

Session I

Establishment of Scientific and Technical Base

A New Adaptive e-Learning Multimedia Styles 'Web Based Model' for Teaching Computer Science Subjects

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ABSTRACT. The true power of e-learning nowadays comes from the exploitation of the wide range of capabilities that multimedia and advanced web technologies afford. One of the most obvious is to provide an instructional content learning model that adapt to learners' needs and desires. The goal of adaptive e-learning, as this paper demonstrates, is aligned with exemplary instruction: delivering the right content, to the right person, at the proper time, in the most appropriate way—any time, any place, any path, any pace. The paper presents an adaptive e-learning model that achieves this lofty goal in an e-learning context for teaching computer networks (CS 416) and computer graphics (CS 454) courses at the Computer Science Department of King Abdul Aziz University .

In addition, being adaptive is important for web based courseware because it has to be used by a much wider variety of students than any "standalone" educational application. A web courseware that is designed with a particular class of users in mind may not suit other users. Adaptive and intelligent technologies as used in the model enhance web based education. We can achieve adaptive presentation for improving the usability of course material, and adaptive navigation for supporting and adapting sequencing for overall course control and for helping the student in selecting most relevant tests and assignments. Problem solving support and intelligent solution analysis is also taken care of in the model. This significantly improves the work with assignments providing both interactivity and intelligent feedback while taking a serious grading load from the teachers' shoulders. Model matching technologies can enforce both administration of distance courses and communication / collaboration between students and teacher as implemented in the model through chatting.

In this paper, a multimedia learning-styles model description and realization is demonstrated. The architecture of the model consists of nine modules that work together to establish the required learning-styles functions of the

system. These modules include: Subject Units contents module, Subject Tutorials module, Exam Generator module, Exam Timer module, Exam Analyzer module, Text Reader module, Chatting module, Video Player module, and System Manager module, respectively. The System Manager module checks student name and password as a registered user or guest. The Video player module allows video education materials to be displayed in film format. Chatting module allows student to communicate together only as well as with their teacher. The Text reader module does read e-text loudly for a student to hear. The exam generator module produces multiple choice quizzes for a student to answer, and the exam analyzer module checks the answers and gives on line marks. The student has the capability to adjust exam time to suite his knowledge level using the Exam timer module. The teacher works as an administrator for the system and has also the capability to add, remove or modify subject contents. The overall system was built for teaching computer networks (CS 416) and computer graphics (CS 454). Thus, the proposed model achieves the predominant learning styles: Reading (visual), Listening (auditory), seeing (visual), Speaking (auditory), Doing (Tactile/Kinesthetic). Hence, effective teaching can be strongly achieved using the proposed model. Since, it combines several approaches and multi-sensory instruction. So that the student can use more than one sense at a time while learning.

1. Introduction

In recent years we have witnessed a heightened awareness of the potential benefits of adaptivity in e-Learning. This has been mainly driven by the realization that the idea of individualized learning cannot be achieved, especially at a “massive” scale, using traditional approaches. A challenging research goal is the development of advanced Web-based educational (WBE) applications that offer some amount of adaptivity and intelligence ^[1-4], since distance students usually work on their own. In addition, being adaptive is important for Web based courseware because it has the potential to be used by a much wider variety of students than any "standalone" educational application. A Web courseware that is designed with a particular class of users in mind may not suit other users. The research has shown that the application of adaptation can provide better learning environment, as explained in section(3), but many issues need to be resolved before an effective and efficient adaptation in learning systems is possible.

There have been many attempts in the last decade to include user models and adaptation features within computer systems with a view to improve the correspondence between user task and system characteristics ^[5-7]. Two classes of systems have been developed for supporting the user in performing various tasks. Systems that allow the user to change certain system parameters and adapt their behaviors accordingly are called *adaptable*. Systems that adapt to the users automatically based on the system's assumptions about the user are called *adaptive*. The whole spectrum of the concept of adaptation in computer systems is shown in Figure 1. Adaptive presentation can improve the usability of course material presentation. Adaptive sequencing and navigation can be used to overall course control and for helping the student in selecting most relevant tests and assignments. Problem solving support and intelligent solution

analysis can significantly improve the work with assignments providing both interactivity and intelligent feedback while taking a serious grading load from the teachers' shoulders. Model matching technologies can enforce both administration of distance courses and communication / collaboration between students and teachers. From another side, adaptive and intelligent technologies [8] have not found yet their place in "real" virtual classroom, i.e., as a part of real courseware used by hundreds of distance students.

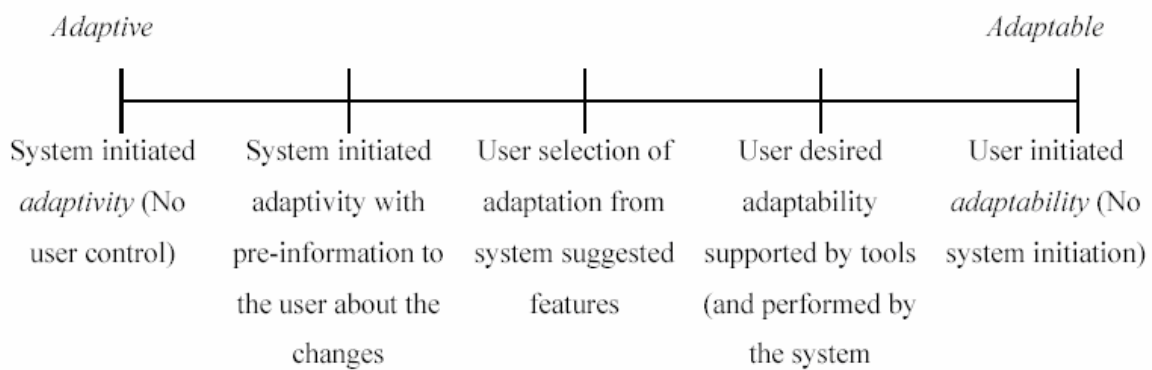


Fig. 1. Spectrum of adaptation in computer systems.

There exist currently several systems which employ adaptive techniques to enable and facilitate different aspects of learning [9]. An important observation one can make going over the related literature is that a dichotomy appears between typically commercial, standards-based e-Learning systems on the one hand, and adaptive learning environments on the other, with little, if any, standards compliance. It is argued that this dichotomy is in part due to the lack of sufficient support for adaptive behaviors in existing e-Learning standards [10]. In support of this argument, this paper uses the concept of adaptivity in the context of e-Learning environments. Furthermore, it attempts a high-level assessment of the sufficiency of existing e-Learning standards for driving the convergence of the two strands of systems outlined above. The intention is to provide a preliminary assessment of the adequacy of existing e-Learning standards for specifying, and guiding the implementation of, adaptive behaviors within learning environments.

2. Benefits of E-learning

E-learning has definite benefits over traditional classroom training. While the most obvious are the flexibility and the cost savings from not having to travel or spend excess time away from work, there are also others that might not be so obvious. Here are just a few to consider [11,12], for example:

- It's **less expensive** to produce - Using trainers authoring software to produce training programs, e-training is virtually free once you reach the break-even

point. E-Learning programs will have continued costs associated with the instructor managing the class, but will still be lower than traditional courses.

- It's **self-paced**: Most e-learning programs can be taken when needed. The "books" that you set up using trainer's software create a module-based design allowing the learner to go through smaller chunks of training that can be used and absorbed for a while before moving on.
- It moves **faster**: e-learning courses achieve faster progress than traditional courses. This is partly because the individualized approach allows learners to skip material they already know and understand and move onto the issues they need training on.
- It can work from **any location and any time** - E-learners can go through training sessions from anywhere, usually at anytime. This Just-In-Time benefit can make learning possible for people who never would have been able to work it into their schedules prior to the development of e-learning.
- It can be **updated easily** and quickly - Online e-learning sessions are especially easy to keep up-to-date because the updated materials are simply uploaded to a server.
- It can lead to **increased retention** and a stronger grasp on the subject - This is because of the many elements that are combined in e-learning to reinforce the message, such as video, audio, quizzes, interaction, etc.
- It can be **easily managed** for large groups of students – trainer's software manager allows corporate training directors, to keep track of the course offerings, schedule or assign training for employees and track their progress and results. Managers can review a student's scores and identify any areas that need additional training

3. Adaptive Learning and Environments

Adaptation in learning environments can be classified into four categories^[10, 13]. These categories include *Adaptive Interaction*, *Adaptive Course Delivery*, *Content Discovery and Assembly*, and *Adaptive Collaboration Support*.

Adaptive Interaction:

It refers to adaptations that take place at the system's interface and are intended to facilitate or support the user's interaction with the system, without, however, modifying in any way the learning "content" itself. Examples of adaptations at this level include: the employment of alternative graphical, colour schemes, font sizes, etc., to accommodate user preferences, requirements or (dis-) abilities at the lexical (or physical) level of interaction; the reorganization or restructuring of interactive tasks at the syntactic level of interaction; or the adoption of alternative interaction metaphors at the semantic level of interaction.

Adaptive Course Delivery:

It constitutes the most common and widely used collection of adaptation

techniques applied in learning environments today. In particular, the term is used to refer to adaptations that are intended to tailor a course (or, in some cases, a series of courses) to the individual learner. The intention is to optimise the “fit” between course contents and user characteristics / requirements, so that the “optimal” learning result is obtained, while, in concert, the time and interactions expended on a course are brought to a “minimum”. In addition to time and effort economy, major factors behind the adoption of adaptive techniques in this context include: compensating for the lack of a human tutor (who is capable of assessing learner capacity, goals, etc., and advising on individualized “curricula”), improving subjective evaluation of courses by learners, etc. The most typical examples of adaptations in this category are: dynamic course (re-) structuring; adaptive navigation support; and, adaptive selection of alternative (fragments of) course material ^[14].

Content Discovery and Assembly:

It refers to the application of adaptive techniques in the discovery and assembly of learning material / “content” from potentially distributed sources / repositories. The adaptive component of this process lies with the utilization of adaptation-oriented models and knowledge about users typically derived from monitoring, both of which are not available to non-adaptive systems that engage in the same process.

Adaptive Collaboration Support:

It is intended to capture adaptive support in learning processes that involve communication between multiple persons (and, therefore, social interaction), and, potentially, collaboration towards common objectives. This is an important dimension to be considered as we are moving away from “isolationist” approaches to learning, which are at odds with what modern learning theory increasingly emphasizes: the importance of collaboration, cooperative learning, and communities of learners, social negotiation, and apprenticeship in learning. Adaptive techniques can be used in this direction to facilitate the communication / collaboration process, ensure a good match between collaborators, etc.

The proposed e-learning web site offers a place to meet students with their teacher to a virtual meeting place instead of a classroom. A list of students is recorded. Teacher can choose from a variety of educational technologies including: Slide presentation, Audio and video conferencing, Application sharing, Interaction with students through audio and video conferencing use instant messaging and chat. Teachers can present questions to students. Students can work together in groups. Audio conferencing can be implemented by connecting computers to the Internet. Common names for this kind of implementation are IP Audio Conferencing or Voice-over-IP. Alternatively video conferencing can also be implemented by connecting computers with digital cameras to the Internet.

4. Adaptive e-Learning Models

Adaptive hypermedia (AH) is an alternative to the traditional “one-size-fits-all”

approach in the development of hypermedia systems. Adaptive hypermedia systems (AHS) build a model of the goals, preferences and knowledge of each individual user, and use this model throughout the interaction with the user, in order to adapt to the needs of that user ^[15]. For example, a student in an adaptive educational hypermedia system will be given a presentation that is adapted specifically to his or her knowledge of the subject ^[16] and a suggested set of most relevant links to precede further ^[17]. An adaptive electronic encyclopedia will personalize the content of an article to augment the user's existing knowledge and interests.

AH systems can be useful in any application area where users of a hypermedia system have essentially different goals and knowledge and where the hyperspace is reasonably large. Users with different goals and knowledge may be interested in different pieces of information presented on a hypermedia page and may use different links for navigation. AH tries to overcome this problem by using knowledge represented in the user model to adapt the information and links being presented to the given user. Adaptation can also assist the user in a navigational sense, which is particularly relevant for a large hyperspace. Knowing user goals and knowledge, AH systems can support users in their navigation by limiting browsing space, suggesting most relevant links to follow, or providing adaptive comments to visible links.

In the context of this paper, a learning environment is considered adaptive if it is capable of: monitoring the activities of its users; interpreting these on the basis of domain-specific models; inferring user requirements and preferences out of the interpreted activities, appropriately representing these in associated models; and, finally, acting upon the available knowledge on its users and the subject matter at hand, to dynamically facilitate the learning process. The model presented is a multimedia styles web based, it is a mix of text, graphics, animation, audio and video to enhance the learning process.

Intelligent Tutoring Systems (ITSs) have not yet proved very successful and one major reason seems to be that research on ITSs has largely failed to recognize the role of the teacher in the ITS design process ^[18-20]. This paper incorporates a 'Human Teacher Model' in an ITS prototype to teach computer science subjects (e.g. computer networks and computer graphics). The project identifies the teacher attributes and formulates them into a coherent teacher model. They are then applied in the prototype, which offers adaptivity to teacher at two levels: presentation based adaptivity and navigation base adaptivity. We believe this work will substantially improve the applicability of ITSs in real academic environment.

5. Learning Styles Development

Knowing a little bit about learning styles a student can determine how much benefits online learning is suitable for him. The interaction methods used in online classes are dramatically different from traditional classes, so understanding how a student can learn is a good part of the teaching decision-making process ^[21-23]. The three predominant learning styles are visual, auditory, and tactile/kinesthetic. Broken down further, people learn by: Reading (visual), Listening (auditory), seeing (visual), Speaking (auditory),

and Doing (Tactile/Kinesthetic). The first three on the list are passive types of learning, while the last two are active types of learning. How much we tend to remember is a function of the type of learning we prefer and our level of involvement in the learning. People often learn through a combination of the ways described above. A combination of doing and speaking about what we learn produces a high retention rate, followed by speaking alone. These levels of involvement are all active learning modes. The combination of listening and seeing produces the next best retention results.

Online courses come in many flavors. Selecting the right online course for student - one that matches his education needs and his learning style - can be a daunting task. Using the table below, a student can get an idea of what types of course activities match his learning style. The proposed model offers these multimedia learning styles including also text reader, graphics displayer, video player, quizzes generator for supporting all types of learning styles to students.

If a student learns best by:	Looks for a course with :
Reading	e-books, textbooks, and other required reading (written lessons are a primary method of delivering curriculum online)
Listening	audio lectures or sound bytes to explain concepts
Seeing how things are done	graphical demonstrations that illustrate new ideas
Doing	Assignments, quizzes, exams, or practical application examples.
Speaking/Communicating	Email, chat, or conferencing for discussion groups, sharing and feedback.

6. Architecture and Components of The proposed Model

The architecture of the proposed model consists of nine modules that work together to establish the required learning styles functions of the system, in addition to teacher module as shown in Figure 2. These modules include: Subject Units, Subject Tutorial, Exam Generator, Exam Timer, Exam Analyzer, Text Reader, Chatting, Video Player, and System Manager, respectively. The System Manager checks student name and password as a registered user or guest. The Video Player allows video education materials to be displayed in film format. Chatting module allows student to communicate together only as well as with their teacher. The Text Reader module does read e-text loudly for a student to hear. The Exam Generator module produces multiple choice quizzes for a student to answer, and the Exam Analyzer module checks the answers and gives on line marks. The student has capability to adjust exam time to a certain time suitable for his knowledge level using the Exam Timer module. The teacher may work as an administrator for the system. He can add, remove or modify subject

contents. The overall system was built for teaching Computer Networks (CS 416) and Computer Graphics (CS 454) courses at the Computer Science Department of King Abdul Aziz University.

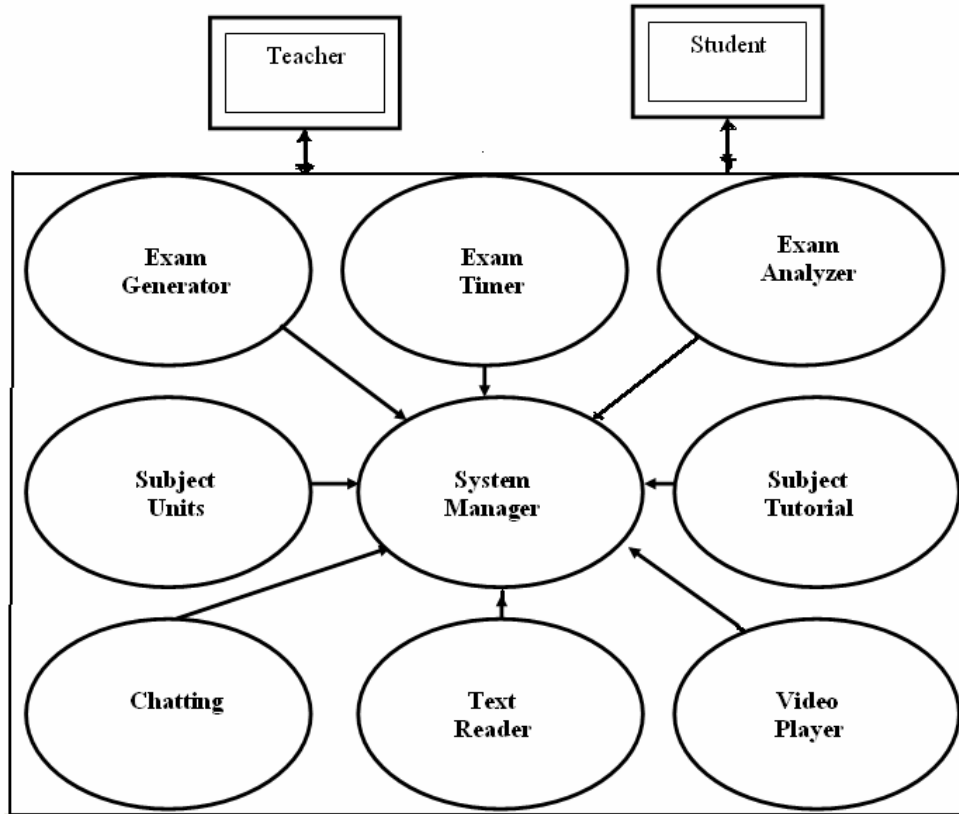


Fig. 2. Model Block Diagram.

The exam Generator module:

One of the more important aspects of reviewing for any exam is to practice test taking. However, this is a difficult part for any instructor to develop. Furthermore, once used, it cannot be reused without modification. This becomes ever more critical when trying to develop an Internet-based review system. To solve this, a test generator module has been developed that generates random questions on different teaching topics.

There are four major advantages of using this test generating module ^[24]. First, it creates more exams than one can put into a problem data bank. Second, each user can get different exams at the same time by allowing the computer to randomly choose the problem templates. Third, the scores and answers are available immediately, since the system checks the answers and records the scores. Also, a student exam file is created for each exam to allow the student to review previous tests and learn from mistakes. Figure 3 shows the block diagram for the operation of the exam generator module.

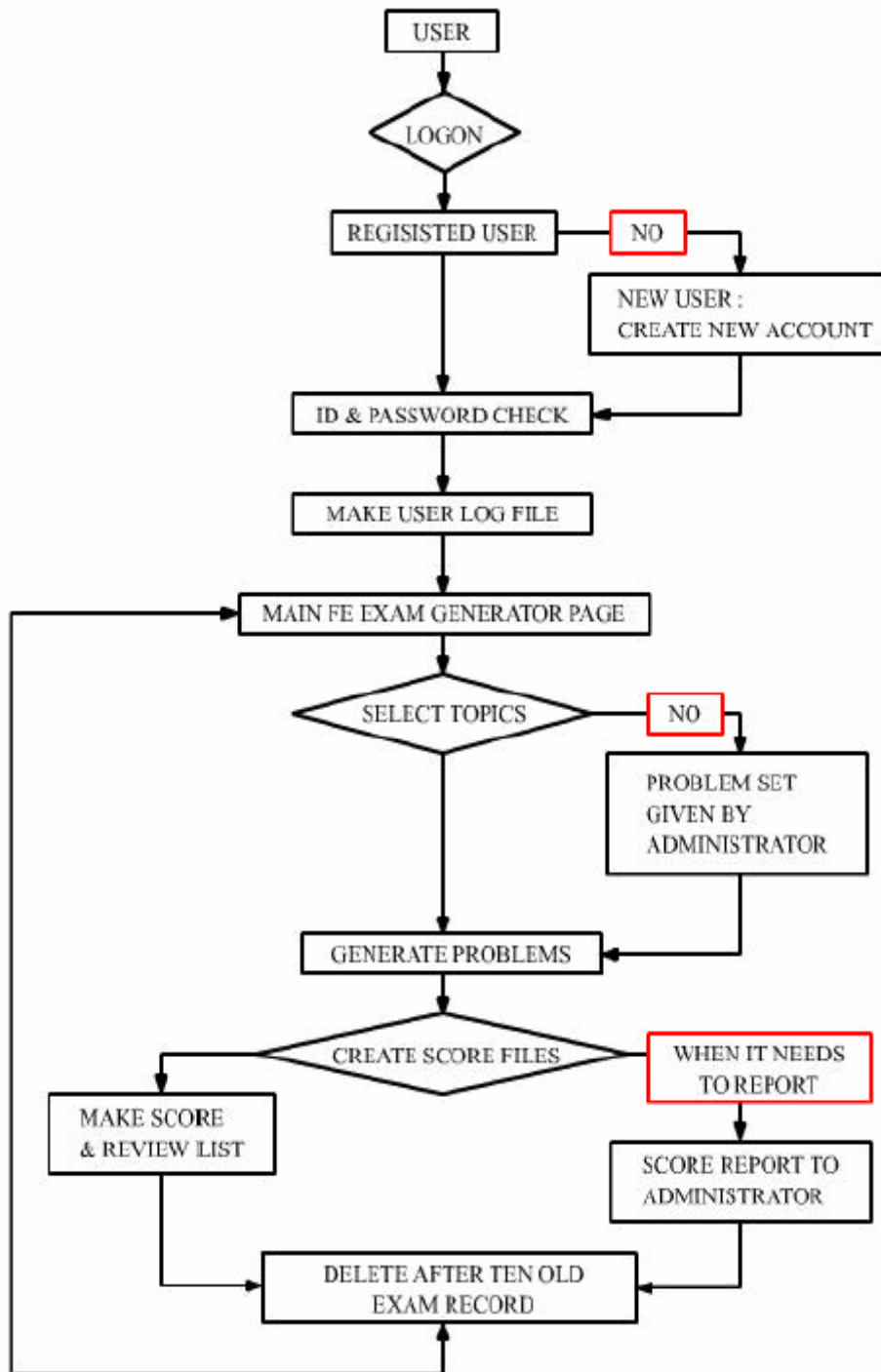


Fig. 3. Exam Generator Operations.

1. OSI layer responsible for mail and file transfers?

transport

data link

application

2. OSI level that ensures error-free delivery of packets?

data-link

network

transport

3. The IEEE specification for a token ring network?

802.3

802.5

802.6

4. A protocol that functions at the transport layer of the OSI model?

IP

IPX

SPX

5. Resolves domain names into IP addresses?

DHCP

DNS

WINIPCFG

Clear Grade =

Correct answers are:

Fig. 4. A sample generated test in computer network (CS 416).

Exam Timer Module:

Teacher can set points (marks), negative marking and time for each question, so each question can have different marks, negative marking percentage and time allocation. Also there is a programming facility for a student to increase the exam time for training and practicing.

Exam Analyzer module:

It checks student answers by comparing it with the write ones and updates the score marks for a student file exam. In addition it gives an immediate voice alarm in the case of correct or wrong answer for a student to hear.

The E-Text Reader Module:

It is designed to help students who have trouble reading or comprehending the printed word. To solve this problem, we developed the E-Text Reader module. This reader will read (using digital voices) the electronic version of books (“E-Books, or E-Text”) to student. The E-Text Reader can read document in Standard Text, MS Word, and HTML formats. The E-Text Reader highlights the words during reading process.

Chatting module:

This is a place for educators to discuss and share ways that television and technology can support education. Student can read what other people have already said

about several educational topics and add his own statement on the topic or he can post a new query. Chatting allows student for a group discussion and live conferencing. By email Classroom students, can chat on line at this website.

By chatting, a great new online education forum, offering those who have interest in education related topics an opportunity to share ideas and insights. Chatting module is designed to facilitate communication between all who share the common interest in quality education. Every student has a chat tool that allows both facilitators and members to create and enter online spaces ("rooms") within which to communicate in real time.

There are definite advantages to using chat technology as opposed to a conference call - especially when dealing with people separated by great distances. A chat can be saved, archived for future reference, and shared easily with other interested parties. It is important to note that when sharing private chats, it's good netiquette to get permission from the participants before making the archived chat accessible to other parties. In addition, during a conversation student can attach files, images and links instead of emailing or faxing them later. Font properties can be manipulated so important information is highlighted. There is no 'asking people to hold' while other people join a conversation. Chatting keeps going and student stay logged into the chat while he simultaneously invites other members.

We stage a chatting sessions for students to discuss the course contents with each other and with their lecturers, which allows them to get an idea how they are doing. Each student's scores are automatically communicated to them, and during the lecture we check and discuss the distribution of correct and incorrect answers. Results show that this approach works, and importantly contributed to this positive results.

In the system, the Chatting module allows several student to communicate with each other. Each participant uses a computer to type their comments. The other participants can see the name of the person and their comments. A shared lesson folders lets a group of student communicate by typing comments, drawing, highlighting and pointing. A conferencing program facility can also be provided that works well with a small group of participants provides video conferencing, audio conferencing and application sharing. With application sharing, a teacher can let the learner take control of the application to practice performing tasks.

7. Adaptivity to the Teacher in the Prototype Model

For effective collaboration between the teacher and the learning model in the process of student education, it is necessary that the system can adjust to different teaching styles, at least in a broad sense ^[25, 27]. For these reasons, a Human Teacher Module is included within the proposed model, which interacts with other components to provide adaptation not only to suit student preferences and competence level (based on student model) but also to incorporate teacher's attributes during the learning process, Figure5.

In order to test and evaluate, we created a basic test bed prototype by incorporating the Human Teacher Module into the system for teaching computer

networks, and computer graphics courses.

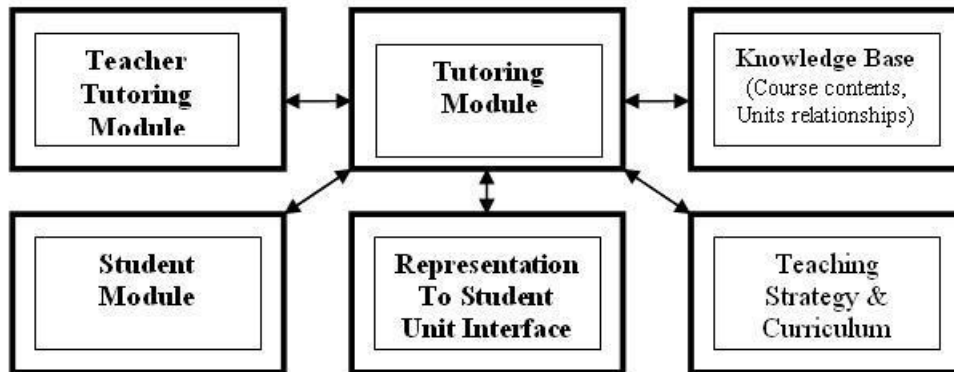


Fig. 5. Interaction Between the teacher and other system modules.

The main operations offered to the teacher are: including/removing/replacing units. Include a reserve unit into the course (under an appropriate container). Remove a unit from the course, putting it in reserve. Replace a unit by the one in reserve (placing the current one in reserve). All operations list above should preserve prerequisite structure. Changing units: Annotate unit; Enable link; Disable link; Annotate link. Course rendering: at any time, teacher should be able to render the course as an HTML (Hyper Text Markup Language) site or a PDF (Portable Data Format) document.

Adaptation levels:

When a teacher attempts to create a new unit, adds various presentation components, or customizes previously available units, system monitors the interaction of teacher and stores the profile of teacher's preferences. The adaptation occurs at two levels: First level, presentation based adaptivity where the system monitors and stores the preferences of teacher for certain types of presentation items and offer the similar items to the teacher at later time. As mentioned above, the system offers choices within the units for alternative presentations; Second level, navigation based adaptivity where the system classifies the units, monitors the type of units teacher is adding preferentially, and then offer similar units at later time (leading to a stage where system can offer completion of a course half-way through). This adaptation takes place when system has a good understanding (in system's assumptions) of teacher's "teaching style".

8. Model Implementation and Realization

The software tools used to build the prototype e-learning model include ASP (Active Server Pages), Visual Basic Script, Adobe PhotoShop, and Access 3 Data base. ASP is a Microsoft's technology to enables HTML pages to be dynamic and interactive by embedding scripts. The ASP and Visual Basic Script are used to build the web site realizing the nine modules explained above. Adobe PhotoShop is used to design and

implement screen windows, buttons, and icons for the user side interfaces. The Access 3 database is used to deal with and implement lessons, tutorials, quizzes, questions, and exam tests. Figure 6 shows the main screen of the site. It contains nine icons and buttons. These are: The Login for a user to enter the site as a registered student or a guest. The Graphics and Networks icons help a student to select lesson subjects. The Chat is for inter chatting room with other student in class or with teacher. Talk is used for conferencing call meeting with student and teacher for discussing a lesson. Exam icon used to practicing quizzes exam test. The E-Mail icon used for student to send e-mail for others and for teacher. Inside the lesson icons another selection for text reader for audio reading text, as shown in Figure 7. And also a video player icon for displaying practical lab experiments and some educational materials related to lessons, as shown in Figure 8. The icon NEWS displays announcements, such as meeting time with a teacher, exam time and other important topics.

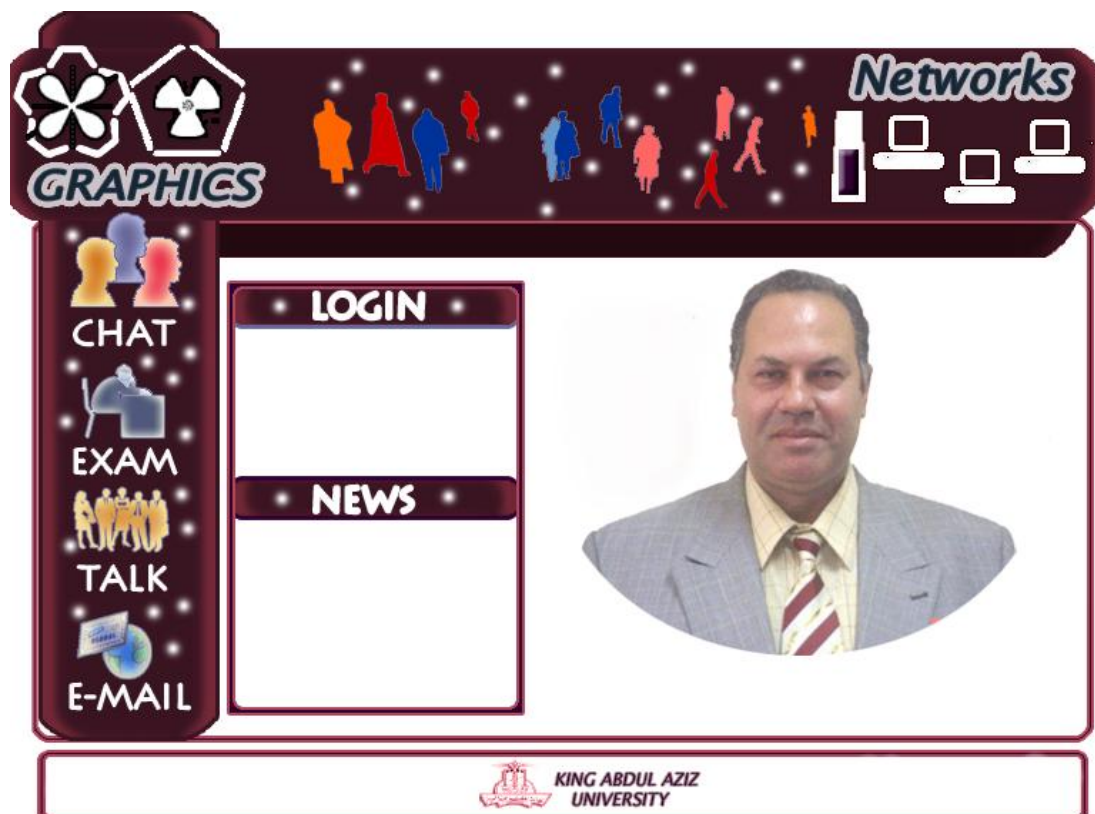


Fig. 6. System Main Screen.

9. Model Results Discussion and Evaluation

Using adaptive e-learning multimedia styles models, such as the proposed model, students can achieve a higher learning gain better than other traditional educational methods [22, 28]. Since, it provides students with multi-sensory e-learning styles with

multimedia facilities. This multi-sensory approach works well because of the way our brain is organized. When we learn, information takes one path into our brain when we use our eyes, another when we use our ears and a yet a third when we use our hands. By using more than one sense we bombard our brain with the new information in multiple ways. As a result students learn better. According to some pioneer educators [29-32], we, and also students, retain 10% of what we read, 20% of what we hear (text reader), 30% of what we see (graphics), 50% of what we see and hear (video), 70% of what we explain (discussion with others, chatting and e-mail), 80% of what we experience (doing exercises) and 95% of what we say and do (teach some one else). So by focusing too closely on the student's current strengths we may overlook his ability to benefit from these teaching methods using combined approaches.

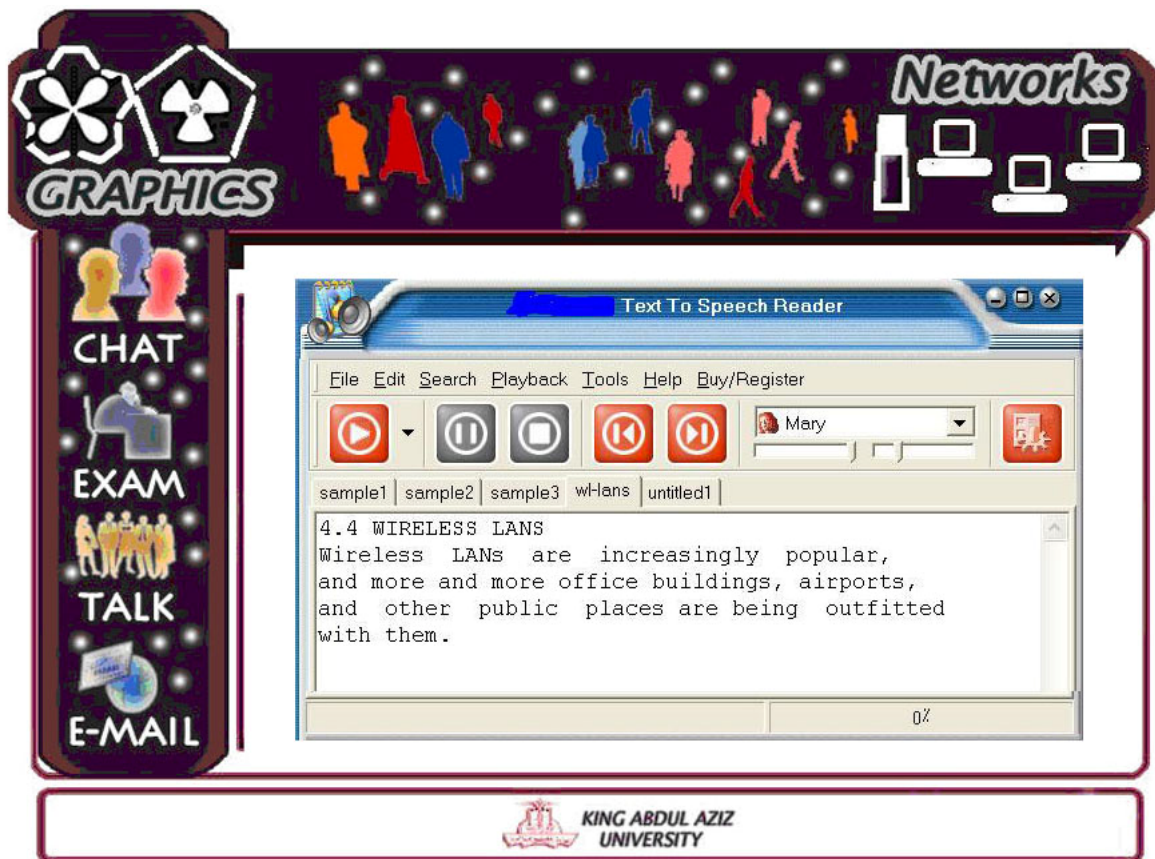


Fig. 7. System Screen for text reader for audio reading text.

10. Conclusion

The paper presented a new multimedia learning styles model for adaptive e-learning. The model is used as a web-site on the internet for teaching computer subjects including computer networks (CS 416) and computer graphics (CS 454) at King Abdul Aziz University. The model is implemented and tested. The system results show robust

achievements of educational goals, among which is that students can achieve higher learning gain, as explained in section (9).

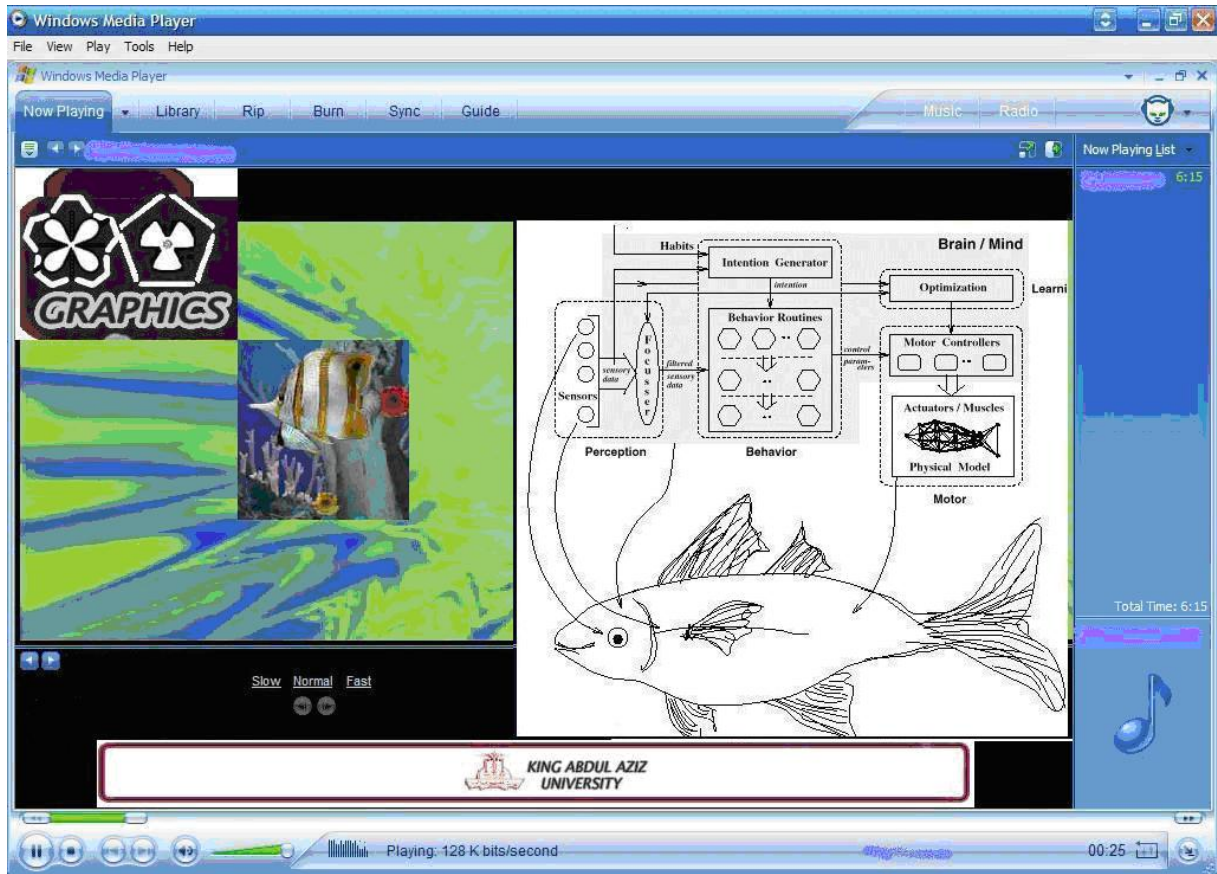


Fig. 8. Shows Video Player displaying some graphic educational materials.

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References

- [1] **Ragab A. M., Al-Harby H. A, and Al-Asmary A. M.,** " *Security Web Site Design*", Bsc Project Thesis No. 24253, Dept. of Computer Science, College of Science, King Abdul Aziz University, Jeddah, Saudi Arabia., (2003).
- [2] **Mödritscher F., Barrios V. M. G., and Gütl C.,** *Enhancement of SCORM to support adaptive E-Learning within the Scope of the Research Project AdeLE*, Institute for Information Systems and Computer Media (IICM), Graz University of Technology, Austria , (2004).

- [3] **Dagger D., Wade V. P., and Conlan O.**, *Developing Adaptive Pedagogy with the Adaptive Course Construction Toolkit (ACCT)*, Knowledge and Data Engineering Group, Department of Computer Science, Trinity College, Dublin, Ireland <http://kdeg.cs.tcd.ie> (2004).
- [4] **Brusilovsky P.**, *A Component-Based Distributed Architecture for adaptive Web-Based Education*, School of Information Sciences, University of Pittsburgh, (2004).
- [5] **Han B., Kinshuk & Patel A.**, *A student model for web-based intelligent educational system*. Proceedings of EdMedia 2001, Tampere, Finland), Norfolk, VA, USA: AACE, 656-657 (ISBN 1-880094-42, June 25-30, (2001).
- [6] **Nokelainen, P., Tirri, H., Kurhila, J., Miettinen, M., & Silander, T.**, Optimizing and profiling users online with Bayesian probabilistic modeling. *In Proceedings of the Networked Learning Conference* (Berlin, Germany, The Netherlands: NAISO Academic Press., May (2002).
- [7] **Sampson, D., Karagiannidis, C., & Kinshuk.**, **Personalised** learning: Educational, technological and standardization perspectives, interactive educational multimedia (on-line journal ISSN 1576-4990), Special Issue on Adaptive Educational Multimedia, 4 (invited paper), April (2002).
- [8] **Brusilovsky P.**, *Adaptive and Intelligent Technologies for Web-based Education*, Carnegie Technology Education and Human-Computer Interaction Institute, Carnegie Mellon University, Pittsburgh, PA 15213, USA, (1999).
- [9] **Kinshuk & Klus J. P.** (Eds.) *Proceedings of IEEE International Conference on Advanced Learning Technologies (ICALT2001)* (Madison, WI, USA), Los Alamitos, CA: IEEE Computer Society, 227-230 (ISBN 0-7695-1013-2) , August 6-8, (2001).
- [10] **Paramythis A. and Loidl-Reisinger S.**, *Adaptive Learning Environments and e-Learning Standards*, Johannes Kepler University, Linz, Austria , (2004).
- [11] National Association of State Boards of Education Study Group. *Any time, any place, any path, any pace: Taking the lead on e-learning policy.*, from http://www.nasbe.org/e_Learning.html Retrieved April 10, (2003).
- [12] **Graesser, A.C., Jackson, G.T., Mathews, E.C.1, Mitchell, H.H., Olney, A., Ventura, M., Chipman, P., Franceschetti, D., Hu, X., Louwerse, M.M., Person, N.K.**, and the Tutoring Research Group, *Why/AutoTutor: A Test of Learning Gains from a Physics Tutor with Natural Language Dialog*, Institute for Intelligent Systems, University of Memphis, 2003.
- [13] **Maki, W. S., & Maki, R. H.** Multimedia comprehension skill predicts differential outcomes of web-based and lecture courses. *Journal of Experimental Psychology: Applied*, 8, 85-98., (2002).
- [14] **Patel A. & Russell D.**, *Intelligent and Adaptive Systems.*, Handbook on Information Technologies for Education and Training, Springer, 79-92 (ISBN 3-540-67803-, (2001).
- [15] **Mylonakis N. and Mc Cullough C.**, *Adaptive Hypermedia – its role in lifelong learning*: thematic workshop report, Prepared for the conference Policy, Practice and Partnership: Getting to work on Lifelong Learning, at Cedefop Thessaloniki, ,June (2003).
- [16] **Bajraktarevic N., Hall W. and Fullick P.**, *Incorporating learning styles in hypermedia environment*: Empirical evaluation, Intelligence Agents Multimedia Group, Dept of Electronics and Computer Science, University of Southampton, Southampton, U.K, 2004.
- [17] **Jung H., Jun W., Gruenwald L., and Dong Y.** *A Design and Implementation of Web-Based Project-Based Learning Support Systems*, Dept. of Computer Education, Seoul National Univ. of Education, Seoul, Korea, (2001).
- [18] **Quinn, C.**, Framework for a learning management system, *Knowledge Planet.com*, Emeryville, CA., (2001).
- [19] **Nikov A. & Patel A.**, Adaptive tutoring in business education using fuzzy back propagation approach., Intelligent Agents and Virtual Reality, *Proceedings of the 9th International Conference on Human- Computer Interaction*, New Orleans, USA, August 5-10, (2001).
- [20] **Shute V., and Towle B.**, *Adaptive E-Learning*, *Educational Psychologist*, 38(2), 105-114, Lawrence Erlbaum Associates, Inc., (2003).
- [21] **Draper S. W.**, *Learning styles (notes)*, <http://www.psy.gla.ac.uk/~steve/lstyles.html>., 2004.
- [22] **Cook, M. J.** (in press). An exploratory study of learning styles as a predictor of college academic adjustment. *Fairfield University Student Psychology Journal.*, (2004).

- [23] **Sam H. K., and Ling C. K.,** *Effects of Learning Styles on Undergraduates' Attitudes, Navigational Patterns, and Use of Navigational Tools in Hypermedia-Based Learning*, Faculty of Cognitive Sciences and Human Development, University Malaysia Sarawak, EJISDC , 2000.
- [24] **Lee J. and Gramoll K.,** Internet-based Exam Generator for Practice Review of the Fundamentals in Engineering Exam, University of Oklahoma, School of Aerospace and Mechanical Engineering, (2000).
- [25] **Tretiakov A., Hong H. & Patel A.,** Human Teacher in Intelligent Tutoring System: A Forgotten Entity! ,*Proceedings of IEEE International Conference on Advanced Learning Technologies (ICALT2001)*, Madison, USA, August 6-8, (2001).
- [26] **Patel, A., Oppermann, R. & Russell, D.** Human Teacher's Role in Emerging Internet-based Intelligent Tutoring. Supporting the Learner through open, flexible and distance strategies: Issues for Pacific Rim Countries, Wellington: *The Distance Education Association of New Zealand*, 209-217., 2000.
- [27] **Retalis S.,** Andreas Papasalouros, Manolis Skordalakis, *Formalising the Design Process of Web-based Adaptive Educational Applications using an Object Oriented Design Model*, Computer Science Department, University of Cyprus, Athens, (2003).
- [28] **Mislevy, R. J., Steinberg, L. S., & Almond, R. G. ,** *On the roles of task model variables in assessment design* (CSE Tech. Rep. No. 500). Los Angeles: University of California, Center for the Study of Evaluation, Graduate School of Education & Information Studies., (1999).
- [29] **Stergioulas L. K., Ahmed H. and Xydeas C. S.,** Educational Adaptive Web-based Engine for the Evaluation of eLearning Resources, Department of Communication systems, Lancaster University, United Kingdom, *Technology & Society* 5(3) (2002).
- [30] **Kruse, K.** *Web rules*, from http://www.learningcircuits.org/feb2000/feb2000_webrules.html, Retrieved April 10, (2003).
- [31] **Meltzer D. E.,** *Relationship Between Mathematics Preparation and Conceptual Learning Gains*, Department of Physics and Astronomy, Ontario University, Canada, August, (2000).
- [32] **Glasser W.,** *Enhance Learning with Technology*, [http:// www. enhancelearning.ca](http://www.enhancelearning.ca)

نموذج تعليمي جديد متعدد الوسائط مبني باستخدام أساليب التعليم الإلكتروني الموائمة والإنترنت لتدريس مواد علوم الحاسبات

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المستخلص: إن من أهم التحديات التي تواجه العملية التعليمية في مجتمع المعلومات هو القدرة على استكشاف الطرق الجديدة للتعليم، واستنباط حلول تستند إلى معرفة الوسائل التكنولوجية الحديثة المستخدمة في التعليم، والتمكن من تصميم بيئة مناسبة للتعليم التفاعلي، والإبداع في استخدام مثل هذه الطرق واستثمارها وإخضاعها لحاجات المتعلمين. ويعتبر التعليم الإلكتروني (e-Learning) واحدا من أهم هذه الطرق. وهو أحد الوسائل التعليمية التي تعتمد على الوسائط الإلكترونية لإتاحة المعرفة لطلاب العلم الذين ينتشرون خارج القاعات الدراسية. وذلك باستخدام آليات الاتصال الحديثة كالحاسب والشبكات والوسائط المتعددة وبوابات الإنترنت من أجل إيصال المعلومات للمتعلمين بأسرع وقت وأقل تكلفة وبصورة تمكن من إدارة العملية التعليمية وضبطها وقياس وتقييم أداء المتعلمين. وقد أتاحت لنا تقنيات الوسائط المتعددة ومواقع الإنترنت المتقدمة المقدرة على تقديم وبناء نموذج تعليمي موائم يراعي الفروق المعرفية لدى الطلاب ويحقق احتياجاتهم ورغباتهم ويرفع مستوى التعليم لديهم.

ويقدم البحث مقترحا جديدا لبناء نموذج تعليمي إلكتروني موائم مبني باستخدام الوسائط المتعددة، يستخدم كموقع على شبكة الإنترنت لتدريس مواد علوم الحاسبات وخاصة شبكات الحاسب والرسم بالحاسب والتي يتم تدريسها بقسم علوم الحاسبات بجامعة الملك عبد العزيز بجدة. ويتكون النموذج التعليمي المقترح من

تسعة مكونات أساسية تشتمل على عارض لمحتويات المنهج لعرض النصوص ، وعارض الإرشادات tutorial ، ومولد الاختبارات الذي يستطيع إنشاء أسئلة متعددة الاختيارات، وضابط الوقت الذي يمكن منه تحديد زمن الاختبار، ومدقق الاختبارات الذي يصحح الاختبار ويعطى نتيجة فورية، وعارض الفيديو لعرض أجزاء تعليمية لتوضيح أجزاء عملية من المنهج، وقارئ النصوص الذي يقدم قراءة مسموعة للنصوص إلكترونياً ، ومنفذ المحادثات والدرشة chatting الذي بواسطته يستطيع الطلاب مناقشة المادة العلمية بينهم ومع المعلم ، ومدير النظام الذي يتحقق من اسم الطالب إن كان مسجلاً في الفصل الدراسي أم زائراً للموقع. ومن المزايا الجديدة لهذا النموذج أنه صمم آخذاً في الاعتبار أشكال التعليم Learning Styles الأساسية، والتي تنمي التعليم لدى الطلاب عن طريق تقديم محتوى الدروس بالنص والصورة (مرئيات) ، وبالنصوص المقروءة (المسموعة) والفيديو (المسموعة والمرئية) ، وكذلك توفير العمليات والأوامر اللازمة لإجراء المناقشات الحوارية، وتنمية الخبرات عن طريق الاختبارات ذات المستويات المتعددة. وبذلك يتحقق جزء كبير مما يشير إليه بعض علماء التربية إلى أن الإنسان يستوعب و يدرك ١٠% مما يقرأه، و ٢٠% مما يسمعه، و ٣٠% مما يراه، و ٥٠% مما يراه و يسمعه، و ٧٠% مما يناقشه مع الآخرين، و ٨٠% مما يجربه، و ٩٥% مما يعلمه لشخص آخر.

ويمتاز أسلوب التعليم الإلكتروني الموائم ، كما يقترح البحث المقدم، بمراعاة الفروق الفردية بين الطلاب و تمكينهم من إتمام عمليات التعلم في بيئات مناسبة لهم و التقدم حسب قدراتهم الذاتية. وكذلك إتاحة الفرصة لهم للتفاعل الفوري إلكترونياً فيما بينهم من جهة وبينهم وبين المعلم من جهة أخرى من خلال البريد الإلكتروني ومجالس النقاش وغرف الحوار . كما يؤدي ذلك إلى نشر ثقافة التعلم والتدريب الذاتيين في الجامعة و التي تمكن من تحسين و تنمية قدرات الطلاب بأقل تكلفة و بأدنى مجهود. ورفع شعور وإحساس الطلاب بالمساواة في توزيع الفرص في العملية التعليمية وكسر حاجز الخوف والقلق لديهم وتمكينهم من التعبير عن أفكارهم والبحث عن الحقائق والمعلومات بوسائل أكثر وأجدي مما هو متبع في قاعات الدرس التقليدية. كما يحقق النظام المقترح أيضاً سهولة الوصول إلى المعلم خارج أوقات العمل الرسمية، وكذلك تخفيض الأعباء الإدارية للمقررات الدراسية من خلال استغلال الوسائل والأدوات الإلكترونية في إيصال المعلومات والواجبات للمتعلمين و تقييم أدائهم.

The Use of Software Tools for Chemical Engineering Education: Students' Evaluations

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ABSTRACT. During the last few semesters we have used a number of commercial software packages as teaching aids. They include the process control training software Control Station, the process flowsheeting package HYSYS and the general-purpose computational package Mathcad. This paper presents our experience with and the students' evaluations of these programs. Overall, the students' responses were highly favorable.

Keywords: Control Station; HYSYS; Mathcad; process simulation; software packages.

Introduction

The last two decades have witnessed a rapid decline in the computer price/performance ratio and the development of fast, reliable and user-friendly computer packages. These developments have made computers within the reach of organizations and people who were deterred by cost or complex mathematics and programming expertise. The ease of use and enhanced capabilities of general-purpose software, like Mathcad or Matlab, have made it possible for engineers who have limited or no formal training in programming to solve relatively complex problems using computers.

The available computing tools have led to large changes in the industrial world. In contrast, the typical engineering educator has been slow to incorporate computer-based concepts in the curriculum and training methods. The reasons for this situation has been attributed to a number of factors, which include the lack of computer literacy/inclination amongst certain staff and the way popular textbooks are written^[1,2].

The positive impact of information technology on teaching and learning is no longer questionable^[3-5]. Kulik and Kulik^[4] reported that most studies found that

computer-based instruction – using the eighties technology – had positive effects on students. In particular, the students learn more and faster (the average reduction in instructional time in 23 studies was 32%). The students also develop more positive attitudes and like classes more when they use computers.

The main objective of this paper is to present our experience with and students' evaluations of three commercial software packages which we, at the Department of Chemical Engineering of the University of Bahrain, have been using as teaching aids. These packages are the process control training software Control Station (www.control.station.com), the process flowsheeting package HYSYS (www.hyprotech.com) and the general-purpose computational package Mathcad (www.mathsoft.com).

Control Station

Control Station (CS) is a process dynamics and control training simulator that provides access to several simulated processes ^[6,7]. The case studies include gravity drained tanks, a pumped tank, a heat exchanger, a jacketed reactor, a furnace, a multi-tank process and a binary distillation column. The software also allows the user to build tailor-made processes and single-loop or 2x2 control structures using a transfer function block oriented environment. Linear process models and Proportional-Integral-Derivative (PID) controller settings may be developed using the design module of the software package. The available controllers in version 3.0 of CS include the classical PID and its variants, cascade, feedforward, Smith predictor, decoupler, sampled-data and single-loop Dynamic Matrix Control (DMC).

During the last few semesters, Control station has been used, in the chemical engineering department of the University of Bahrain, as a teaching aid in a number of bachelor and diploma courses on process dynamics and control. It is employed for both assignments and hands-on workshops. As shown later, the feedback from the students on the use of the program was very positive. The program made it easier for them to understand process control material and concepts, and in shorter time compared to traditional lectures-only classes. It also helped the students to relate theory to practice.

Two workshop examples of how CS can be used to teach control concepts are shown in Figs. 1 and 2. Fig. 1 illustrates why the derivative action should not be employed for processes having noisy measurements; the addition of the derivative action to a PI controller leads to a deterioration (not an improvement) of the closed-loop response. Also, the derivative term leads to unacceptable fast movement of the control valve.

The use of CS significantly contributes to teaching advanced control strategies such feedforward, cascade and decoupling control to undergraduate students. Figure 2 clearly illustrates the effect of process interaction on the performance of conventional controllers in multi-input-multi-output processes. The distillate composition controller results in good closed-loop performance when the bottoms composition controller is on manual mode. Closing this latter loop leads to a deterioration of the performance of the first loop due to the 'fight' or interaction between the two controllers. The students are

usually asked to check the loops' interaction by calculating the relative gain array^[8] and to design and test a decoupler for the distillation column.

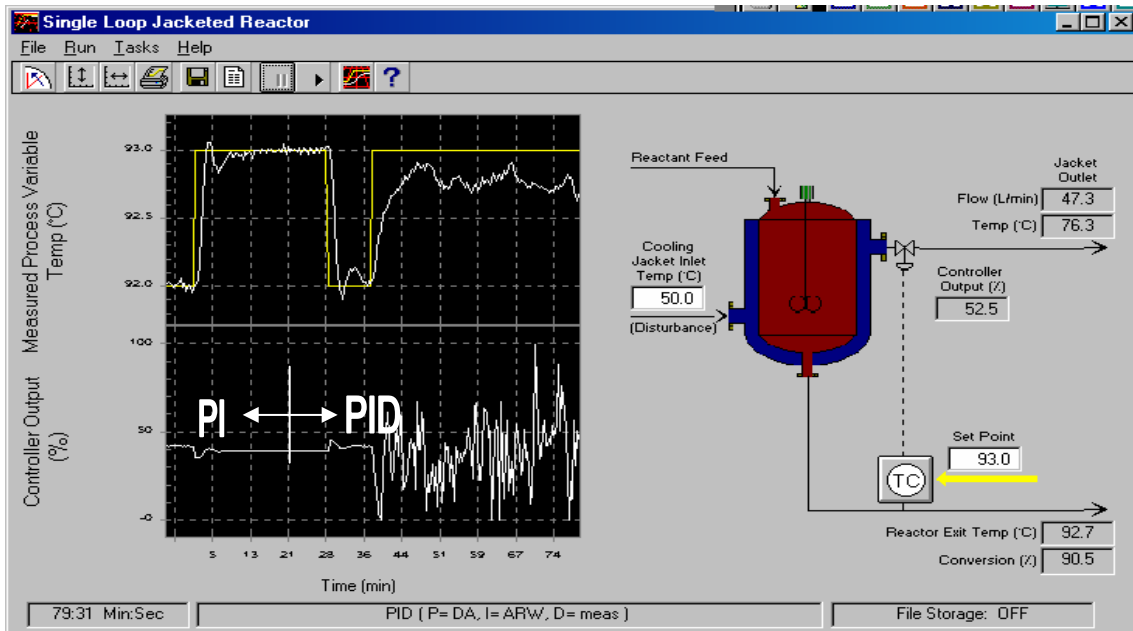


Fig. 1. Impact of noise on derivative action (Control Station).

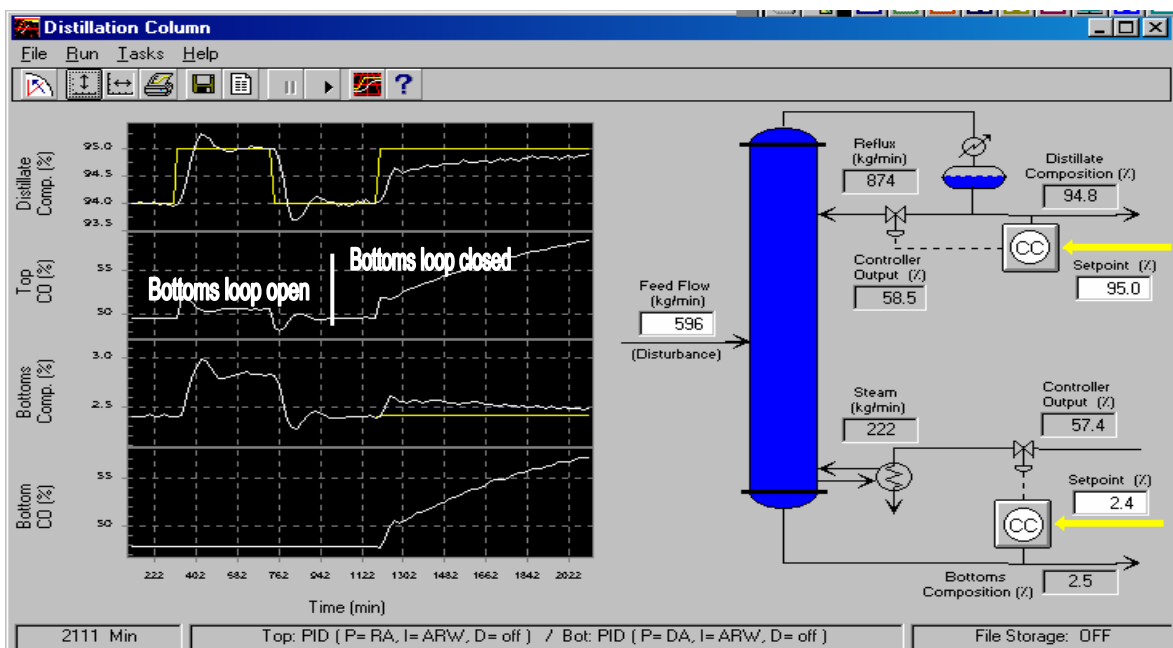


Fig. 2. Effect of interaction on SISO loops (Control Station).

Hysys

HYSYS is a modular commercial process flowsheeting program that is widely used by universities and industry (particularly hydrocarbon related companies). It is capable of doing material and energy balances for static and dynamic conditions, and is a very powerful tool for process simulation. It has built in routines to solve many specialized unit operations. One of the important features of HYSYS is the availability of an "Oil Manager" option dedicated to support refinery simulations. A comprehensive library of thermodynamic property packages is supplied with HYSYS to enable the user to design and solve many varieties of problems. At the Chemical Engineering Department of the University of Bahrain, HYSYS is used as an effective teaching tool in a number of courses including process analysis (material and energy balances), plant design and the senior projects.

In the process analysis course, a systematic approach is followed during which the students effectively analyze the systems and develop comprehensive degree of freedom tables to determine whether a problem is correctly specified and the order of solving the various units. The basic concepts used in modular simulation packages are thoroughly discussed. Among the problems associated with modular solution is the presence of recycle streams, which necessitate the iterative tear stream solution. Determining the number of tear streams, their positions, the convergence techniques and the order or sequences of their converging are basic issues that are clarified.

Figures 3 and 4 show flow diagrams of simple HYSYS case studies which the students were requested to develop. In Fig. 3, the effect of operating parameters such as temperature, pressure and composition of inerts on the production rate are evaluated for an equilibrium type ammonia reactor (parametric analysis). The variation of ammonia output composition with the operating pressure is shown in Fig. 3. The significance of the recycle loop and the selection of the suitable convergence acceleration method are emphasized by the second case study on a methanol synthesis loop (Fig. 4). Solving this problem also gives the students an insight into the philosophy of the modular flowsheeting programs and the nature of the sequential solution strategy.

Mathcad

Mathcad is one of the four most popular computational packages used in industry and academia; the other three programs are Matlab, Maple and Mathematica. Mathcad combines some of the best features of spreadsheets (like MS Excel) and symbolic math programs. It provides a very good graphical user interface and can be used to efficiently manipulate large data arrays, perform symbolic calculations and easily construct graphs. One of the quite useful features in Mathcad, not found in the other packages listed above, is its ability to perform calculations with units; this is indeed an important feature for the engineering students. In a recent survey conducted by the discussion group on Computer Applications in Chemical Engineering (<http://www.che-comp.org/>) Mathcad was the preferred computational package for 16.2% of those who participated in the survey. The survey included a large number of known packages and the only two

programs, which were found to be preferred by more people are Ms Excel (35.3%) and Matlab (23.4%).

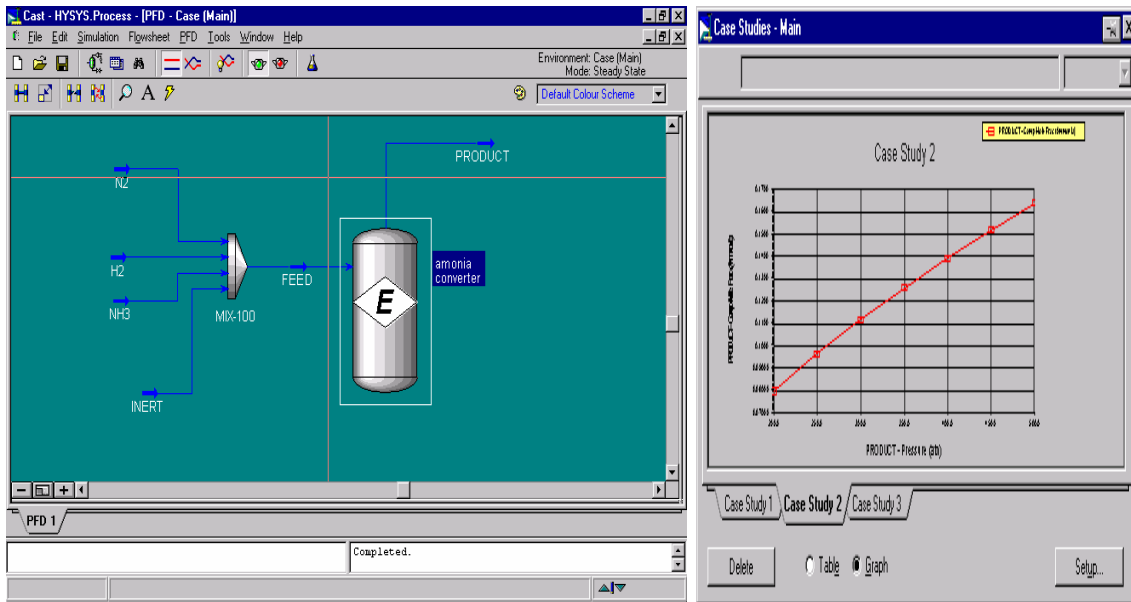


Fig. 3. Simulation of an ammonia reactor (HYSYS).

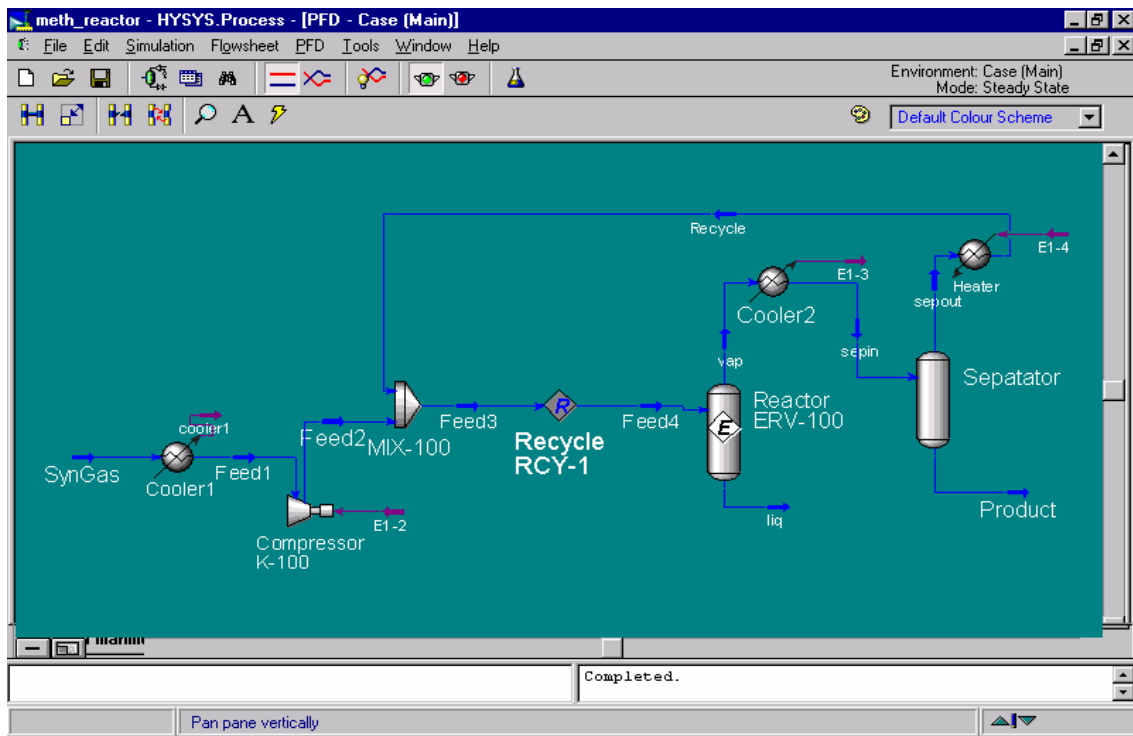


Fig. 4. Methanol synthesis loop (HYSYS).

Students' Evaluations

To measure the usefulness and effectiveness of the considered software packages, the evaluation form shown in Table 1 was filled-in by the students at the end of the course for which the software was used. The sixteen questions were selected from the list of 24 questions proposed by Iglesias *et al.* [9]. Eight questions were dropped based on the recommendations of the authors and the inability of students to clearly understand some of them. Iglesias and co-workers classified the questions into three categories: (1) teaching content and methodology (questions 1-5), (2) software and design features (questions 6-10) and (3) user's reaction (questions 11-16). The first class attempts to test the usefulness of the educational software in terms of subject content, design features as well as the teaching methodology used in the course. The second category evaluates mainly the user interface (number of resources presented, quality and effectiveness of graphics, tables, animation, etc.) and ease of use of the package. The third class tests the user's reaction to the program by considering aspects like documentation for user, degree of interaction between user and program, and time needed for program execution. Note that the three categories are not totally independent and distinct. The questionnaire is ended by asking the student to comment on the reasons for which he/she felt attracted to or bored by the program.

The students' evaluations for the three considered packages are shown in Tables 2 to 7. The overall results are presented in Fig. 5. Control Station and Mathcad were, respectively, evaluated by the process control and process analysis undergraduate classes. HYSYS was evaluated by students from process systems engineering courses.

As the tables and Fig. 5 show the students evaluations of all three software packages were highly favorable; the overall marks varied within a relatively narrow range from 3.52 to 3.74.

For the case of control station, questions 1 and 13 received high marks indicating a strong correspondence between the software and the knowledge conveyed in the class and that the use of computer workshops in the course is highly justified. Question 14 received the second lowest mark (3.0). This was expected since chemical engineering students do generally feel that their first process control course includes more material than an average course and that it is rather difficult. This is due to the well-known fact that process control is quite different from traditional chemical engineering courses and that it includes a significant number of new theories and terms.

For HYSYS, questions 2, 9 and 12 received the highest marks, indicating that the students found the software resources to be very effective and that the program has significantly contributed to their study of the courses considered. Note that prior to the availability of process flowsheeting packages the students had to carry out lengthy design calculations manually. The students gave their lower ratings to questions 10 (3.05) and 16 (3.09), i.e., they felt that the program is not very easy to operate and that the time for simulating case studies is not too small. The speed of execution is, of course, dependent on the size of the problem at hand. With HYSYS being a commercial flowsheeting package, even simple problems include significant amount of details.

High marks were given to questions related to Mathcad design characteristics; the overall mark is 4.03 (Table 7). This is not surprising since the package is truly user friendly and the fact that prior to using Mathcad the students were programming in Fortran. For all three programs, the students evaluated the programs' documentation as above average (see question 11). Although we feel that the material handed out to the students was very good, this issue is currently being addressed by (1) conducting more tutorials on the use of the packages, (2) supplying the students with more copies of shorter versions of the users guides and (3) preparing simpler getting started handouts.

Table 1. Students' Evaluation Form

1. Justification for the use of program in the course (1=unjustified; 5=absolutely justified):	1	2	3	4	5
2. Contribution to study of the subject by program use (1=irrelevant; 5=very effective):	1	2	3	4	5
3. Ease of achieving the goal aimed for (1=difficult; 5=easy):	1	2	3	4	5
4. Clarity in the means used to convey knowledge (1=confusing; 5=absolutely clear):	1	2	3	4	5
5. Relationship between the complexity of the concept given and the resources supplied to do it (1=inadequate; 5=absolutely adequate):	1	2	3	4	5
6. Number of resources (information) simultaneously presented on screen (1=excessive; 5=balanced):	1	2	3	4	5
7. Computer skills required (1=excessive; 5=null):	1	2	3	4	5
8. General quality of presentation (1=poor; 5=excellent):	1	2	3	4	5
9. Effectiveness of the resources used: graphics, tables, and texts (1=ineffective; 5=very effective):	1	2	3	4	5
10. Ease of operation (1=complex; 5=very easy):	1	2	3	4	5
11. Documentation for user (1=deficient; 5=excellent):	1	2	3	4	5
12. Clarity of the goal aimed for (1=confusing; 5=perfectly defined):	1	2	3	4	5
13. Correspondence between program and knowledge conveyed in class (1=absolute disconnection; 5=highly related):	1	2	3	4	5
14. Amount of specific knowledge required about subject for program use (1=excessive; 5=reasonable):	1	2	3	4	5
15. Degree of interaction between user and program (1=passive schemes; 5=very interactive):	1	2	3	4	5
16. Time needed for program execution (1=excessive; 5=suitable):	1	2	3	4	5
Comment on the reasons for which you felt attracted to or bored by the program:					

Table 2. Evaluation results for Control Station (10 students)

Question	Mean value	Standard deviation
1	4.10	0.99
2	3.70	0.82
3	3.20	1.03
4	3.30	0.95
5	3.50	0.97
6	3.90	0.88
7	3.40	1.07
8	3.50	0.71
9	3.90	0.74
10	3.40	1.17
11	2.90	1.20
12	3.10	0.88
13	3.90	0.99
14	3.00	0.47
15	3.40	0.84
16	4.10	0.99

Table 3. Overall marks for Control Station

Category	Mean	Std. Dev.
Content and teaching methodology	3.56	0.97
Program design characteristics	3.62	0.92
Users' reaction	3.40	0.99
Overall	3.52	0.96

Table 4. Evaluation results for HYSYS (21 students)

Question	Mean value	Standard deviation
1	3.59	1.33
2	4.00	1.07
3	3.50	0.91
4	3.41	1.14
5	3.36	1.05
6	3.59	1.18
7	3.59	1.05
8	3.57	1.16
9	4.27	0.83
10	3.05	1.05
11	2.86	1.08
12	4.18	0.80
13	3.82	1.22
14	3.32	1.09
15	3.32	0.99
16	3.09	1.34

Table 5. Overall marks for HYSYS

Category	Mean	Std. Dev.
Content and teaching methodology	3.57	1.11
Program design characteristics	3.61	1.11
Users' reaction	3.43	1.17
Overall	3.53	1.12

Table 6. Evaluation results for Mathcad (6 students)

Question	Mean value	Standard deviation
1	3.50	1.52
2	3.33	1.51
3	3.33	1.03
4	3.67	1.21
5	3.33	0.82
6	4.50	0.55
7	3.67	0.52
8	4.00	1.10
9	4.00	0.63
10	4.00	1.10
11	3.17	1.17
12	3.50	1.05
13	4.17	1.60
14	4.50	0.84
15	3.67	1.37
16	3.50	1.05

Table 7. Overall marks for Mathcad

Category	Mean	Std. Dev.
Content and teaching methodology	3.43	1.17
Program design characteristics	4.03	0.81
Users' reaction	3.75	1.20
Overall	3.74	1.10

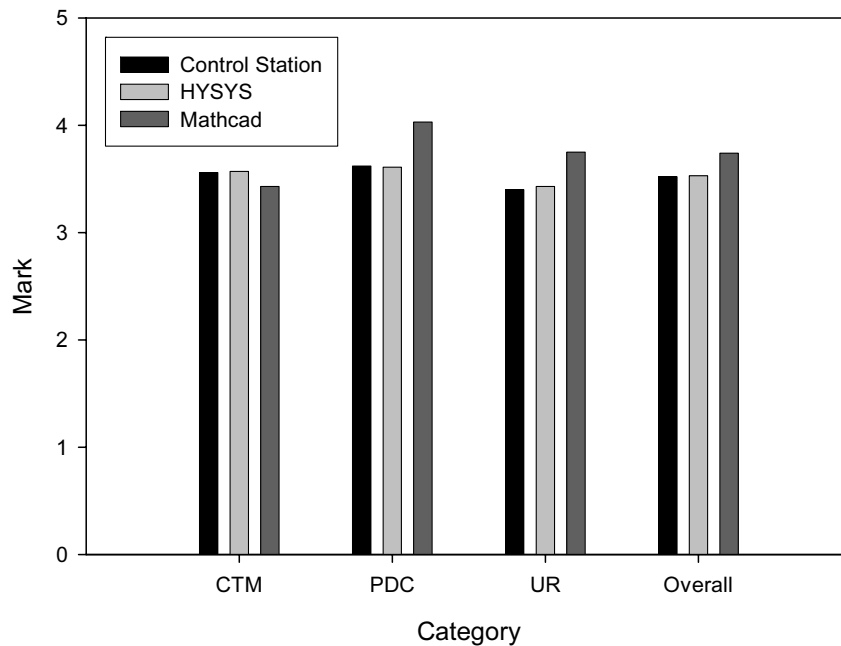


Fig. 5. Overall marks for the three packages. CTM = Content and Teaching Methodology, PDC=Program Design Characteristics, and UR = Users' Reaction.

Concluding Remarks

The computer has become an integral part of engineering education. As the power of both hardware and software continues to increase rapidly, we expect the use of information technology in the classroom/laboratory to grow at a much faster rate in the near future.

The use of multimedia and software packages enhances teaching and learning. In particular, the students learn more and faster and hence they allow the teacher to cover more material in the precious time allocated for the course. Of course, the information technology tools have a large number of benefits which are not within the scope of this paper. For example, they are invaluable tools for web-based education and distance learning and training.

References

- [1] **Kantor, J.C.** and **Edgar, T.F.**, Computing Skills in the Chemical Engineering Curriculum. In B. Carnahan (Ed.), *Computers in Chemical Engineering Education*, CACHE Corporation, (1996), pp. 9-20.
- [2] **Benyahia, F.**, Process Simulation Packages in Undergraduate Chemical Engineering Courses, *The (1998) IchemE Research Event*, CD-ROM (ISBN 0 85295 400 X).

- [3] **Edgar, T.F.**, Information Technology and ChE Education: Evolution or Revolution? *Chemical Engineering Education*, Fall (2000), pp. 290-295.
- [4] **Kulik, J.A. and Kulik, C.C.**, *Contemporary Education Psychology*, (1987), **12**, p. 222.
- [5] **Montgomery, S. and Fogler, H.S.**, Interactive Computer-Aided Instruction. In B. Carnahan (Ed.), *Computers in Chemical Engineering Education*, CACHE Corporation, (1996), pp. 57-72.
- [6] **Cooper, D. and Dougherty, D.**, Enhancing Process Control Education with Control Station Training Simulator, *Compt Appl Eng Edu*, (1999), **7**, pp. 203-212.
- [7] **Cooper, D.J. and Sinha, N.**, Picles+Digest = Control Station™ for Windows, *CACHE News*, (1997), **44**, pp. 14-18.
- [8] **Bristol, E.H.**, On a New Measure of Interactions for Multivariable Process Control, *IEEE Trans Auto Control AC-11*, (1966), **133**, pp. 133-134.
- [9] **Iglesias, O.A., Paniagua, C.N. and Pessacq, R.A.**, Evaluation of University Educational Software, *Compt Appl Eng Edu*, (1997), **5**, pp. 181-188.

استخدام برامج الكمبيوتر في تعليم الهندسة الكيميائية

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المستخلص: لقد قمنا خلال السنوات الماضية باستخدام مجموعة من برامج الكمبيوتر كوسائل تعليمية أثناء تدريس عدة مقررات بقسم الهندسة الكيميائية بجامعة البحرين ، و من ضمن هذه البرامج برنامج التحكم في العمليات و المسمى Control Station و برنامج تصميم العمليات المسمى HYSYS و برنامج الحسابات الرياضية المسمى Mathcad ، و هذه الورقة تعرض خبرتنا في مجال استخدام هذه البرامج كوسائل تعليمية بالإضافة إلى تجاوب الطلبة مع هذه التجربة و الذي قمنا بتقييمه عن طريق استبانات وزعت عليهم ، و بصفة عامة كانت ردود الطلاب إيجابية و مشجعة على الزيادة في استخدام هذه الوسائل التعليمية.

The AAST Collaboration in the Development of Multimedia E-Learning Solutions

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ABSTRACT. The rapid growth of technology has changed the way we live, the way business is conducted, the way we communicate with each other, and certainly technology advancements have affected the way we teach and learn. Trying to keep pace with the rapidly growing information technology, it is now a matter of necessity to consider the integration of Computer Based Training (CBT) and Web Based Training (WBT) in the educational and training fields. Using computers has a lot to promise in this matter. CBT and WBT courses run on standalone PC's, network computers, the Internet, or intranets. They require no need for direct support or assistance by instructors. Having a good deal of experience in the education and e-learning fields, the AAST has developed several multimedia courseware solutions and an online learning management system in order to help in the development of a new technological age in education and training.

1. Introduction

Learning can no longer be bounded by physical space. Faculty members standing in a classroom will not anymore control the knowledge as they have been for centuries.

The rapid growth of the multimedia accompanied by the high improvement of the speed and bandwidth offered by the World Wide Web (WWW) must for sure open a new age for both the educational and training fields. Many educational institutions are answering this challenge by developing distance e-learning educational programs.

Online e-learning using the internet is proving to be the most successfully growing e-learning field. Once something is online, it is available everywhere there is an Internet portal.

The resultant is that traditional universities can no longer stay the way they are; they have to adopt the option of e-learning to keep surviving in an environment where the education market requires this change.

Developing well managed E-learning courses (whether computer based or web based) will give the ability to learners to further their education without having to leave their work or have to attend classes for long periods of time.

2. Why E-Learning

Education and training can be a very difficult and extremely expensive matter. In order to start a course, learners have to be convinced to invest their available time in learning, they have to be motivated to attend the course lectures, and they have to pay a lot to attend a valuable course.

Here comes E-learning as the best solution for all of these problems. E-learning courses can be very effective and cost efficient. They may be in many different forms including CD-ROM discs, DVD discs or on the Internet. Computer tools can follow and score the learner performance.

Well designed and implemented e-learning courses can offer many advantages in education and training, the most important of which are:

- Self-paced. Learners can work at their own pace,
- Flexibility. Learners can work in their own spare time as the courses are available all the time,
- Measurability. Progress of learners can be followed, recorded and reported,
- Up-to-date Knowledge. Courses can be updated using Internet downloads or Upgrading packages.

3. Offline and Online E-Learning

E-learning can be in one of two forms: online or offline. A blend of online and offline e-learning can also be used to deliver learning in the form of hybrid.

3.1 Offline E-learning

The completed multimedia course needs to be stored and delivered to the learner on storage media. The most widely used storage media for multimedia courses are CD-ROM discs (Compact Disc – Read Only Memory) and DVD's (Digital Versatile Disc).

Offline courses can be school syllabi, training manuals, simulation modules or any other certification modules or courses required for learners.

3.2 Online E-learning

Online e-learning means the educational or training courses will be delivered to students through Intranets or the Internet, where students can interact with experts. Through online e-learning systems, students can undergo examinations online, thus not having to stop work to attend exams.

Well designed online e-learning courses can be used to deliver high quality, interactive, well controlled and managed courses for all kinds of education and training specially higher education.

The main advantage of online e-learning courses is the involvement of human

instructors in the learning process in order to follow up the students' progress, examination and assessments results.

3.3 Offline/Online Hybrids

Some e-learning courses can be designed to use a blend of offline and online technologies; these are mainly called CD/Web hybrids. CD/Web hybrids decrease the Internet connection time by offering the interactive learning material on CD-ROM discs (for example) and offering performance tracking activities and evaluation assessments and examinations online.

4. Communication in an Online E-Learning System

Communication between students and experts (lecturers) or different students in an online e-learning portal can be either synchronous or asynchronous.

4.1 Synchronous

Students and lecturers involved in an activity must perform their part at the same time. Such events are sometimes called real-time collaboration or live events. Synchronous events include:

- Chat sessions
- Whiteboard sessions
- Audio conferencing
- Video conferencing
- Application sharing
- Online exams/ quizzes
- Student tracking

4.2 Asynchronous

Students can participate in an experience whenever they want. Permanently posted WebPages and automatically scored tests are clearly asynchronous, which learners can access at anytime. This means no live (real-time) collaboration is required. Asynchronous events include:

- Emails
- Discussion groups
- Announcements
- Bulletin boards
- Subject Matter Expert (SME) assistance
- Exercises
- File download

5. Concerns of Using E-Learning Technologies

Although using computers and the Internet in education and training can be a great solution in helping the improvement of learning, yet several concerns still arise

and worry experts involved in the field:

- What kind of courses can be offered through e-learning?
- How can we judge the strength or weakness of an e-learning course?
- How interested are learners in e-learning?
- How much spare time can a working individual have to engage in an online e-learning course?

6. The AAST Online E-Learning Portal

The AAST Multimedia Center developed an online e-learning portal which includes a flexible, adaptable and superior content dedicated to help deliver the best educational experience to students.

The portal addresses the needs of the entire educational enterprise, from administrators to students and faculty looking for ways to enhance teaching and learning.

The portal consists of three main sections:

- Student Space
- Instructor Space
- Administrator Space

6.1 Student Space

The student space is the STUDENT interface to the system. It contains customized pages for accessing courses in which the student is registered. The student may access the course study material, communicate with instructors and online classmates, receive announcements, submit assignments, and follow up grades and performance. Weekly schedules are constructed to help tasks organization.

The student space is divided into the following main parts:

- Information
- Study Material
- Communication
- Assessment
- Personal Tools
- General Utilities

6.1.1 Information

- Schedule
- Students Info
- Instructor Info
- Frequently Asked Questions
- System Requirements
- Technical Support

6.1.2 Study Material

- Study Guide: The study guide should be the first part to be read by the students. It contains an overall idea about the course, its contents, assignments, what is exactly required from the students to get a high grade, and how evaluation takes place. It contains:
 - Introduction to the course
 - Description, Objectives and Goals
 - Instructor Information
 - Course contents (lectures titles and overview)
 - Course Evaluation (Assessment) & Grading Policy
- Contents: The online student doesn't attend a real class, nor has the chance to listen to the instructor and understand the complex parts of the lecture. Therefore special care was taken of the explanation of the lectures, to be a helpful guide as a replacement for attendance. Good design and correct multimedia tools helped achieve this objective.

Contents main features are:

- The use of the different multimedia tools: text, graphics, audio, video, 2D and 3D animation.
 - Effective use of interactivity.
 - Effective use of animation with audio to simplify complicated contents.
 - Easy navigation through the different parts of the lecture, as the lecture is divided into topics and subtopics available all the time in a navigational tree.
 - Bookmarks: the student may bookmark any of the lecture pages for further direct access.
 - Glossary: a list of technical terms to assist the student.
- Resources: Supporting the students with different online resources is one of the main benefits of online learning. The lecturer should carefully prepare this part to assist his students in their studies. Resources are: Handouts, Presentations, Bookstore, Articles, Papers, Links, Past Exams, and FAQ

6.1.3 Communication

Easy communication is one of the most important aspects of an online e-learning system. Students don't "physically" attend the class, therefore the system has to provide other means for communication with the instructor, classmates or administration to avoid the feeling of isolation.

The AAST Portal is neither purely synchronous nor asynchronous. A mix of synchronous and asynchronous activities and events make up the system.

Synchronous: Chat

Asynchronous: Announcements, Mail, Discussion Groups, and Shared Files

6.1.4 Assessment

The assessment part defines all the assessment items, their due dates, weights, passing grade, and the student's submission and grading status. Students will be assessed through the assignments and the final exam and will be able to follow their grades and progress. They have chances for practicing and self assessment through the exercises (quizzes and activities).

- **Assignments:** A list of all the assignments will be displayed with a start date, due date, type, description, weight, number of files, and file format required and the submission status. Assignments features:
 - Upon submission of the assignment, the student gets a confirmation message.
 - Assignment resubmission is available till the due date.
 - The student can check his grade and read the instructor's feedback.
 - Reminders of submission dates will be displayed in the homepage.
- **Exams:** The final exam will be conducted in examination centers.
- **Exercises (Quizzes – Activities):** Exercises consist of Quizzes and Activities and they are not graded, for practicing and self testing.

Quizzes: A quiz consists of a number of lecture questions about which will be automatically graded by the system. Quiz features are:

- Automatic scoring.
- The number of attempts and the grade of last attempt will be recorded.
- A hint to the correct answer for each question.
- Result summary: no of correct, wrong or unanswered questions and correct answers.
- Customized quiz: student can chose reviewing questions on some or all lectures.

Activities: A list of all the activities will be displayed with a start date, due date (optional), description, file format required and submission status. Activity features are:

- Upon submitting the activity, student gets a confirmation message with file name and size.
- Activity resubmission is possible.
- Instructor feedback.
- **Progress Report:** A report for student's grades and status in all the courses he is registered in.

6.1.5 Personal Tools

Calendar, Address Book and Personal Profile

6.1.6 General Utilities

Help, Search and Site Map

6.2 Instructor Space

The INSTRUCTOR interface to the system helps him access and manage the courses he teaches and to track and evaluate the students. The instructor's role in the online e-learning system is very crucial and has a significant impact on the success of the learning experience. The design of the system should therefore support and help the instructor to manage the course successfully through:

- Tracking and evaluating students
- Managing synchronous/asynchronous Communication
- Timely feedback
- Providing suitable study material
- Providing assignments and questions
- Flexible time table modification

The instructor space is divided into the following main parts:

- Course Preparation (Setup)
- Information
- Study Material
- Assessment (Evaluation and Tracking)
- Communication
- Personal Tools
- General Utilities

6.2.1 Course Preparation (Setup)

The setup part is available for a specific period before the start date of the course. It's used to enter course tasks and study material. The following items will be set:

- Weights: Setting the total assessment weights for Assignments and final exam.
- Schedule: Setting weekly tasks required and delivery due dates.
- Assignments: Posting assignments plus setting their details.
- Exercises: Entering quizzes questions and activities (optional due date).
- Discussion Groups: Posting weekly topics.

6.2.2 Information

- Schedule: After setting the course weekly schedule in the setup phase, the instructor can modify the weekly tasks. Modification includes:
 - Modifying tasks: assignments, quizzes, activities, discussion groups, readings, and chat.
 - Adding task to coming weeks: assignment, quiz, activity, and discussion groups.

- Deleting task from coming weeks.
- Students' Info, FAQ, System Requirements, and Technical Support are similar to the student space.

6.2.3 *Study Material*

- Resources: Resources are very important for online students and therefore should be regularly reviewed and updated by the instructor. The system gives instructors the following options:
 - Handouts/ Presentations: The lecturer can upload or delete a presentation/handout for a specific lecture.
 - Bookstore: The lecturer can add or delete a reference.
 - Articles/ Papers/ Links: The lecturer can add or delete a paper/ article/ link.
 - Past Exams/ FAQ: The lecturer can upload or delete a file.
- Study Guide and Contents are the same as the student space.

6.2.4 *Assessment*

The assessment part is the main part of the instructor space, through which he can track and evaluate the students and follow up their progress.

- Assignments: In the assignments, the instructor has the options to:
 - Add/modify assignments with: start & due dates, description, contents, weight, format, etc.
 - Download students' assignment files.
 - Enter students' grades plus sending comments for each student.
 - Re-grade or raise the grades.
- Exercises (Quizzes – Activities):
 - Quizzes: In the quizzes part the instructor can:
 - Add/ modify quizzes for lectures with details: start date, due date, description, and questions.
 - Follow up number of attempts and grades of students.
 - Update questions of lectures by adding (within the specified types) or deleting questions.
 - Activities: In the activities part the instructor can:
 - Add/ modify an activity with details: start & due dates, description, contents, and file format.
 - Download student activity files.
 - Send feedback and follow up students' progress in activities.
- Progress: The progress part gives instructors an overall idea about students progress in two views: per student and per week. Through this part

instructors can follow up: students' submissions, grades, class average, and highest and lowest grades.

- Tracking: The system helps the instructor follow up students' access to the system and its pages.

Students/ Pages Tracking:

- First and last access to the system and its different pages.
- Number of hits to the system and its different pages.
- Total and average time spent on the system and its different pages.

6.2.5 Communication

- Announcements: The instructor can post announcements to all students, for example:
 - Changing a due date.
 - Modification of an assignment.
 - Changing exam dates.
- Discussion Groups: In order to encourage the participation of the students through the discussion groups the instructor can:
 - Add a new topic for discussion.
 - Check the replies of each topic.
 - Follow up students' topics and the communication amongst them.
- Chat: The weekly chat is the chance to meet the students online. Discussions are held about the lecture main topics and any problems the students are facing. Whiteboard can be used to aid the communication through sketching. The instructor can modify the date and time of any coming session, an automatic announcement will be sent to the students with the new changes.

The rest of the Communication part is the same as the student space: Mail and Shared Files.

6.2.6 Personal Tools

Calendar, Address Book and Personal Profile: the same as student space.

6.2.7 General Utilities

Help, Search and Site Map: the same as student space.

6.3 Administrator Space

The ADMINISTRATOR interface is used to maintain and follow the system. This includes:

- Performing Backups: Backups provide a snapshot of the system. If something goes wrong and the information stored on the system is lost, it can be retrieved from the backup.
- Checking Server Performance: Assessing the server performance to ensure that it can cope with the demands placed on it, if not then the performance must be improved.

- Reporting and Managing Problems: Five types of problems may occur: software, hardware, configuration, logistic, and educational. A form is to be filled which allows users to indicate the specific problem. Good management of reports and quick feedback is to be done. System errors must be fixed immediately to gain users' confidence in the reporting and maintenance system.
- Creating an Emergency Plan: It is very important to make a contingency plan in the event of sudden problems in the system.
- Analyzing Log Files: Analyzing the log files that the server keeps is important to know how the system is being used. There are a number of log files. Examples are: 'Error Log Files' which report the errors experienced by the server, and Access Log Files.

A second part of the administration system is for:

- Students' registration and general progress follow up.
- Students and instructors usernames and passwords
- Setting courses schedules
- Posting general announcements

7. Conclusion

E-learning in education especially higher education holds great promise for academic instruction. More colleges and universities are shifting towards the development of multimedia e-learning courseware solutions and online learning management systems.

Multimedia e-learning systems will soon play a more prominent role in educational institutions. Learning will be more student-paced, with time for individualized instruction, which will increase and aid the learning process.

Modern e-learning management systems can either be online or a hybrid of online and offline systems, whichever form that aids better in instruction.

It is a must for educational institutions in the Middle East to adopt the option of e-learning in order not to fall behind and keep surviving in an environment where the education market requires this change.

In order to help in the development of a new technological age in education in the Middle East through e-learning, the AAST has developed an online learning management system and several multimedia courseware solutions.

References

- Youssef, M.A.** 'Multimedia Technology in Education and Training'. *Proceedings of the 'Academia Lebanon 2004' conference, 26th - 28th February (2004).*
- Youssef, M.A.** 'The AAST Collaboration in the Development of Multimedia E-Learning Solutions'. *Proceedings of the 2nd Conference on e-Learning Applications in Egypt, 10th – 11th January (2004).*
- Ohler, J.** (2001). 'A Buyer's Market: Education in the New Economy'. *The State Education Standard, 2(1)*. Published by NASBE (The National Association of School Boards of Education).

Moursund, D. and **Smith, I.** 'ISTE Research on Technology in Education'. <http://www.iste.org/research/reports/tlcu/multimedia.cfm>

Radford, A. 'The Future of Multimedia in Education'. First Monday, *Peer-Reviewed Journal of the Internet*, Vol. 2 No. 11 - November 3th. (1997).

DeLong, S.E. 'The Shroud of Lecturing'. First Monday, *Peer-Reviewed Journal of the Internet*, Vol. 2 No. 5 - May 5th. 1997

دور الأكاديمية العربية للعلوم و التكنولوجيا في إنتاج برامج للتعليم الإلكتروني باستخدام الوسائط المتعددة

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المستخلص: في محاولة لملاحقة التطور السريع لتكنولوجيا المعلومات، فإنه أصبح من الضروري إدخال التدريب باستخدام الحاسوب وشبكة الإنترنت في مجالي التعليم والتدريب حيث إن استخدامهما يعد بالكثير في هذا المجال. مناهج التعليم الإلكتروني يمكنها العمل على الحاسوب، على الشبكات الداخلية أو على شبكة الإنترنت مباشرة وهي لا تتطلب تدخلاً أو مساعدة من المعلم أو المحاضر. نظراً للخبرة الواسعة والجيدة للأكاديمية العربية للعلوم و التكنولوجيا في مجال التعليم عامة والتعليم الإلكتروني خاصة فإنها قد قامت بإنتاج حلول دراسية وبرامج ومناهج متعددة باستخدام تكنولوجيا الوسائط المتعددة. كما قامت الأكاديمية أيضاً بإنشاء بوابة للتعليم الإلكتروني على شبكة الإنترنت في محاولة منها لمعاونة النهوض بالتعليم و التدريب في العصر التكنولوجي الحديث.

Faculty Development Program: KFUPM Experience

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ABSTRACT. While nothing substitutes hard work, career development plans for junior faculty can accelerate the process of flourishing a junior faculty and may very well reduce frustration. Experience gathered from implementing junior faculty career development programs indicates that faculty members whom their institution actively contributes for their career development are more likely to pay back to that institution in scholarly, productivity and creativity. King Fahd University of Petroleum and Minerals (KFUPM) developed and started to implement a structured comprehensive faculty development program. The faculty development program at KFUPM has two main components. This paper presents issues related to faculty development in general and the components of KFUPM faculty development program in particular.

Introduction

Faculty member wishing to achieve a successful career faces a multitude of challenges resulting from his various responsibilities. A freshly appointed junior faculty needs to quickly develop to cope and adapt to effective teaching, evolving instructional technologies, and advances in his field of interest. Other faculty members need to develop to attain their highest expectations. While nothing substitutes hard work, career development plans for junior faculty can accelerate the process of flourishing a junior faculty and may very well reduce frustration. Experience gathered from implementing junior faculty career development programs indicates that faculty members whom their institution actively contributes for their career development are more likely to stay longer and give back to that institution in scholarly, productivity and creativity.

Many colleges and universities have established teaching and learning centers to help faculty members develop and polish their teaching skills ^[1]. Increasingly universities have developed centers that not only provide teaching resources, but also

help faculty use technology in both their teaching and research responsibilities ^[2]. The focus of the study by Epper and Bates ^[2] is on comprehensive teaching and learning centers that offer instruction, assessment services, and instructional resources which provide general support to enhance the teaching mission of the university as well as assist faculty in using technology in their classrooms. As noted by Diamond ^[3] and Wright ^[4], such centers are typically located within the office of the provost. Teaching and learning centers have become an integral part of many college and university faculty development programs. A well-written discussion of teaching and learning centers by Sorcinelli^[1] distills ten principles of good practice for developing and maintaining teaching and learning centers; Sorcinelli^[1] principles are based upon both her own experience in developing two teaching and learning centers, as well as research which supports these practices. Of particular interest were the identification of "best practices" that could help others who are either seeking to initiate or strengthen an existing teaching and learning center. The survey questions were: (1) What are one or more of your "best practices" that have made your Teaching and Learning Center effective?, (2) List one or more factors that have helped the Teaching and Learning Center achieve its goals, (3) List one or more of the obstacles that have hindered the Teaching and Learning Center from achieving its goals, and (4) What would you recommend as the best organizational or reporting structure for a Teaching and Learning Center? The survey results indicated that the responses from directors of teaching and learning centers were consistent with the ten principles of good practice outlined by ^[1]. Offering workshops was listed as the number one "best practice" of teaching and learning centers. Under this practice were a host of specific workshops themes and objectives. Providing faculty-mentoring programs (one-on-one assistance) emerged as the second "best practice." The most important factors that contribute to the success of teaching and learning centers are strong support from administrators followed by supportive faculty who are engaged in the work of the center. The top two obstacles to achieving the goals of teaching and learning centers are budget constraints followed by faculty perceptions that it's research, rather than teaching, that "counts" toward the quest for promotion and tenure. Finally, the overwhelming best reporting structure for a teaching and learning center is for the director of the center to report to the chief academic officer of the institution (provost). The study provides evidence that faculty still need symbolic and substantive reminder of the importance of teaching in the constellation of their job responsibilities. Teaching and learning centers are an important way of communicating the central role teaching plays in the life of colleges and universities.

King Fahd University of Petroleum and Minerals (KFUPM) developed and started to implement a structured comprehensive faculty development program. The program has two main components that include: structured review process to identify the faculty member needs and a set of activities that are expected to assist the faculty member in achieving the KFUPM criteria in teaching and research. The objectives of the faculty development program at KFUPM ^[5] are to foster an environment of continuous improvement and development and improve students' learning.

Faculty Development

Faculty members in higher education are usually hired because of their subject-area knowledge, not because they are excellent teachers. Faculty members at most universities arrive with high levels of professional and content expertise, but with varying levels of teaching and educational technology exposure ^[6]. Most faculty have never been formally taught how to teach and how people learn. Initial needs are to ensure that faculty (1) are comfortable with educational technology use, (2) have solid understanding of the instructional design and development process, and (3) have basic understanding of how learning theory can be applied to enhance teaching and learning in their own classes. Ongoing needs are to ensure that new faculty members are appropriately trained in these areas, and that continuing faculty members are constantly updated on theory, technologies, and applications. One additional need must be addressed: the changing role of faculty in the information age. Technology has made information available to anyone with access to a computer and modem. Students have heterogeneous backgrounds, and traditional methods of providing content don't meet the needs of all students. Faculty must learn to cope with student diversity by choosing the teaching approach that best fits the content to be taught ^[7, 8, 9, 10]. The role of teaching assistants (TAs) is becoming different in technology-rich environments, because new learning models often replace the large lecture class with smaller mini-lectures and keynote lectures that preface collaborative and problem-based learning activities, and incorporate learning technologies into courses to greater or lesser extent. Thus, TAs will need an overview of learning theory, pedagogy, and course-design methodology. TA training will improve their teaching skills.

Faculty-Development Programs

Faculty-development programs have been instituted in academia to help faculty learn new and better ways of teaching as well as to increase organizational effectiveness in higher education ^[11-15]. Research shows that most institutions do not have a formal faculty-development plan. Recent studies showed that, while there is more planning for faculty development than there was a few years ago, only limited comprehensive faculty-development planning is being carried out, particularly in relation to technology-rich environments.

A faculty-development program obviously must be tied to the academic mission of the institution. A faculty-development program should ensure that everyone in the institution clearly understands the role of teaching and learning at that institution. A set of goals for teaching and learning should be available and strategies for meeting those goals should be made. The goals evolve directly from the mission-and-vision statements. It is important that development starts with pedagogy and stress technology as a support to pedagogy, not vice versa ^[16,17].

It is important for faculty members to participate in faculty-development activities. For some, the new knowledge and increased sense of competency will motivate them to participate. But for many others, faculty-development activities may seem just one more burden in a crowded schedule of other activities. The value of

faculty development must become part of the organizational culture and norms. Rewards and incentives for participating in continuing faculty-development activities must be set at the institutional level, and recognition for excellence in teaching must be public and ongoing.

KFUPM Faculty Development Program

The program has two main components: structured review process to identify the faculty member needs and a set of activities that are expected to assist the faculty member in achieving the KFUPM standards in teaching and research. Based on the components of the program, frameworks for teaching and research have been constructed as shown in Figs. 1 and 2. It is worth mentioning that the program strikes a good balance between teaching and research.

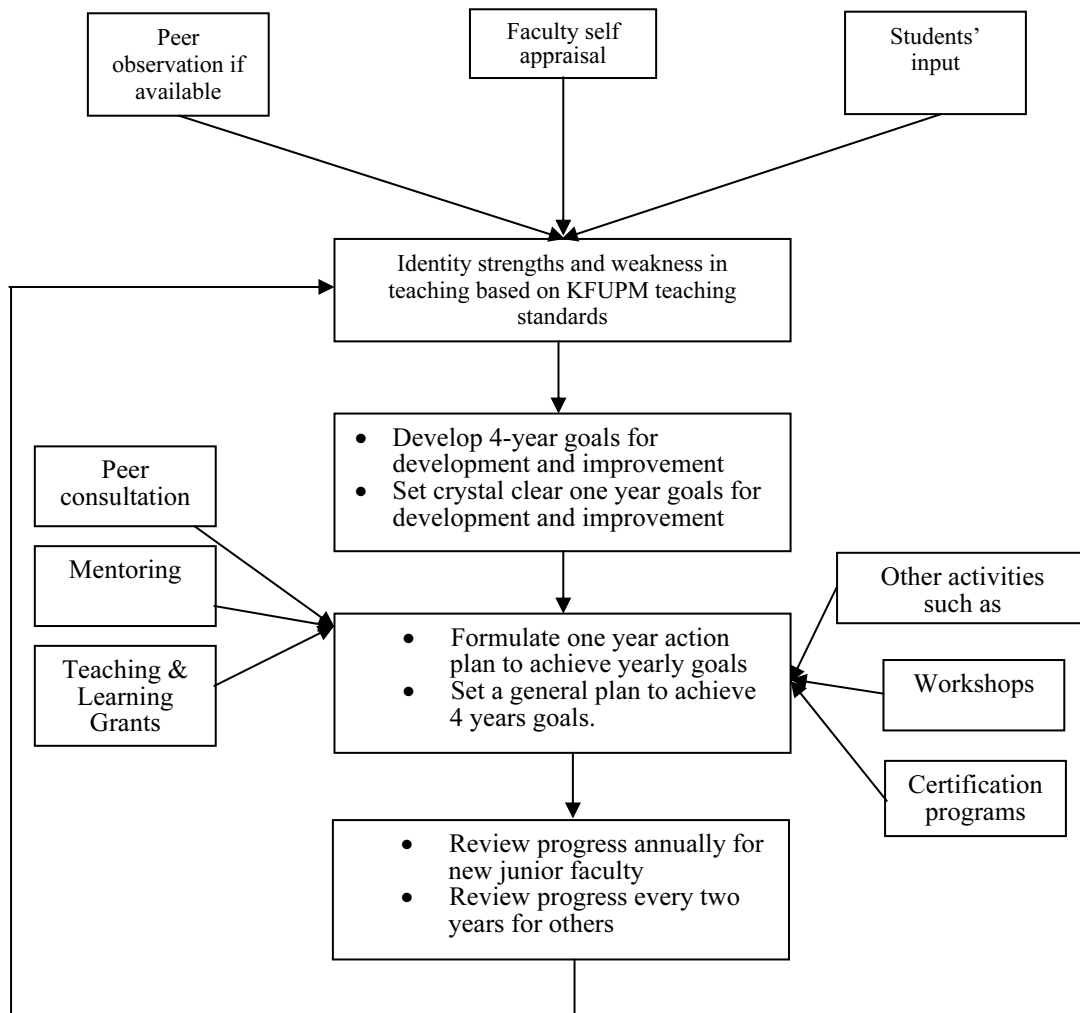


Fig. 1. A framework for faculty development in teaching.

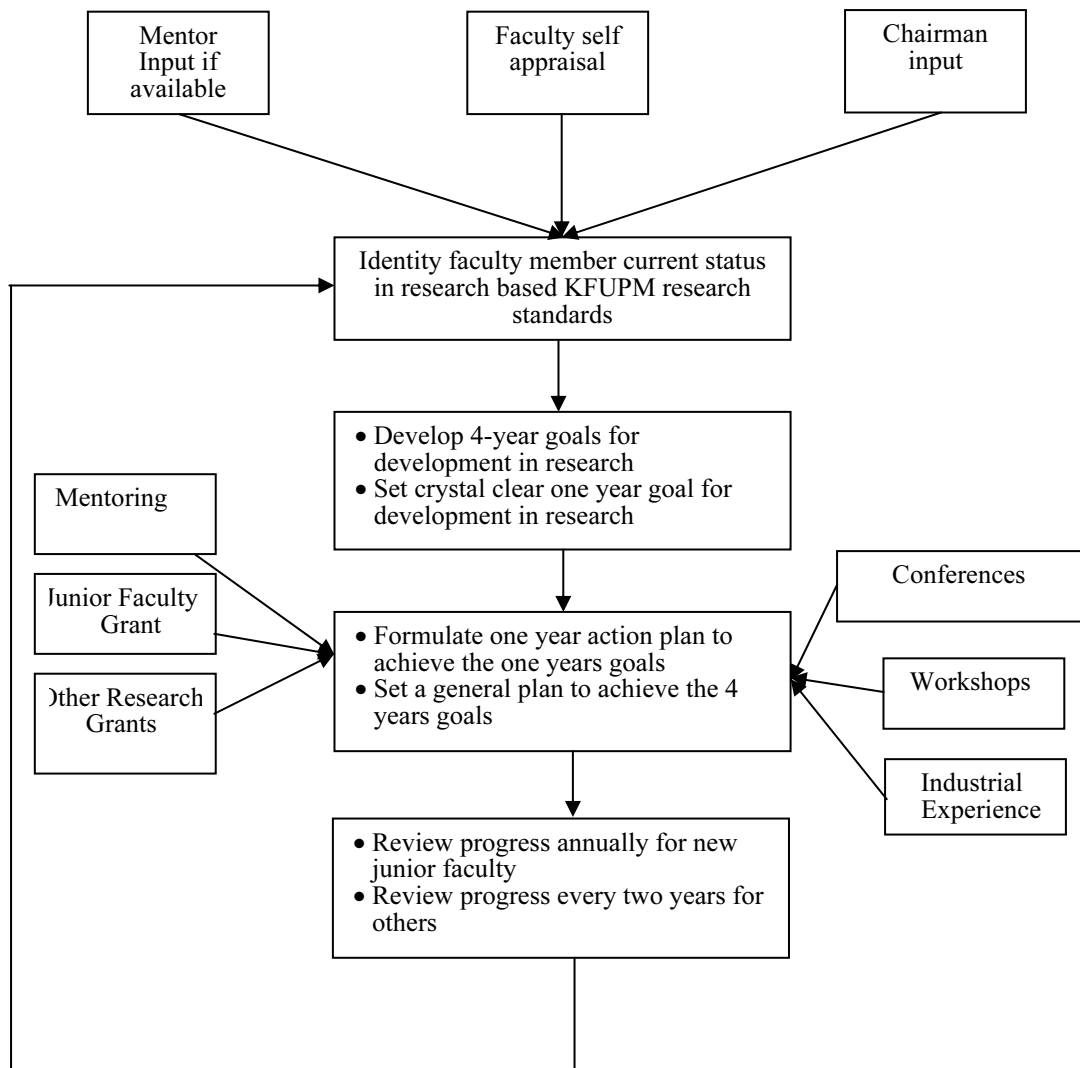


Fig. 2. A framework for faculty development in research.

1.0 The Review Process

The purpose of the review process is to develop a clear four years faculty development plan in teaching and research and set yearly achievable goals. Then develop an action plan to achieve the yearly goals. The faculty member assisted by his mentor (if available) and the department chairman develops the four-year plan and the yearly goals. The frequency of the plan progress review depends on the seniority, experience and the rank of the faculty member. The progress review frequency is recommended to be yearly for junior faculty members and every two years for senior faculty members. The chairman plays a pivotal role in this regard.

2.0 Faculty-Development Activities and Services:

The Teaching and Learning Center (TLC) under the Deanship of Faculty Development (DAD) provides a variety of activities, services and grants. These include training, support, and professional development programs for faculty, chairmen and deans. TLC sponsors and organizes a range of academic development workshops, discussion forums and seminars related to teaching, research, faculty evaluation, student learning and curriculum. It is often that international, national and local experts participate in these events. A list that indicates titles and dates of seminars, discussion forums and workshops that has been conducted is shown in Table 1. Each activity was evaluated by the participants. The evaluation results indicated that more than 80% of the participants were very much satisfied with the quality and usefulness of these activities.

Table 1. Seminars, Discussion Forums and Workshops

SEMINARS	
Excellence in Higher Education: A Model based on Best Practices	April 20, 2004
Strategic Planning	April 11, 2004
Faculty Development	June 15, 2003
Smart Classrooms	March 27, 2001
Applied Research Activities at KFUPM	October 08, 2000
Scientific Research at KFUPM	September 17, 2000
Balancing Your Teaching & Research Efforts	April 11, 2000
DISCUSSION FORUMS	
Critical Thinking	November 28, 2004
Proposed Policy for the Selection of Majors	October 12, 2004
Faculty Annual Evaluation System	September 26, 2004
Faculty and Student Motivation	May 23, 2004
Research at KFUPM :Challenges and Opportunities	May 20, 2003
Enhancing Student Learning at KFUPM	March 26, 2002
Student Learning at KFUPM: Challenges and Opportunities	March 25, 2001
Faculty Evaluation by Students	May 07, 2000
WORKSHOPS	
Overview of faculty practice standards and campus life at KFUPM	September 14, 2004
Workshops for Junior Faculty	September 04 - 08, 2004
Preparing to Teach	September 04, 2004
Motivation and Student Learning	September 05, 2004
Engaging Students in the Classroom	September 06, 2004

Assessment of Student Learning	September 07, 2004
Student-Centered Teaching and Learning	September 08, 2004
Things I Wish They Had Told Me!	September 08, 2004
Workshops for All KFUPM faculty	September 04 - 07, 2004
Developing the Communication Skills of Students	September 04 - 05, 2004
Active Learning to Foster Critical Thinking	September 06, 2004
Using Groups and Student Teams to Promote Learning	September 07, 2004
Mentoring to Enhance Faculty Development	September 01, 2004
Peer Consultants in Teaching Program	August 31, 2004
Providing Effective Feedback: Workshop for Chairmen	August 30, 2004
Faculty Development Program	June 02, 2004
Strategic Planning	April 12 - 13, 2004
Developing the Role of Department Deans as Academic Leaders	March 22 - 23, 2004
Developing the Role of Department Chairmen as Academic Leaders	March 20 - 21, 2004
Overview of faculty practice standards and campus life at KFUPM	September 14, 2003
Critical Thinking	September 07 - 10, 2003
Effective Presentation	July 27 - 29, 2003
Increasing Effectiveness as a University Teacher	September 09 - 11, 2002
Making Effective use of Student-Centered Learning	September 09, 2002
Assessing Different Types of Learning Outcomes	September 09, 2002
Basic Principles of Curriculum Development	September 10, 2002
Making Effective Use of Electronic Learning	September 10, 2002
Using Games and Simulations to Teach Science and Engineering	September 11, 2002
How Students Learn - Things Every Teacher Should Know	September 11, 2002
Overview of faculty practice standards and campus life at KFUPM	September 09, 2002
How to be an Effective University Teacher	September 07 - 08, 2002
Specifying Student Learning Outcomes	September 07, 2002
Selecting Appropriate Teaching/Learning Methods	September 07, 2002
Planning and Delivering Lectures	September 08, 2002
Assessing Student Performance	September 08, 2002
The Role of the Department Chairperson in Sustaining and Improving the Quality of Teaching	April 16, 2002
Fostering Students Learning	April 09 - 10, 2002
Conception of Teaching: Implications for Students Learning	April 09, 2002
Motivation and Student Learning	April 10, 2002
Engaging Students in Classroom	April 10, 2002
Striving for Excellence in University Teaching and Learning - III	April 07 - 16, 2002

Feedback to Enhance Student Learning	April 07, 2002
Assessing Students Fairly	April 07, 2002
Questioning Strategies and Critical Thinking	April 14, 2002
Introduction to Problem-Based Learning (PBL)	April 16, 2002
Preparing Prospective Peer Consultants for the Collaborative Peer Review of Teaching Program at KFUPM	April 06 - 17, 2002
The Role of the Department Head in Sustaining and Improving the Quality of Teaching	August 28, 2001
Striving for Excellence in University Teaching and Learning - II	August 27 - 29, 2001
Feedback Strategies in Teaching and Learning	August 27, 2001
Integrating Technology into Teaching	August 28, 2001
Recording and Documenting Teaching Quality: The Teaching Dossier	August 29, 2001
Managing "Difficult" Situations in Teaching	August 29, 2001
Preparing to Teach: Instructional Development Program for Recently Appointed Faculty	August 26 - 27, 2001
Planning and Starting a Course	August 26, 2001
Motivation and Student Learning	August 26, 2001
Engaging Students in the Classroom	August 27, 2001
Managing Teaching and Learning in the Classroom	August 27, 2001
Overview of faculty practice standards and campus life at KFUPM	August 25, 2001
Striving for Excellence in University Teaching and Learning	April 28 - May 01, 2001
Conceptions of Teaching: Implications for Learning	April 28, 2001
Motivation: What Teachers Need to Know About What Motivates Students	April 29, 2001
Engaging the Classroom: Making Learning More Active	April 30, 2001
Teaching Large Classes	April 30, 2001
WORKSHOPS (Contd.)	
Using Small Groups Effectively in Teaching	May 01, 2001
The Effectiveness of Programs for Improving University Teaching	May 02, 2001
Learning, Teaching, Curriculum, and Assessment	August 28 - 30, 2000
The Science and Art of Teaching	August 28, 2000
Learning	August 28, 2000
Teaching	August 29, 2000
Achieving Excellence and Improvement in Teaching	August 29, 2000
Curriculum	August 30, 2000
Assessment	August 30, 2000

2.1 Activities

To achieve teaching and research goals several activities could be conducted. *Faculty-Development Activities include:*

University Orientation Programs: New-faculty-orientation programs normally are held just prior to the beginning of the first semester. It is intended to introduce new faculty to the different services departments at KFUPM (such as housing, medical center, re-creation center, post office), Information Technology center, Library and administrative staff of the university.

Beginning of the Year Program: Such program is tailored towards the needs of more-experienced faculty members. The Program might include:

- Presentations about new resources and support programs at the institution or in the departments.
- Announcements of upcoming grants, awards, and other opportunities for faculty.
- Demonstrations and hands-on time with new technologies.
- Meetings with senior administrators to discuss concerns, programs, etc.
- Social events.

Improving Teaching: The past few years witnessed extensive research and development in areas of teaching and learning. New models for teaching and learning have been developed over the past several years. Hence, new faculty members need to be exposed to these developments. Continuing faculty need to be updated on new approaches in teaching and new theories of learning. Such exposure and updating is being provided by conducting workshops on areas of teaching and learning. These workshops include:

- Workshops on various aspects of pedagogy and learning theory.
- Workshops on course design and development methodologies.
- Workshops on specific teaching topics of interest to continuing faculty, such as alternate methods of assessing learning, course design for various types of courses and effective techniques for working with small groups
- Workshops on using technology in teaching and learning.
- Other programs that are specifically targeted at improving teaching among experienced faculty members include:
 - Providing regular newsletters highlighting teaching and learning resources, excellence, and related events that might interest faculty.
 - Grants for developing new methods and resources for teaching, or for doing research on teaching and learning.
 - Videotaping. Videotape identifies habits of speech, body language, and other aspects of presentation style upon which to improve.

Peer Mentoring: Assigning a more-experienced faculty member to assist and guide a newer member in professional development. Mentoring is becoming more popular on

university campuses ^[18, 19]. Peer-mentoring programs also have benefits for continuing faculty members who are mentoring new faculty. Very few institutions have implemented informal peer-mentoring programs where experienced faculty can formally or informally mentor each other, sharing hints and tips, resources and contacts when considering and trying new approaches to teaching [20]. However, experienced faculty members are less inclined to participate in formal peer-mentoring programs. This reluctance can be resolved by one of the following approaches:

- Make peer-to-peer mentoring mandatory. It might be best to pair mentors from different departments so that there is less feeling of competition.
- Offer faculty the choice of mentoring peers from other programs or new faculty from their own programs. This approach implies that some form of mentoring is necessary for all faculty, but gives a sense of choice.
- Assign mentoring in groups. This approach can be successful with graduate teaching assistants.
- Provide a peer-mentoring pool, with a coordinator who matches faculty who wish to enter a peer-to-peer mentoring arrangement with other senior faculty who are also interested in peer mentoring.

Microteaching: TLC organizes and facilitates microteaching workshops in which six to eight participants present brief lessons in their field, and then receive feedback from their peers

Department-Based Workshops: TLC encourages and support departmental-based workshops on topics related to teaching and learning. Such workshops offer practical information on how to improve teaching skills, while providing an opportunity for teachers to come together to discuss issues related to teaching and learning.

Groups: TLC encourages and support group activities on topics related to faculty development. One group that is already formed in KFUPM is the Critical Thinking Group.

2.2 Services:

The services offered by TLC are for professional development only. The Center does not participate in any way with performance or promotion evaluations of individual faculty members. The offered services include:

Class Videotaping and Consulting: This free of charge service provides faculty, teaching assistants, and other instructors the chance to have one or more of their classes videotaped and to review the tape with a professional teaching consultant.

Peer Consultation in Teaching: The main objective of Peer Consultation in Teaching (PCT) is to provide faculty members with formative feedback on their teaching. It is intended exclusively for faculty self-development of their teaching skills. The main tool

of PCT will be class-visits by specially trained individuals (peer-consultants). Such visits will take place upon the request of the faculty interested in getting consultation (client). A flow-chart that summaries the key steps for requesting and conducting Peer Consultation in Teaching (PCT) is shown in Table 2. A survey was conducted regarding Peer Consultation in Teaching (PCT) program at KFUPM. 93 % of the faculty members participated in the program indicated that it is a very effective tool to improve teaching.

Teaching Consultation: Offers Discussions with Peer (senior) consultants who have been working with a number of faculty members and observed a good number of classes.

Resource Room: In addition to the above services, DAD administers a resources center, which has a collection of publications on the subject of faculty development and the enhancement of teaching and learning.

Academic Development Grants: TLC offers a number of academic development grants. The purpose of the academic development grants is to provide financial support for faculty members to carry out projects and activities that assist in achieving the deanship's mission and objectives. Areas of the grants include:

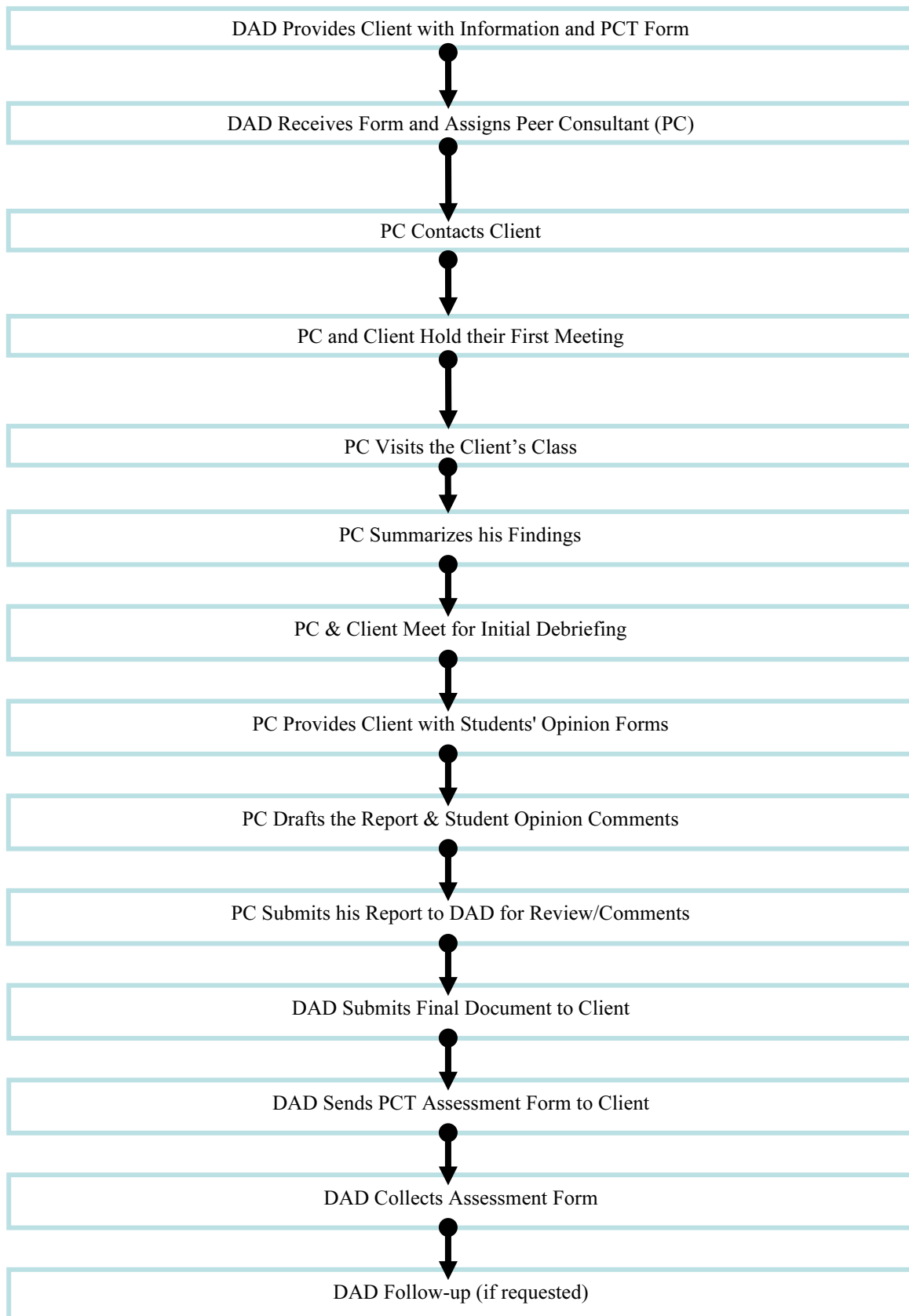
- Enhancement of learning environment
- Technology – Enhanced Learning.
- Faculty Development

Conclusions

To foster an environment of continuous improvement and development, KFUPM developed a structured faculty development program. The program has two main components that include: structured review process and a set of activities that are expected to assist the faculty member in achieving the KFUPM standards in teaching and research. Based on KFUPM experience, the authors recommend the followings:

1. It is essential that every higher education institute develops and implements a comprehensive faculty development program. The program should have a mission statement , specific goals, objectives, and strategies for implementing the mission. It should include the following activities:
 - New faculty-orientation programs.
 - Semester-start faculty-development program.
 - Workshops and training on pedagogy/teaching and learning, including learning theories and approaches and techniques for teaching for junior faculty members.
 - Workshops and training on topics of professional interest to continuing faculty.
 - Grants for encouraging research and innovation in teaching.
2. Position teaching excellence as an organizational value.
3. Establish a centralized center for faculty development and teaching excellence.

Table 2. A flow-chart that summaries PCT program key steps.



4. Encourage continuing faculty development through incentives and rewards for participation in faculty-development activities.
5. Encourage excellence in teaching through recognition and rewards.
6. Encourage faculty members to participate in off-campus faculty-development activities.
7. Encourage faculty-development idea-exchange programs with other institutions.
8. Develop and implement peer-mentoring and peer consultation programs for junior and continuing faculty.
9. Develop and deploy a cadre of master teachers.
10. Periodically review and update the program.

References

- [1] **Sorcinelli, M. D.** (2002). Ten principles of good practice in creating and sustaining teaching and learning centers. In Gillespie, K. H., Hilsen, L. R. & Wadsworth, E. C. (Eds.) *A guide to faculty development: Practical advice, examples, and resources*. Bolton, MA: Anker Publishing Company, Inc.
- [2] **Epper, R. M. & Bates, A. W.** (2001). *Teaching faculty how to use technology: Best practices from leading institutions*. Westport, CT: Oryx Press and The American Council on Education.
- [3] **Diamond, R. M.** (2002). Faculty, instructional, and organizational development: Options and choices. In Gillespie, K. H., Hilsen, L. R. & Wadsworth, E. C. (Eds.) *A guide to faculty development: Practical advice, examples, and resources*. Bolton, MA: Anker Publishing Company, Inc.
- [4] **Wright, D. L.** (2000). Faculty development centers in research universities: A study of resources and programs. In Kaplan, M & Lieberman D. (Eds.) *To improve the academy: Resources for faculty, instructional, and organizational development*. Boston, MA: Anker Publishing Company, Inc., 291-301.
- [5] Faculty Development Program. *Deanship of Academic Development Document*, March 2004. King Fahd University of Petroleum & Minerals, Dhahran, Saudi Arabia.
- [6] **Cheung, S. A.** (1999). [online]. The first year faculty experience. *Focus Online* 9 (2). Available at <http://www.dal.ca/~oidt/focus92.html>
- [7] **Gandolfo, A.** (1998). Brave new world? The challenge of technology to time-honored pedagogies and traditional structures. *New Directions for Teaching and Learning* 76: 23–38, Winter.
- [8] **Matthew, K., Parker, R. and Wilkinson, L.** (1998). Faculty adoption of technology: Stages of concern. In "Proceedings: SITE 98," *Society for Information Technology & Teacher Education International Conference (9th)*, Washington, DC, March 10–14.
- [9] **Pincas, A.** 1998. [online]. New media, homogenous knowledge and education. CPD, Issue 2. Available at <http://www.openhouse.org.uk/virtual-university-press/cpd/Issue2/newmed.htm>
- [10] **Wright, A.** (1999). [online]. Improving teaching by design. *Focus Online* 8 (2). Available at <http://www.dal.ca/~oidt/Focus82.html>
- [11] **Graf, D., et al.** (1992). Faculty development's role in improving undergraduate education. *New Directions for Teaching and Learning* 51: 101–9, Fall.
- [12] **Gullatt, D., and Weaver, S. W.** (1997). Use of faculty development activities to improve the effectiveness of U.S. institutions of higher education. Paper presented at the *Annual Meeting of the Professional and Organizational Development Network in Higher Education (22nd)*, Haines City, FL, October 16–19.
- [13] **Knight, P.** (1997). [online]. Embedding excellence in higher education. *Focus Online* 7 (1). Available at <http://www.dal.ca/~oidt/Focus1.html>

- [14] **Millis, B.** (1994). Faculty development in the 1990's: What it is and why we can't wait. *Journal of Counseling and Development* 72 (5): 454–64, May–June.
- [15] **Oromaner, M.** (1998). Faculty and staff development. ERIC Digest ED416941. Los Angeles, California: ERIC Clearinghouse for Community Colleges.
- [16] **Eastmond, D., and Lawrence, B.** (1998). Instructing faculty to develop and deliver distance courses with computer network technology. *Journal of Educational Technology Systems* 26 (4): 315–24.
- [17] **Horgan, B.** 1998. [online]. Faculty, instruction and information technology. *The Technology Source*, August. Available at <http://horizon.unc.edu/TS/development>
- [18] **Luna, G., and Cullen, D.** (1995). Empowering the faculty: Mentoring redirected and renewed. ERIC Digest ED399888. Washington, DC: ERIC Clearinghouse on Higher Education.
- [19] **Kerka, S.** 91998. [online]. New perspectives on mentoring. ERIC Clearinghouse on Adult, Career and Vocational Education Digest #194. Available at <http://www.peer.ca/Perspectives.html>
- [20] **Scott, D., and Weeks, P.** (1996). Collaborative staff development. *Innovative Higher Education* 21 (2): 101–11.

تطوير أعضاء هيئة التدريس ، تجربة جامعة الملك فهد للبترول والمعادن

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المستخلص : يواجه عضو هيئة التدريس الذي يرغب في تحقيق مهنة ناجحة العديد من التحديات الناجمة عن مسؤولياته المتعددة. ويحتاج عضو هيئة التدريس الجديد أن ينمي قدراته للتكيف مع التعليم الفعال وتطوير تقنيات التعليم والارتقاء في مجال اهتماماته. كما يحتاج أعضاء هيئة التدريس الآخرين أيضاً إلى التطوير لتحقيق أقصى ما يتوقع منهم . وحيث أنه لا بديل عن العمل الجاد فإن خطط التطوير المهنية لأعضاء هيئة التدريس الجدد يمكنها أن تعمل على تسريع التطوير. وبينت الخبرات التي تم تحصيلها من تطبيق برامج التطوير المهنية لأعضاء هيئة التدريس الجدد أن أعضاء هيئة التدريس الذين ينتمون إلى مؤسسات تسهم بشكل فاعل في التطوير المهني للعاملين بها ، يستمرون لمدة أطول ويسهمون لتلك المؤسسة بالإنتاج العلمي والإبداعي .

الهدف العام لبرنامج الجامعة لتطوير أعضاء هيئة التدريس هو تحسين تعليم الطلاب بمساعدة أعضاء هيئة التدريس لبلوغ أقصى ما لديهم في مجالي التعليم والتعلم والأبحاث. وتشمل محتويات برنامج التطوير معايير الجامعة ومقياساً للتعليم والتعلم والأبحاث الفعالة ، تكوين عملية مراجعة لتحديد الحاجة لأعضاء هيئة التدريس ووضع الأنشطة المتوقع أن تساعد أعضاء هيئة التدريس في تطوير وتحقيق المعايير .

تعتمد معايير التعلم والتعليم على الإنجازات في المستوى المعرفي وتطبيقات القواعد المعرفية ونقل المعرفة والمهارات الشخصية والدوافع. وتعتمد معايير الأبحاث على توجيهات الجامعة التشجيعية التي تتضمن القدرة على النشر في الدوريات العالمية المحكمة والمشاركة في الأبحاث الممولة. أما هدف عملية المراجعة فهو تكوين خطة واضحة لتطوير أعضاء هيئة التدريس في مجال التعليم والتعلم والأبحاث و وضع أهداف سنوية قابلة للإنجاز . كما يلزم إنجاز أهداف برنامج الجامعة لتطوير أعضاء هيئة التدريس مجموعة من أنشطة التطوير في مجالات التعليم والتعلم والأبحاث . تقدم هذه الورقة شرحاً تفصيلياً لمكونات برنامج تطوير أعضاء هيئة التدريس بجامعة الملك فهد للبترول والمعادن وتجربة الجامعة في هذا الصدد .