The International JOURNAL of LEARNING

Active Learning Strategies in Engineering Education in Gulf Countries

Kasim Randeree

VOLUME 12, NUMBER 11

COMMON GROUND

www.Learning-Journal.com

INTERNATIONAL JOURNAL OF LEARNING
http://www.Learning-Journal.com

First published in 2005/2006 in Melbourne, Australia by Common Ground Publishing Pty Ltd
www.CommonGroundPublishing.com.

ISSN: 1447-9494 (print), 1447-9540 (online)
Publisher Site: http://www.Learning-Journal.com

The INTERNATIONAL JOURNAL OF LEARNING is a peer refereed journal. Full papers submitted for publication are refereed by Associate Editors through anonymous referee processes.

Typeset in Common Ground Markup Language using CGCreator multichannel typesetting system
http://www.CommonGroundSoftware.com.

Active Learning Strategies in Engineering Education in Gulf Countries

Kasim Randeree, The British University in Dubai, United Arab Emirates

Abstract: Teaching engineering has involved numerous strategies which have been evolving over the past decades due to innovations in technology. New and fashionable educational methodologies, e-learning and wireless networked laptop technology are only the latest in a series of developments available to the engineering instructor. The Internet as a tool for acquiring information from global sources has also proved invaluable to engineering students worldwide as an aid to research in many areas of their study. Engineering departments, for their part, have responded by preparing courses that develop the skills of their students in using these technologies and methodologies. The focus of this paper deals with active learning and new technologies in teaching students in engineering faculties in the UAE. Furthermore, the paper examines two key educational areas. Firstly, the implementation of strategies to facilitate the transition of students from passive to active learning. Secondly, the role of educational methodologies in promoting independent and group centered learning skills as opposed to their prior experience of highly dependent learning.

Keywords: CAD, Laptop, Active Learning, Integration

Introduction

COURSE DEVELOPMENT IS an ongoing and ceaseless process, with re-training of instructors being necessary and frequent in order to keep pace with advances and in order for these instructors (be they early or late adopters) to comfortably appreciate and implement such technology [1]. Additionally, some observers feel that the entire educational system, not only in Gulf countries, but in the Arab world as a whole is in desperate need of an overhaul [2]. Understanding the needs of company management is also important at the educational level in engineering departments, in spite of graduates often becoming part of a national workforce where employment is seen to be guaranteed. Employees need graduates who are team players, can use initiative and are ready to work rather than having to be re-trained on variations of a given technology.

These issues need to be addressed early in any undergraduate engineering program as much of the learning in schools in the Gulf is still highly dependent and teacher centred. To illustrate the important aspects of the topic, a discussion of active learning is presented and a case study is featured highlighting some of the technology issues also predominant in engineering education today. The case study examines the College of Engineering at the United Arab Emirates University (UAEU) as representative of engineering programs delivered in the state university system in the Gulf. During the early period after its foundation (1980-1992), it followed a classical curricula, similar to that dominant in the region at the time. Realizing that tomorrow's engineer has to face the challenges of modern technology and the demands of modern society, the university administration initiated a major effort to modernize the engineering curricula to parallel the most recent international trends, particularly the curricula promoted in the USA as well as in many other countries.

Overview of Active Learning

Teaching is fundamentally about creating the pedagogical, social, and ethical conditions under which students agree to take charge of their own learning both individually and collectively.

Therefore, the goal of an active learning strategy is to teach in a way that engages students in learning. As such, teaching consists of getting students involved in the active construction of knowledge. Thus, the aim is not only to transmit information, but also to transform students from passive recipients of other people's knowledge into active constructors of their own and others' knowledge.

To implement active learning as a viable strategy, the instructor must impart four key objectives in every classroom session. These are activity, reflection, collaboration and passion. The class time should be managed in such a way that there is not only a fifty minute lecture in the traditional sense, but rather that the class time is broken into distinct blocks of learning. For example, this could begin with a 10-20 minute introductory mini-lecture, followed by a 15-20 minute small group activity, followed by 5-10 minutes of group feedback and finishing off with

concluding remarks and learning outcomes from the instructor [4].

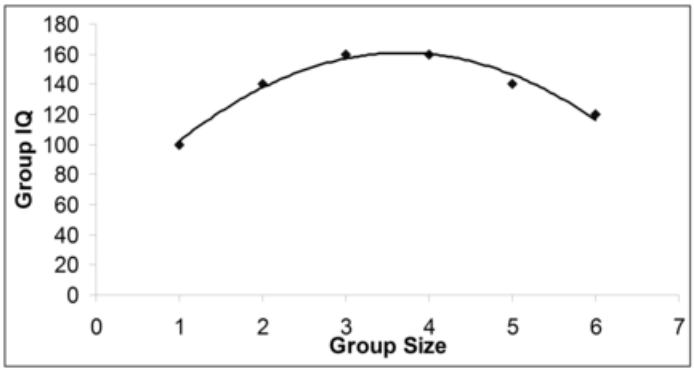

Figure 1: Importance of Collaboration in the Learning Process [5].

There are numerous active learning methods and approaches that are facilitated by new technologies and their application often varies from one discipline to another, often within the same faculty. These various methods are valuable in assisting the development and restructuring of courses. Some of these are outlined here.

Engaged Learning deals with increased and focussed student interaction, as well as collaboration amongst instructors and students. The focus is on the instructor as a facilitator and an emphasis is placed on technology as a tool for learning.

Project-Based Learning deals with real-world issues in engineering and requires a sustained period of cooperative investigation and collaboration amongst a student group in the completion of a project or task.

Cooperative learning (CL) is a generic term for various small group interactive instructional procedures. Students work together on academic tasks in small groups to help themselves and their team-mates learn together. CL involves people working in teams to accomplish a common goal. It consists of various key concepts. The most essential of these are positive interdependence, where all members must cooperate to complete the assigned task, individual and group accountability, where each member is accountable for the complete final outcome, face-to-face promotive interaction, teamwork skills and group processing. Optimization of group size is also critical for effective CL (Figure 1).

Problem-based Learning is a philosophy of teaching and learning through which students work together to solve problems of priority to them and to their community through input from experts, research, and the collaborative testing of potential solutions. Structured problem-solving can be used in conjunction with several other cooperative learning structures.

Effective Team Learning

Though team learning is a vitally important skill in today's engineering company, adopting active learning strategies to facilitate both implementation and assessment of this type of learning is very difficult in this region. The greatest problem faced by instructors as well as the studious participant is the "Hitchhikers and couch potatoes" phenomenon [6], the former being an individual in the group who is carried with the group by making a minimal, insufficient contribution and the latter is simply too lazy to make a contribution often relying on the committed student to do the work for him. Though this is not solely limited to the Gulf educational zone, with similar problems evident in the west, it seems that cultural influences in the region affect the group dynamic in a more diverse way than in the western model.

Student Motivation

The value of active learning must be considered within an appropriate context when dealing with students in a Gulf setting. A major issue here is to understand that a positive learning experience can only occur when diversity is appreciated. From an instructor's perspective, development of curricula must reflect an understanding of different teaching styles. This is especially important in the region, as undergraduate engineering courses are largely delivered in numerous repeated classes by different instructors, in addition to gender segregation of classes in state universities often requiring classes to be run on different campuses. In terms of students, consideration of cultural and gender issues is of paramount importance in the region.

One way to look at this is to consider motivational theory and organizational behaviour. Theory X and theory Y is a good example. Though essentially a management model, it relates well to active learning and team dynamics. Theory X assumes that people

inherently dislike doing any work and that people must be coerced into working to achieve set objectives. Thus, people prefer to be directed. In education, this relates very closely to the mindset of the Gulf archetypal student, where students in the early stages of tertiary education require or expect a "spoon-feeding" approach to learning, with little or no critical thinking and no effort beyond the limits of what has been stated by the instructor.

In contrast, theory Y assumes that people view work as being a natural part of life, accepting as well as seeking responsibility, progression, promotion [7]. This relates well to the archetypal western student who naturally goes beyond the bounds of the classroom dialectic to further explore, research and investigate the subject matter. Traditionally, as a result of these archetypal student types, the theory X model has over time resulted in the "stick" approach, where, in order to get valuable work out of students, they are given very specific tasks each of which are closely related to the marking regime, or GPA. In contrast, students following the theory Y model are taught with a bias towards the "carrot" approach, given only broad outlines to the nature of work in addition to a set of learning objectives. Thus Theory X is a much more dependent learning style than Theory Y. The goal of an active learning methodology in the Gulf, therefore, is to encourage a shift from Theory X dependent learning guided by the "stick" to Theory Y independent learning encouraged by the "carrot".

Another aspect of motivational theory of interest was outlined by F. W. Taylor [8] who stated that people are inherently motivated by money and will only work according to financial benefits to be gained from the work. Again, by analogy, it can clearly be seen that the archetypal Gulf student is motivated by GPA score. This is evident from both behaviour and dialogue. Gulf students will almost always ask the point value of any piece of work before making any attempt at it. Often a student will not turn in a homework assignment if he knows that it was assigned for gaining an understanding of the material, rather than for "money", in this case represented by the points awarded. What such a student fails to ultimately realize, is that through gaining greater understanding of the material, his marks will naturally increase when graded assignments are due.

Intensive and Reflective Learning

One more recent consideration amongst those involved in active learning strategy is the concept of intensive and reflective learning, where, rather than having an evenly spread curriculum for a course, say over a sixteen week period, instead, blocks of teaching are introduced, followed by periods of enhanced learning through research, reflection and reporting. This method, though valuable in the west, can prove problematic in the Gulf, particularly at the (early) undergraduate levels where students still remain in need of a cultural shift towards independent learning. New technologies have also enhanced this thinking as the use of email, internet, intranet, video walls etc have allowed interaction between student and instructor during the blocks of reflection.

Class Size

"The greatest single challenge to SMET pedagogical reform remains the problem of whether and how large classes can be infused with more active and interactive learning methods." [9]

Class size has become an ever increasing problem in the Gulf as well as worldwide. In engineering, student numbers have increased so dramatically over the past decade that attempts at keeping up with changes is proving difficult, particularly in areas such as team based learning, management of classroom dynamic, individual skills testing such as oral presentations and so on.

Another related issue is copying, cheating and plagiarism, cases of which are becoming more widespread (due, in part to the increase in technology use as well as class size) and less easy to detect. Although consistency with other international universities (USA in particular) is advisable for a coherent policy on plagiarism, cultural variation must also be taken into account. For example, the dominant culture in the Middle East is that of a much greater spirit of cooperation than their contemporaries in the west. Although this in itself is a noble attribute, such students will happily provide their work to a fellow student, without considering themselves as unethical or copying his original work. In addition, the student copying his work will regard his colleague as merely helpful. In contrast, students in the west are more competitive and consequently more possessive of their own work. Thus, the nature of plagiarizing is more confined to copying textual and IT sources (Internet) rather than fellow students.

Case Study: Engineering Design and the Use of New Technologies at UAEU

The computer and other information technologies revolutionized the way engineering practice many years ago. They are, however, only now beginning to revolutionize the way engineering subjects are taught [3]. In order to examine the impact and implementation of new technologies on engineering curricula as well as its role in facilitating active learning in the Gulf, a sample case study is presented here. The study looks at two interrelated courses delivered

at UAEU, Engineering Design and Computer Aided Design (CAD). Modernization of teaching methodology for the Engineering Design and Graphics course followed the trend adopted in the freshman year curriculum some years ago. Five courses were developed in 1996 and five more were implemented the following year. In the teaching of all these courses, the conventional lecture method in which the engineering instructor recites and demonstrates information and concepts was reduced to a minimum. In the newly developed approach, the engineering instructor assumes the role of "manager of learning". In this format, the student is lead through a series of activities that will enable him/her to master fundamental concepts. Nowhere is the approach more evident than in the Engineering Design and Graphics course.

The Engineering Graphics course deals with geometric constructions using 2-D CAD, fundamentals of orthographic projections using both freehand sketching and CAD software, dimensioning techniques, scaling of CAD drawings, isometric sketching, 3-D solid modelling using solid primitives and Boolean operations to create composite solids, coordinate system and viewing transformations.

The Design Project course covers an introduction to the engineering design process, where students work in teams on a project, with the instructors serving as project advisors. A final group oral presentation is made to a jury panel composed of faculty members and a final written group report is submitted.

Since these courses are taught early in the undergraduate program, prior to students having chosen their specialization in a particular field of engineering, it is important for the instructors teaching these courses to be aware of this fact and deliver the material in a generic and unbiased way. At UAEU, College of Engineering, this is by no means a small task, as, at this level, both male and female Emirati students remain unsure as to which discipline is of interest to them (Figure 2). Furthermore, instructors are themselves already specialists in a particular engineering discipline.

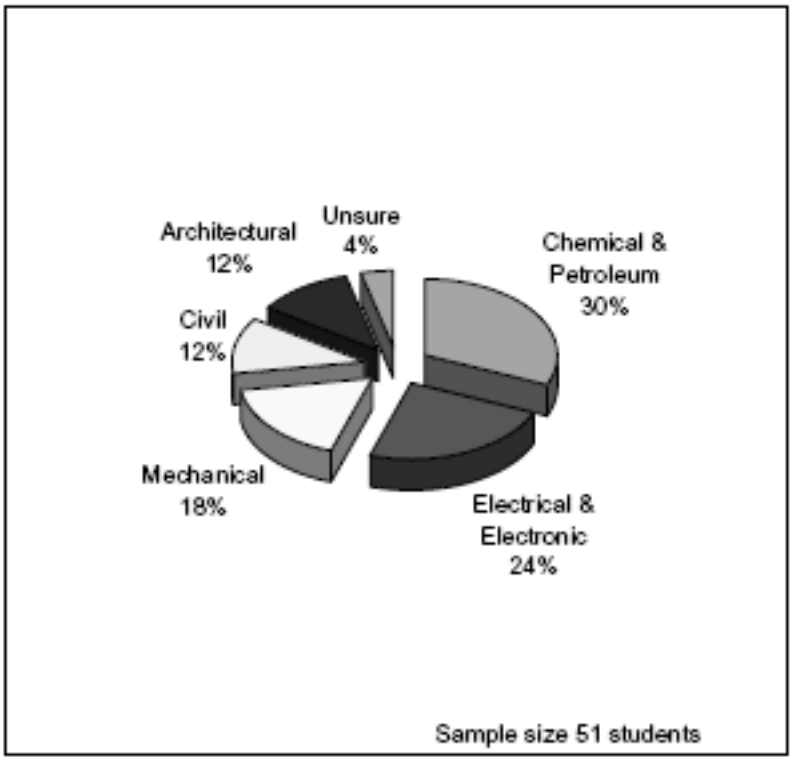

Figure 2: Initial thoughts of Specialization Discipline of Students entering the College of Engineering at UAEU [10].

Engineering classes are facilitated by the use of new technology. This allows for greater student interaction during class time, as well as electronic distribution and submission of assignments and quizzes and electronic grading, thus creating a paperless environment and maximizing wireless laptop applications.

In a practical sense, the instructor can circulate around the classroom during the session and can also remotely monitor the students. For example, during assignment work carried out in teams, instructors circulate or remotely monitor the students, giving hints, and checking for understanding. This is helpful in providing instruction for leadership, decision-making, communication, and conflict management.

In addition to moving to a wireless laptop environment, five types of software are used in the Engineer-

ing Design and CAD courses. Internet Explorer is used by the instructor and the students to search and browse the Internet for information about their design project and to access the course materials posted on the UAEU website. AutoCAD is used by the students to complete examples and assignments. NetOP is used by the instructor to monitor students and remotely control individual student machines (when required). Blackboard is used by the instructor to post and manage course materials on the web. On line quizzes are provided to assess the individual student performance. The software is also used by students for accessing course material and using available communication tools (e.g., chatting, e-mail, forums …etc.). "ViewLet" software is used by the instructor to develop animations that show the use of AutoCAD. Table 1 outlines how these new technologies have effected change in terms of classroom management.

Table 1: Implementation of New Technologies into the Learning Process.

New Delivery Method	Old Delivery Method
Viewlets, NetOP and Blackboard to broadcast PowerPoint presentations, Word documents, clarify the main concepts of the discussed AutoCAD examples as well as the design projects' background.	Whiteboard used to discuss the example assignments and design project background.
AutoCAD examples and Viewlets have some interactive parts that can be used by the students to discover and simulate different scenarios of the problems.	Whiteboard used to discuss the details of the example problems and project background.
Instructors use NetOP to monitor the activities of individual or group of students during the hands-on AutoCAD sessions. Instructors also (in some cases) circulate around the students to answer questions and discuss problem related issues.	Instructors circulate around students to answer questions.
Instructors post and manage the essential course materials on the web using Blackboard.	Instructors distribute handouts.
Blackboard is used for the collection of student files for the solved assignments, quizzes in AutoCAD.	Instructors distribute hardcopies of the assignments and students are required to hand-in the hardcopy of the solved assignments.
Remote office hours and chat capabilities built into Blackboard are used as a medium for student-student and student-instructor communications.	Instructors specify office hours at which they have to be available in their offices.
On-line and traditional quizzes used to assess the students' performance and provide students with instant feedback.	Hardcopy quizzes are used to assess the students' performance.
"Viewlets" (animations) showing the use of AutoCAD are used in the class and are available online for the students' access.	Real-time use of AutoCAD is displayed for the students.

Consequently, course development often requires the selection of a number of e-learning tools such as web delivery tools, multimedia tools, specialized software as well as other discipline specific software and techniques. Figure 3 illustrates the generic model for course development at UAEU, College of Engineering with a view to integrating the traditional development processes with technology based subjects and technology demanding delivery.

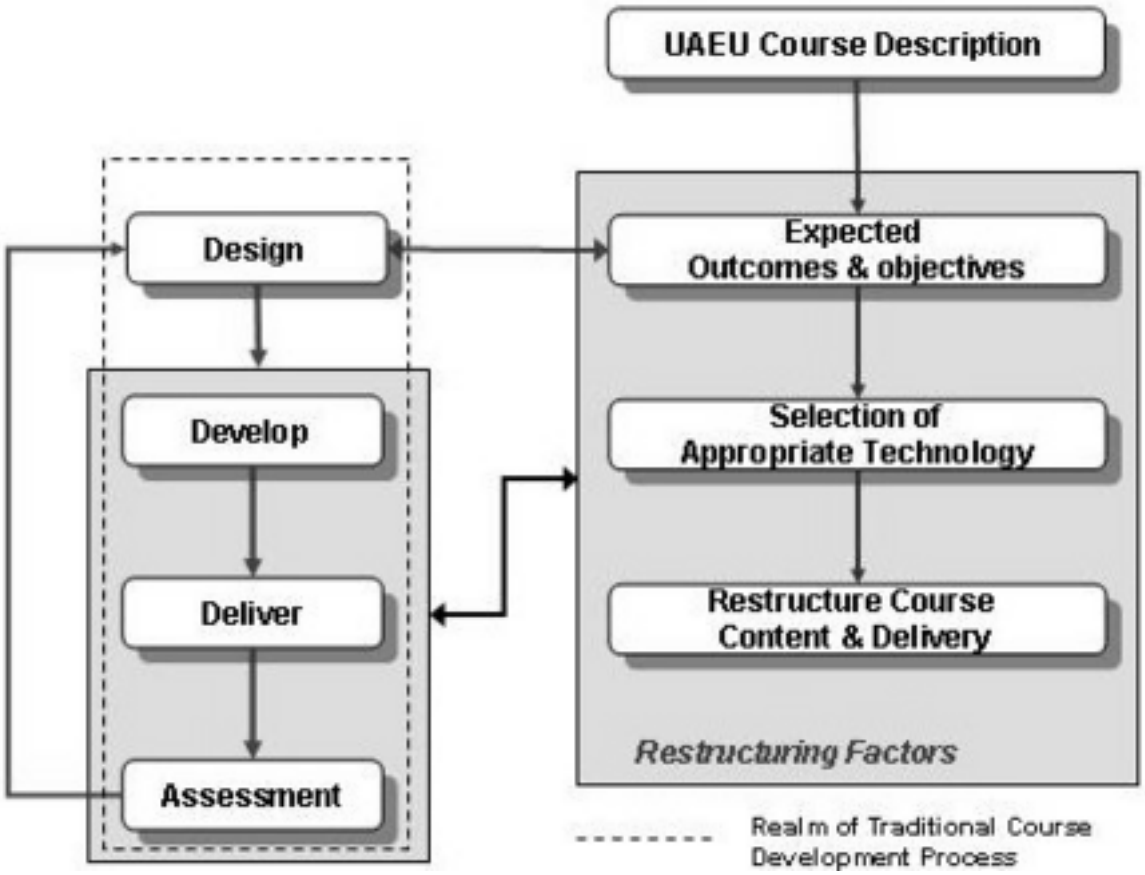

Figure 3: Course Development Process at UAE University, College of Engineering.

Conclusion

The paper has dealt with three key aspects of Engineering Education in the Arabian Gulf.

First, the importance of examining and understanding active learning and how this can make a positive contribution to students in the Gulf.

Secondly, the use of new technology in facilitating such learning through the use of NetOP substituting the whiteboard, "Viewlets" for online display of the use of relevant software, remote office hours concurrently available with traditional office hours, communication through e-mails and chatting being encouraged, student-student collaboration to promote communication skills and student interaction with interactive course materials. All these technologies and more can help to promote independent learning.

Finally, the paper examined the Design and Engineering Graphics courses and their latest developments within the dialectic of active learning and new technology.

It is envisaged that ultimately all of the current course materials will be transformed into a digital format and posted on the web using Blackboard. This will require further animations which may be developed using ViewLet technology or similar, to describe the use of CAD and design tools. Furthermore, work towards a fully integrated on-line quizzing regime is being developed as well as new interactive presentations for the example assignments.

References

1.McKenzie, J., Scoring High with New Information Technologies, From Now On: The Educational Journal, Vol. 8, No. 7, 1999.
2.Al-Maeena, K., , "Where is the Quality in Arab Education?", Arab News, Jeddah, Saudi Arabia, (17th June) 1997.
3.Byron-Pipes and R., Wilson, J., A Multimedia Model for Undergraduate Education, Technology in Society, Vol. 18, No. 3, pp 387 – 401, 1996.
4.Roland Christensen, C., Garvin, D. A., and Sweet, A., Education For Judgment: The Artistry Of Discussion Leadership, Cambridge, MA: Harvard Business School, 1991.
5.Perkins, D., King Arthur's Round Table: How Collaborative Conversations Create Smart Organizations, Wiley, New York, 2003.

6.Oakley, B., It Takes Two to Tango: How 'Good' Students Enable Problematic Behavior in Teams, Journal of Student Centered Learning, Vol. 1, Issue 1, pp. 19 – 27, Fall 2002.
7.Heil, G., Bennis, W. and Stephens, D.C., Douglas McGregor, Revisited: Managing the Human Side of the Enterprise, John Wiley and Sons, New York, 2000.
8.Wood, J.C., Wood, M.C., F. W. Taylor: Critical Evaluations in Business and Management (Critical Evaluations in Business and Management), Routledge, London, 2002.
9.Seymour, E., Tracking The Processes Of Change In US Undergraduate Education In Science, Mathematics, Engineering, And Technology, Science Education Journal, pp. 79 - 105, 2001.
10.Randeree, K., The Internet as a Tool for Effectively Understanding the Engineering Profession, Proc. 6th Saudi Technical Conference, King Fahd University of Petroleum and Minerals (KFUPM), Dhahran, Kingdom of Saudi Arabia, 2002.

About the Author

Dr Kasim Randeree

Dr Randeree has an academic career spanning the past 12 years, with experience as a lecturer in both the United Kingdom and the United Arab Emirates. For the past 6 years he was a Lecturer in Engineering at the United Arab Emirates University in Al Ain and has recently moved to BUiD. He has a growing portfolio of research and consultancy projects, collaborating with a number of blue chip companies, government departments and SME's in the UK, in addition to numerous publications at reputed international conferences in Europe and in the Middle East. Dr Randeree holds a Bachelors of Engineering degree in Engineering Design and Manufacture awarded by the University of Hull, U.K., and a PhD specialising in advanced manufacturing systems, from the same university. His current research interests lie in the management and control of manufacturing processes, engineering design as well as in the advancement of engineering and management education in the Middle East.

THE INTERNATIONAL JOURNAL OF LEARNING

SCOPE AND CONCERNS
Visit: http://www.Learning-Journal.com

SUBMISSION GUIDELINES
Visit: http://www.Learning-Journal.com

INQUIRIES
Email: cg-support@commongroundpublishing.com