

Can mouse and keyboard chase out chalk and blackboard in engineering education?

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Abstract

The face-to-face method of instruction has dominated the teaching arena from time immemorial. However the rapid advances in information, computer and communication technology is rapidly changing the mode of knowledge transfer from teacher to learner. Remote classrooms and the virtual environment has seen the distribution of learning in time and space. However there are challenges that must be faced in order for this mode of teaching to permeate all corners of knowledge transfer. There has been some resistance to adopting virtual classroom in practical-intensive, equation-laden courses. This paper discusses strategies that may be employed to surmount the hurdles. It shows that developing a digital learning suite is a prerequisite to successful floating of laboratory and/or equation intensive courses. The digital learning suite is a prerequisite to floating engineering courses in a virtual learning platform where the chalk and blackboard has been replaced by mouse and keyboard.

Introduction

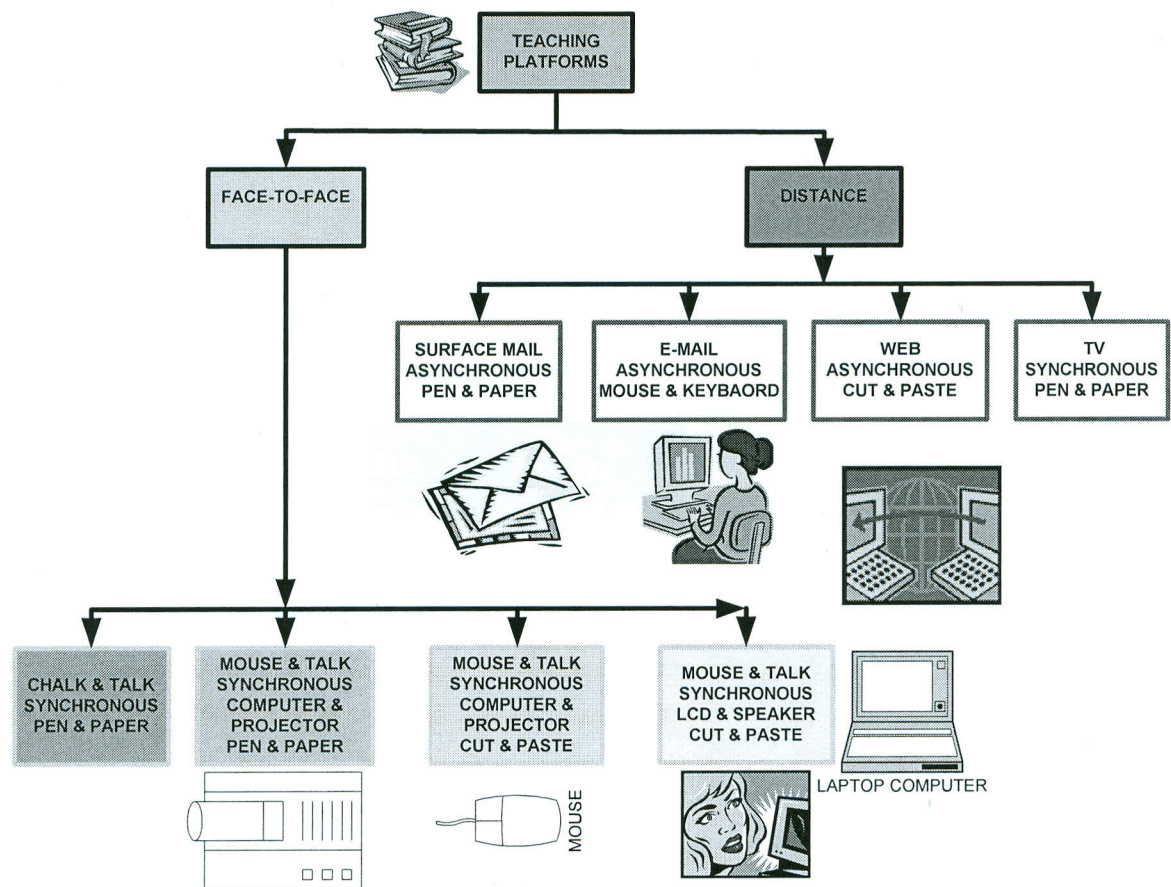
The teaching platform has evolved from the traditional synchronous, face to face, otherwise known as "chalk and talk", to asynchronous flexible location modes. The teaching platform has been classified, for the purpose of this paper, into face-to-face and distance modes. The face-to-face lecturing platform has dominated instruction methods for a long time and is still a dominant mode. But this method of teaching is giving way to remote methods via distance learning, interactive and video conferencing and web-based education.

In face-to-face lecturing, the use of a blackboard/whiteboard remains a major method of conveying information. The use of the overhead projector to convey pictures and salient points that was later introduced added flexibility to teaching. The entry of data projector and portable computers and local area networks, Internet, we refer to as digital teaching suite or DTS, is now rapidly changing the method of instruction administration to learners. This DTS is now promoting the use of digital lecturing methods as opposed to analog or "chalk and talk" method. It is now mouse and keyboard method. There are three stages in the mouse and keyboard regime.

- **Synchronous Mouse & Talk** where data is projected from a single computer. The students have to use **pen & paper** to take notes
- **Synchronous Mouse & Talk** with network capability where the information is projected and the note can be made available to students on line or off line. The students move to **cut & paste** regime.
- **Synchronous Mouse and Talk** where each student is hooked to his work station and via **multi-media** facility can communicate with the lecturer. Information is available to the students in softcopy and so operates in **cut &**

paste regime. This is the ultimate regime where student and staff may not necessarily be in the same location.

Information Communication Technology, ICT, plays a prominent role in the distance mode of knowledge delivery [1,2]. Distance learning has graduated from the snail-mail-based correspondence platform to asynchronous web-based e-learning regime. The distance platform also benefits from the digitization of information and transmission over high bandwidth channels. We now have a truly open learning regime where a student can study in his/her own time in his/her own location at his/her own pace. Mouse and keyboard have formed an inevitable partnership in both in the distance learning as well as in face-to-face platforms [4].



EVOLUTION OF TEACHING PLATFORMS

But to what extent will the mouse and keyboard chase out “talk and chalk” particularly in engineering education? What are the strategies that must be put in place to permit the smooth and quick exit of the chalk and talk method in engineering education?

Digital Teaching Platforms

This emerging platform of instruction dissemination has several advantages which include information storage, linkage as over your own website or global web site [1,2].

It is easily upgradeable from year to year and can be distributed with ease to all concerned. There is no longer a need to distribute material for distance education by video or s-mail. It encourages active learning which produces better results than chalk-and-blackboard-lecture-only method, since it encourages more student participation and activity [3]. However, DTS faces many problems one of which is the algorithms for the assessment of assignments and tests given to the students. While performance in examination may not be a total reflection of the learners' ability, it however provides an inevitable feedback about the depth of information exchange. DTS has been deployed in several learning areas especially in humanities and soft skill disciplines but it is snail-crawling into the physical science arena.

Digital lecturing and assessment in a practical intensive course is a challenge. To illustrate the problems and algorithm developed, which is still being perfected, in tackling these problems, a course was digitally taught and assessed. Tests and assignments were administered both in real-time and off-line mode. Feedback to students was also communicated in the same way. Tests were of a hybrid type consisting of theoretical and practical components. A fully developed virtual lab is inevitable for a full DTS. In the absence of this type of lab, students were required to acquire data in the conventional way and plug it back into the digital teaching platform. Knowledge delivery on the DTS platform has several advantages which include the following

- Students develop self-learning attitude early and sustained this through out the course.
- DTS discouraged rote learning since the amount of information available is beyond cramming. Students therefore quickly learnt to internalise the basic concepts.
- DTS encouraged group learning by the students since they can exchange notes over the network and discuss questions in a mini forum
- Examination questions tend to migrate upward in Blooms taxonomy hierarchy and move towards application of concept rather than "define" mentality. This is quite a big challenge to the teacher.

Challenges of Digital Lecturing Suit

In order to effectively deploy DTS in knowledge transfer, various challenges must be surmounted:

- The material must available in digital form.
- There must be an effective digital communication channel between the learner and the teacher.
- There must be a positive attitude to the new procedure of information dissemination by both parties.
- The teacher must be mouse and keyboard literate .
- The learners must be VDU/LCD conversant.

These are some of the challenges militating against the full digitisation of instructional materials and delivery processes in engineering and science. These challenges depend on the portfolio of the lecturer, the available infrastructure, learners change of attitude, as well as information sourcing.

Many older teachers are used to pen & paper method of forming notes, but in this digital age, this is rapidly being replaced by mouse and keyboard approach. This is quite a challenge to those who are not keyboard literate as well as to the "2-finger typists." The availability of many similar data on the Internet has however added flexibility to the way in which a teacher may make notes. A three-prong strategy may be considered to cope with this challenge: - type, scan or cut & paste.

Handling of equations still resents a tough challenge particularly when multivariable polynomials with subscript and superscript are involved such as

$$2jk \partial u / \partial z = \partial^2 u / \partial x^2 + k^2 (r^2 - \beta^2) u. \quad (1)$$

A way out of the woods is to acquire digital textbooks or e-books where difficult equations may be cut for pasting. E-books are however not yet a common place in many such equation infested courses. There are a few digital library sites with equation-laden books with public access [3]. To write simple equations on the spot, one may use few functions of the MS Word while complicated ones may be imported from other equation friendly packages such as Mathtype.

The physical library is rapidly being replaced by the digital library while the conventional professor's bookshelves have almost given way to folders in the laptop or personal website. With the huge source of information comes the challenge of sourcing and sorting. Use of search engines such as Google has proved helpful. Another way of meeting this challenge is via networking with other institutions with similar courses where declassified information may be used to build your own library. Lecturers may not wait to re-invent the wheel, a careful search and appropriate networking with peers will usually provide much needed information for building your own library piecewise.

Pictures and figures convey a good depth of, and quick, useful knowledge. Free hand sketching was easy on the blackboard or whiteboard but not so easy on the keyboard. There are however software packages that allow teachers to sketch directly on the screen, but the price is still a barrier to popular usage. A combination of the use of Microsoft Office platform and other graphical friendly packages may be used to face this challenge. With the emergence of handwriting-friendly packages, this will soon be an easier task.

One critical challenge is the administration of tests in a course that is digitally taught. There are 4 options:-

- Students use pen & paper to answer
- Questions are multiple choice or single word answers that could be marked automatically on line
- Student submit word-processed solutions to descriptive questions off line
- Student use mouse and keyboard to submit solutions to descriptive questions on line.

A popular and easy way out is to require the students to use pen and paper to answer questions during examinations but word-process off-line assignments. Students are increasingly now required to sit and answer questions on the computer! This opens up a new challenge of question format, security of questions and assessment protocol of their work. This paper discusses some algorithms adopted to simplify the task of setting,

marking and reporting digitally assessed course. These challenges are faced squarely in a course that is offered digitally at the Department of Electrical Engineering, Polytechnic of Namibia.

Algorithm for assessment

The red pen on paper has been used for assessing paper written tests and assignments. How will digitally answered tests be graded? Various methods may be used for this interesting aspect of teaching and learning. Objective testing has been used for a long time or grading multiple choice questions. The art has been perfected; automated and now web-based versions are available. Web-based programs for single or few unique words have been developed, as used in filling forms. But the use of online grading of essays, remain a difficult issue. Word-processed documents have such facilities as *comment* which can be used to pass information back to the student on his own document. There are other facilities such check mark \checkmark which can also be used. Marks awarded per section can be inserted by using the same method, eg. $\frac{1}{2}$. By using the Track Changes facility, corrections can be effected on the student's paper.

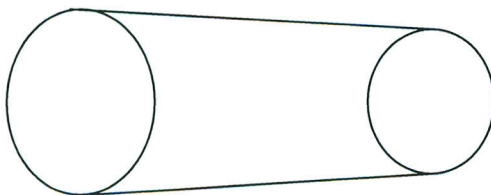
Note formation

The three methods of forming a digital note, i.e. keying, scanning and cut & paste have been employed to assemble information for knowledge dissemination. The challenge comes when you need to make simple sketches and tables "on-line" teaching. The MS Office has been used extensively. For example, an Excel sheet can be used to construct a table which may need to be sorted or filtered. If no data processing is needed, the MS-WORD table facility can be used.

Student	Age	Gender
Keyboard	20	m
Chalk	70	f
Mouse	15	m
Overhead Projector	20	f
Data Projector	10	m

TABLE 1 Student of DTS and Hypothetical Age

FIGURE 1 Pulley System Drawn "On-Line" Using Word Draw Facility



Circular and irregular objects may be drawn using the Draw function of MS WORD or from Visio or other packages. Once these packages are available you can modify any of the objects pasted into your Word document.

A flowchart may be imported from Visio or other packages.

1. The course was structured in away that would permit digital presentation with little recourse to the blackboard or whiteboard
2. Assignments were designed to include not just objective or one word answer which is easy to mass-grade using tested automatic methods, but also to include written answers that would be graded by the lecturer.
3. An important component of the algorithm is the use of rubrics in tests and assessment. Learners are given an incremental rather than single mark for a question.

Conclusion

Introduction of DTS in engineering education is highly desirable. It presents some challenges which can be met with attitudinal changes on the part of the lecturer. The little extra effort needed in getting the suite organized, will be paid for by the flexibility of its operation.

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Scott K On line Education expands and evolves

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**Towards Education for All :
The critical role of open and distance learning in
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