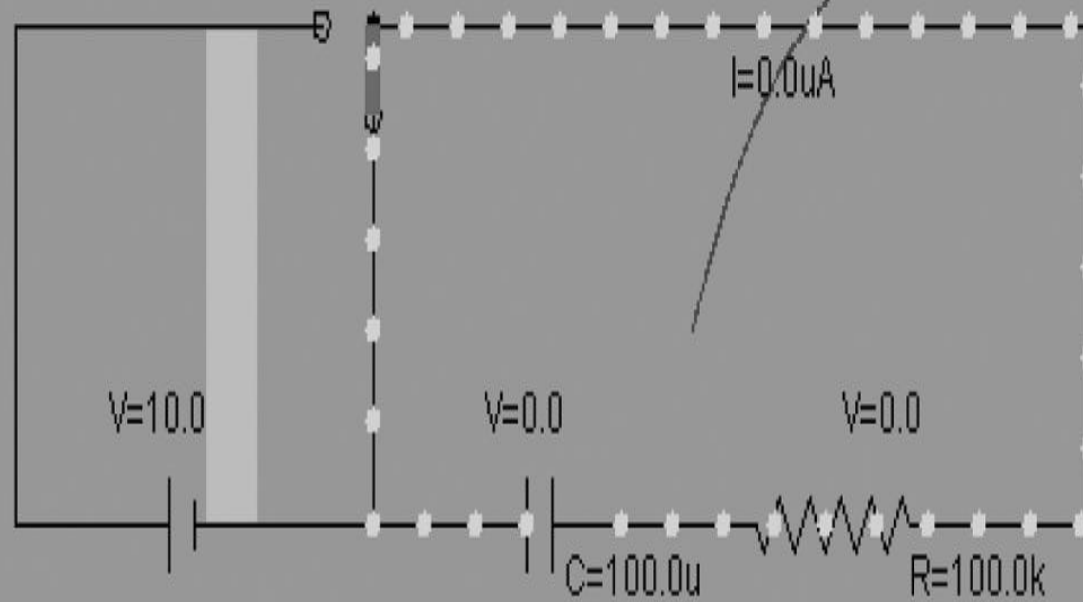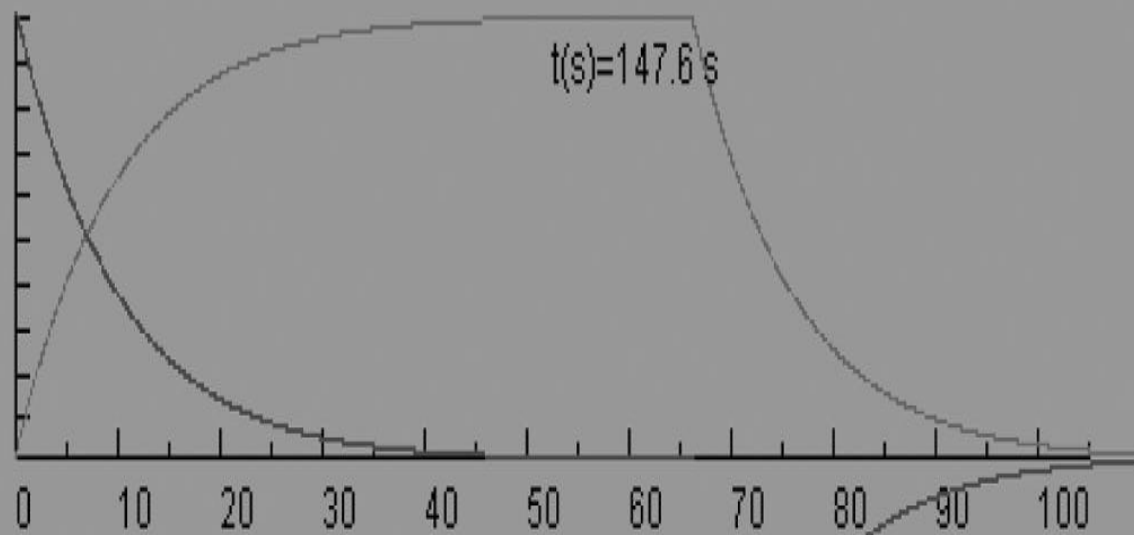*Figure 3* *JavaScript-based self-test GUI providing interactive feedback*

Figure 4 *Exploratory investigations of the cathode ray oscilloscope controls*

R= [100 ▼] kohm , C= [100 ▼] uF, V= [10 ▼] V [Update]

[Reset] [time, Vc, Ic]

t(s)=147.6 s

| 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |

I=0.0uA

V=10.0   V=0.0   V=0.0

C=100.0u   R=100.0k

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*Figure 5**Visualisation of DC transients*

Figure 6*Java applet simulation of the lightning phenomenon*

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