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## INTERACTIVE ONLINE ENGINEERING COURSES BY CONSIDERING LEARNING STYLES

BY

\*A. ADĂSCĂLIȚEI, \*\*C. DUMITRESCU and \*R. A. BRAȘOVEANU

**Abstract.** This paper analyzes different types of online interactivity by considering learning styles. The courseware learning modules realized based on this approach will be available via: <http://www.ee.tuiasi.ro> and <http://www.imc.ro>). Interactive learning environments are designed to improve student performance in engineering courses offered at Technical University Iași and Maritime University Constanța, Romania.

**Keywords:** Interactive Learning, Web-based Multimedia, Learning Styles, Engineering Education.

### 1. Types of online interactivity

As with all good teaching, it is important to provide interactive learning environments where students can test and critically evaluate their understandings, apply their knowledge to solve problems and discuss issues relevant to their profession[1]. These strategies work to improve learning effectiveness and knowledge retention and to build skills in the application of that knowledge in professional contexts. Interactivity in any teaching and learning context involves students responding to information, seeking feedback on their responses, reflecting on the feedback and acting appropriately to tailor their personal learning experiences [2]. These practices motivate students to engage with the material, giving them more control over achieving their learning outcomes. In the online environment, interactivity in teaching and learning means students not only read text online, but also interact with online resources, and/or people (teachers and peers), using different online tools. These activities can improve student learning outcomes in relation to the course objectives.

#### 1.1. Learner use of the technology

This involves basic online computer literacy skills such as knowing how to use e-mail, databases, discussion boards and web browsers. Often this form of interactivity is given emphasis over other strategies that can be used to enhance student learning. While ease of use of the technology is important, simply clicking a link, or uploading a file, is just the first step towards other experiences of interactive learning. The student finds information by, for example, clicking on hyperlinks to find answers to their own questions or to set questions. By

using buttons, links and navigation within a well-designed site, students can learn the principles of using web sites as resources. The student uses online tools (text boxes, files uploads) to share information (e.g. text, voice, images, and other media).

### **1.2. Learner interaction with stored information**

Student engagement with stored information, for example web resources and online texts, helps them develop their body of knowledge. Students engage with ideas and principles that can promote reflection and critical analysis. *Interaction with content.* Students interact with *World Wide Web resources* that introduce them to online resources relevant to their professional area (web sites, databases, e-journals, e-books) and learning (e.g. online workshops). These can develop their information literacy within their professional environment and extend their body of knowledge. Students use *online quizzes* to test and critically evaluate their body of knowledge, utilising the embedded feedback to extend their body of knowledge. This student learning is done in an environment that is independent of the teacher, and promotes the development of autonomous work practices in students. In online quizzes the interaction occurs between the student and stored information. When students provide a response to a question, the feedback is immediate and can be designed to address common misconceptions within a topic. As quizzes are online, they can be accessed at anytime and on multiple occasions. Quizzes that incorporate feedback, do involve time and effort when first developed, but once created, can be reused over and over again. They can also be modified and extended when required. In *online journaling*, students are given an online environment where they can record their thoughts privately. These can include embedded prompts from the lecturer, that the student can select to see, that guide them during the reflective journaling process. The entries can be compiled, retrieved and ‘copied and pasted’ in assignments, or into student resume. Different types of *educational software* can be made available online, on the hard drive of student pool computers, on CD-ROM or floppy disks. Although their purposes will vary depending on the discipline, typically they provide a space for the student to interact with stored information. Some have been designed to improve problem-solving skills and extend the body of knowledge.

### **1.3. Learner interaction with other learners and/or teachers**

Students can also interact with people as part of their online learning experience. This interaction can be with the tutor, course co-ordinator or another teacher in the area. Interaction can also occur with other learners, to socially construct understandings. These various forms of interactivity are possible in an online environment, and can be facilitated by a range of tools to achieve different learning outcomes. Online communications can be archived and made

available to students for revision, and to teachers for reflection on their teaching practices. In addition, online interactivity with people develops the capacity to communicate effectively in professional practice and as a member of the community. A more detailed exploration of interactivity that encourages online learning conversations can be found in the teaching guide about online collaboration. The tools available to support online interactivity with people include *asynchronous discussion groups, e-mail, and online surveys*. *Asynchronous discussion groups can be used as: a bulletin board* to keep students updated with events within a course. The communication here is generally one way, teacher to student, which does not strictly qualify as interaction; or a *way of focusing discussion about an assignment*, where the student is able to interact with the tutor about any issues that arise. Communication flows both ways between the teacher and student. Because the interaction happens in a shared environment, all students may benefit from groups to raise questions and concerns so that all students can access responses. *Online surveys* are another type of online interaction available through University Intranet. The interaction is between student and teacher initially (online collection of information from students) and then teacher to student (when the collated responses are reported and acted upon). These practices provide models of the self-evaluation skills students need to develop. *Online role-play and simulations* are an example of a way that multiple interactive online tools can be combined in a single online learning experience. Learners can take on a role relevant to their profession. They may learn about this role by interacting with stored resources, and by experiencing that role together with other participants within asynchronous discussion groups, and/or email. Role-play and simulations can be used to: develop team work skills; present students with social, cultural, international and ethical issues relevant to their profession; encourage students to develop their communication and problem solving skills to find workable solutions to problems.

## 2. Using Multimedia Websites as Instructional Tools

**Media** -- In the context of computers, media generally refers to: 1) the objects on which data can be stored (e.g., disks, CD-ROMs), and 2) the form and technology used to communicate information – audio, video, graphics. Media enables students to reread lectures, which they may have missed in class while taking notes. **Multimedia**, then, refers to the use of computers to present concurrently, in an integrated manner, more than one medium -- text, graphics, video, animation, and sound. Any website can be viewed as a multimedia presentation, even if it simply contains text and images (e.g., a lecture with graphics). Multimedia in instruction have the ability to present information in various ways to accommodate the various ways students learn (e.g., visual, auditory) and to use the media to suit the subject or learner (e.g., assigning

kinesthetic homework). **Multimedia** are *interactive* when the audience has some control over the display or presentation. User control or reaction to input distinguishes them from, say, motion pictures. Interactive multimedia runs from high interactivity, as with video games, to online forms, which give fewer options for user interaction (you simply fill in the blanks). Interactive multimedia can be both synchronous and asynchronous. In a live videoconferencing session (synchronous interactive multimedia), the instructor can query students, who then respond, which may stimulate further discussion from other classmates. Students taking quizzes on a course website and then receiving grades for their performance, and corresponding with their classmates or instructor via discussion boards, are examples of asynchronous multimedia interaction. In both of these examples, however, the activities are no more interactive than in face-to-face classroom participation. The degree of interactivity does not increase but the quality may increase. Students working from a computer have more time to ponder a question before responding than they would if they were in the classroom. Instructors find that e-mail or discussion boards enable their students to have in-depth and uninterrupted discourse. Students who are timid about speaking out in class feel freer to express their opinions online. A good relationship between instructor and students, making them feel they're getting a personalized education, doesn't just happen by posting lectures and a syllabus online. Quality interaction with students takes effort. **Asynchronous communication** offers a choice of where and when students access learning. An example would be a web-based course in which the instructor posts a lecture and assignments on the Internet. At another time, students view and complete these assignments, and then send them to the instructor for evaluation.

### 3. Online education based upon student learning styles

Some strategies that have been taken to accommodate a variety of student learning styles [4] in the Electric Circuit Theory Engineering Course are outlined below as an example. *Active Learners* prefer trying things out and working with others. Practical sessions require students to perform laboratory experiments in small teams of 2-3 students. During these sessions, practical supervisors will ask students questions related to the experiment. Students will submit team reports on performed experiments and all students in a team are required to contribute to writing each report. *Reflective Learners* prefer to think things out and work alone. Study guide and the course web site contain all necessary information about the material to be covered in lectures and practical sessions. Students are advised to prepare for all classes by reading from the textbook and other resources. This allows students to reflect on material being presented. *Sensing Learners* like learning facts and using tried methods in practical settings. Practical sessions will be supported by detailed guidelines on how to perform

experiments. Also practical supervisors will be available for help with the procedures. A number of typical problems will be solved during tutorial sessions and step by step procedure explained. Also practical sessions are good hands-on opportunity for relating theory and practice. *Intuitive Learners* are innovative and enjoy abstract concepts. Practical sessions will be accompanied with a number of questions to be answered by students in their reports. These questions are of various-graded level of difficulty and are aimed to enforce students' abilities to draw conclusions that link practical results with the theory. *Visual Learners* relate well to graphs, pictures, diagrams etc. All lectures will be presented in power point mode with lots of diagrams to allow students visualization of electrical circuits, which are by their nature invisible. Wherever possible interactive and other multimedia material will be used to support visual learning style. *Verbal Learners* enjoy reading and lectures. Students will be required to write 4 reports based on experiments done in the laboratory. Report writing will support development of verbal learning style as well as development of technical writing skills that are important in engineering practice. Students will also be encouraged to discuss material using electrical engineering jargon. Use of the course textbook and the study guide is largely verbal. *Sequential Learners* prefer taking logical steps toward an outcome. Material will be presented starting from fundamental concepts towards more advanced topics. Although some topics may seem not to be related they may be related in the similar concepts used to understand different systems like electrical vs. magnetic circuit. Therefore it is important for students to attend regularly all classes and follow the sequence of the material presented. *Global Learners* grasp the big picture quickly and work out the steps later. This course is designed to give students a global overview of electrical circuit theory and various methods for analysing electrical circuits. The course introduces students to global concepts and then case studies are analysed to enforce students' understanding of application of learned principles in various specific cases. [3]. All students may be tested for their preferred learning styles and be given detailed information on how to interpret test results and how to use this information to make their learning more effective. The teaching arrangements in this course also aims to expand the students' learning styles, therefore it is important for students not only to practice their preferred leaning styles but to try to develop other learning styles using techniques more suitable for these styles.

#### **4. Conclusions**

We developed a framework to teach systematic problem-solving skills and allow students to complete interactive exercises at their own pace. Conventional web-based exercises tend to take two major forms: multiple-choice questions and short problems asking students to fill in numerical answers. The multiple-choice question format, even in a regular classroom, tends to encourage guessing

or elimination to arrive at the correct answer. While the ability to guess or to eliminate incorrect answers is desirable, the lower-level courses need to teach students how to use basic theory to arrive at the correct answer. The implementation of this format on the web leads to another undesirable learning characteristic: students can get to the correct answer after several wrong clicks without even guessing. There is essentially no learning involved in this fast-click exercise. The short-problem format, with filled-in boxes, avoids these drawbacks but fails to teach students how to proceed step-by-step from the problem statement to the correct solution. The systematic problem-solving skill is the major learning outcome of low-level engineering courses, and web-based instruction needs to provide methods to teach this skill.

Our web-based instructional methodology focuses on teaching this systematic problem-solving skill.

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### REALIZAREA CURSURILOR ONLINE ÎN INGINEREȘTI CONSIDERAȚIE STILURILE DE ÎNVĂȚARE (Rezumat)

Acest articol analizează metodele de interactivitate online în funcție de stilurile de învățare. Modulele de curs web realizate pe baza acestei metodologii vor fi active la adresele: <http://www.ee.tuiasi.ro> și <http://www.imc.ro>). Mediile interactive de învățare contribuie la creșterea performanței studentului din cadrul Universității Tehnice "Gh. Asachi" Iași și a Universității Maritime Constanța, Romania.



# INTERACTIVE ONLINE ENGINEERING COURSES BY CONSIDERING LEARNING STYLES

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# Abstract.



- This paper analyzes different types of online interactivity by considering learning styles. The courseware learning modules realized based on this approach will be available via: <http://www.ee.tuiasi.ro> and <http://www.imc.ro>). Interactive learning environments are designed to improve student performance in engineering courses offered at Technical University Iași and Maritime University Constanța, Romania.
- **Keywords:** Interactive Learning, Web-based Multimedia, Learning Styles, Engineering Education.



# Types of online interactivity



**Interactivity in any teaching and learning context involves students**

- responding to information,
- seeking feedback on their responses
- reflecting on the feedback and
- acting appropriately to tailor their personal learning experiences



# Learner use of the technology



This involves basic online computer literacy skills such as knowing how to use e-mail, databases, discussion boards and web browsers.



# Learner interaction with stored information



Student engagement with stored information, for example web resources and online texts, helps them develop their body of knowledge.

**Interaction with content.** Students interact with *World Wide Web resources* that introduce them to online resources relevant to their professional area (web sites, databases, e-journals, e-books) and learning (e.g. online workshops). Students use *online quizzes* to test and critically evaluate their body of knowledge, utilising the embedded feedback to extend their body of knowledge.



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Online communications can be archived and made available to students for revision, and to teachers for reflection on their teaching practices.

Online interactivity with people develops the capacity to communicate effectively in professional practice and as a member of the community.

The tools available to support online interactivity with people include *asynchronous discussion groups, e-mail, and online surveys.*



# Using Multimedia Websites as Instructional Tools



Multimedia in instruction have the ability to present information in various ways to accommodate the various ways students learn (e.g., visual, auditory) and to use the media to suit the subject or learner (e.g., assigning kinesthetic homework). ***Multimedia* are *interactive*** when the audience has some control over the display or presentation.



# Online education based upon student learning styles



*Active Learners* prefer trying things out and working with others. Practical sessions require students to perform laboratory experiments in small teams of 2-3 students. During these sessions, practical supervisors will ask students questions related to the experiment. Students will submit team reports on performed experiments and all students in a team are required to contribute to writing each report.



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*Global Learners* grasp the big picture quickly and work out the steps later. This course is designed to give students a global overview of electrical circuit theory and various methods for analysing electrical circuits. The course introduces students to global concepts and then case studies are analysed to enforce students' understanding of application of learned principles in various specific cases.



# Conclusions



**DPPD** (Department for Teacher Training) developed a framework to teach systematic problem-solving skills and allow students to complete interactive exercises at their own pace.

Conventional web-based exercises tend to take two major forms: multiple-choice questions and short problems asking students to fill in numerical answers.

