Intelligent Decision Support System on Flexible Learning Structure in Higher Education.

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ABSTRACT
Intelligent decision support system is the one that behaves like a human consultant; has the ability to learn, can support decision makers by gathering evidence, analyze it, identify and diagnose problems, propose possible courses of action and evaluate the proposed actions. The aim of the Artificially Intelligent Techniques embedded in a decision support system enables these tasks to be performed by a computer that can simulate the human capabilities as closely as possible. In our paper we are representing Intelligent Decision Support System (IDSS) that demonstrates the above mentioned tasks for implementing a flexible learning system in higher education. To give better understanding about our IDSS we model the structure and activities of IDSS by using UML which is de facto standard language for modeling. Our objective is to provide a learning structure where students can attain self-directed education. We are considering an environment which provides such flexibility in curriculum which gives student the freedom to choose amongst wide variety of courses and create and academic curriculum of their own choice. To achieve this objective we have designed an IDSS based on fuzzy logic which behaves like a consultant for a student and guide them for selecting their courses for coming term in such a manner that their credit requirements are fulfilled.

General Terms

Learning, Intelligent Decision Support System (IDSS), Unified Modeling Language (UML), Fuzzy Logic.

Keywords

Decision support system, Flexible Learning Structure, Higher Education, Fuzzy Rule Based Systems(FRBS).

1. PROLOGUE
Internet and the World Wide Web provide us with the ability to communicate worldwide. The Internet can be used by the universities to cope with a common problem faced by institutions concerning the limited availability of courses that the students can learn in an educational program. In order to acquire a "hands-on" experience which is vital for most of the science and engineering programmes, it is very important that students should be able to pick the area of their interest in a flexi-structure system. This can be enabled by placing a flexi-course selection expert system online and making it accessible to all the students for remote access and operation. Before taking admission, the students can go through the list of courses and choose out the best possible combination for them. By this way, sharing of the intelligentsia between different institutes worldwide can also be enabled and students outside campus can be provided with any help and support online. In addition to that, with the added evaluation and guiding capabilities, students who are choosing their subjects online will not need a teacher or a lab assistant that might not be available in their institutions and will be happy to read the subjects or areas of their choice with the online specialized tutors available. Therefore, Flexible learning approach is the need of hour that encompasses activities which permit for greater responsiveness to students learning interests, needs and circumstances. It aims to offer learning which is accessible, appropriate and valuable to a diverse student base, and deploy strategies and technologies to meet the varying needs of students regarding the location and time of study.

2. HISTORY
In 1971, in an effort to re-focus the university on the quality of instruction, Syracuse University established the Center for Instructional Development within the office of Academic Affairs. This office, with staff experienced in instructional design, faculty development, evaluation and media production, was charged with working with faculty and academic leaders in the design and structure of new courses and curricula more attuned to the needs of the discipline, the students, and the community. There were no charges for these services. As work began in a number of high priority programs in academic units throughout the university at both the undergraduate and graduate levels, a number of common questions began apparent for which we had no clear answer:

- What were the assumptions being made by faculty about the students entering their courses and degree programs, and how accurate were the norms?
- What knowledge and skills did students actually bring to particular classes or programs?
- If students entered an introductory course with a wide range of knowledge and competencies, why should they all start at the same place?
- If students had advanced skills or knowledge, could they be exempted from certain units within a course or curriculum?
- Can all the students move through a course or program at the same pace? If some students required more time to complete a unit, how could we handle grades at the end of the semester when the work was not yet complete?
- How could we address financial aid and academic progress requirements for full-time enrollment when a student might be enrolled full-time but had only earned six credits by the end of the semester?
- How could we handle enrollment fees when certain students were taking more time and using more resources than others to develop the required level of competence before advancing within a course or

program?

- How could we allow students who were interested to take additional credits in a course to do so? Could this decision be made during the semester? How could fees be established for such additional work?
- **Figure 2: Activity Diagram depicting working of Advisor**
- How could we take advantage of technology and independent study to make better use of faculty and student time?
- If we had students enrolled in a course with different majors, could we have small concurrent group sessions that applied the same principle or concept to their respective fields of study?
- If we used faculty from other departments or faculty from other areas of specialization in the same department to teach these groups, how could we handle teaching loads for such short assignments?
- If different topics in a course were offered by different faculty, how should we average the grades of each unit to get a final course grade?

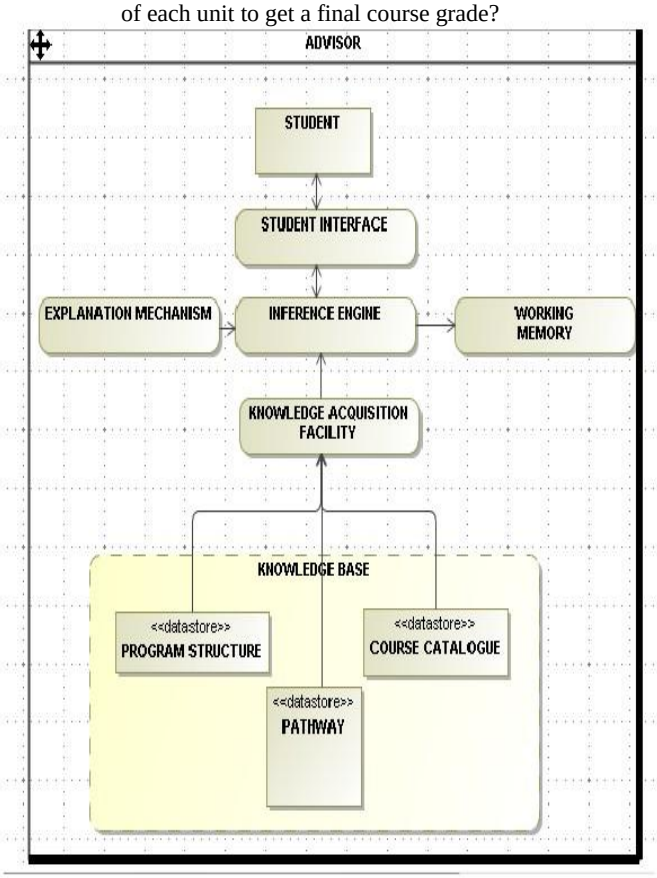

Figure 1: Structure of flexi system

3. DEFINITION OF THE PROBLEM

Flexi Credit system is a system wherein a student (with the guidance of an Advisor) has a choice to follow an academic pathway to fulfill minimum credit requirements of the programme. Flexible learning incorporates understandings of the physical, social as well as technological network, and opens up possibilities that extend learning environments into the social and professional worlds of learners. An effective application of flexible learning is the blended learning approach, in which engaging the learner is a primary concern, and the mix of face-to-face and online learning can bring new possibilities of extended interaction spaces, and improved outcomes.

The programmes have three Dimensions:

3.1 Dimension 1 contributes towards the "Academic Reach" of the student that is based on Credits. This Dimension is further sub divided into 2 categories – namely "General Faculty Requirement" (GFR) and "Major" courses requirement which is related to the discipline. In "General Faculty Requirement" (GFR), the student will be offered a broad spectrum of courses which he/she can choose. In "General" category students can choose from projects on different spheres such as technical (projects inter and intra disciplinary) projects, community projects, arts, sports and cultural. The "Major" category contributes towards fulfilling the requirement of the discipline courses comprising of core courses, breadth electives and depth electives.

3.2 Dimension 2 stresses on the "Skill Orientation" where basic emphasis will be laid on enhancement of students' ability in Writing, Presentation, Project/ Field work/Design and laboratory/ workshop. This dimension is defined on the basis of units. For e.g a 10 minute presentation with a write up on an allotted topic will earn the student 1 unit.

3.3 Dimension 3 defines the "Perspective" required to inculcate awareness in a student related to legal aspects, environmental issues, global issues or social issues that he/she can choose from a pool of courses depending upon his/her interest.

4. DESIGNING THE COURSE

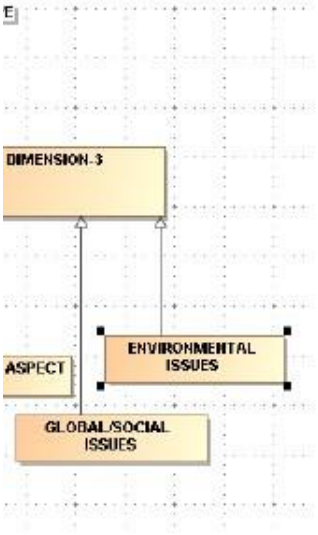

Figure 2: Activity Diagram depicting working of Advisor

CATALOGUE

In the Course Catalogue an exhaustive list of courses will be available for a student from which the student will choose the required courses for his pathway along with the guidance of an advisor so as to graduate. "A Pathway" is the list of suggested courses by the advisor which a student can opt so as to fulfill the minimum requirements of all the three dimensions in order to graduate. In the pathway courses:

- Blue color depicts the elective courses from the list.
- Yellow color depicts the free electives.
- Pink color depicts the compulsory courses.

This structure is providing a successful framework that can guide the students for the better achievement of their goals through easily accessible interface. Human computer interaction and web-based intelligent tutoring concepts come into play while implementing an online educational tool whose target is mostly unskilled or novice users. The users (the students in this context) have to be provided with tools that will be helpful in improving their skills in the targeted area. A successful education system should have intelligence to tackle the variation in student skills and backgrounds and it should also be able to adapt its contents according to that variation. These mentioned issues are the main concerns that help a student both to learn and to gain experience about the control of the subjects they want to study throughout programme in the targeted area. In order to adapt the context of the experimentation to the variation in student behaviors, students should be modeled according to their skills and knowledge backgrounds. Modeling is an important aspect of both human computer interaction and intelligent tutoring research areas.

Figure 2 illustrate the UML activity diagram and give understanding about IDSS for learning system. Student is interacting with the IDSS interface. Decision making will take place at inference engine. The inference engine can be described as a form of finite state machine with a cycle consisting of three Action states: match rules, select rules, and execute rules. In our system Rules are represented in the system by Pathway where a pathway contain list of suggested courses by the advisor which a student can opt so as to fulfill the minimum requirements of all the three dimensions in order to graduate. In the first state, match rules, the inference engine finds all of the rules (suggested courses) that are satisfied by the current contents of the data store. The fetching of rules is done by Knowledge acquisition facility. When rules are in the typical condition-action form, this means testing the conditions against the working memory. The rule matching that are found are all candidates for execution (selected courses that are suitable according to grades for the term): they are collectively referred to as the conflict set. We are using explanation mechanism which can truly confirm the suitability of required selections for particular term for the students.

5. PROPOSED METHODOLOGY

The work done in this research is to find ways to fulfill the objectives stated in the previous section to provide a general framework for an interface that can be used for access to robotic applications through the Internet or the WWW. The emphasis is on modeling and profiling the student behavior and coaching the students according to this information. In addition, a useful and a relevant scenario is constructed that will be a test platform for the student assessment and coaching system. The framework is applied to an existing remotely controlled system through the Internet, where it is integrated in the general Internet software. The student assessment and coaching system, which works as an intelligent program to model and evaluate the student performance, is called from the interface while the general experimentation program is running.

The student assessment and coaching system proposed in this paper is composed of different modules which take errors done during the whole task as inputs and output informative messages sent to the experiment interface for the student such as new task assignments or repeats, as well as the user grade values subsequently added to the user record. An artificial neural network and a fuzzy-rule based decision process are used for modeling and classification of student behaviors, evaluating the student performance during the online experimentation and giving necessary grades and performance-improving directions to students. The user interface of the framework is designed to be simple yet informative to the student and having the ability to support the needs that the framework is applied to. In summary, methods presented in show that fuzzy approaches are potentially useful for student performance evaluation. However, it can be observed that these methods too have several shortenings.

If the total credit of courses which is selected by user matched with the total requirement of the credit for that semester, then it will display the courses selected by you. Otherwise it will ask you to select again. Firstly, these methods produce a new total score in terms of crisp values before a new grade can be awarded. This can be a substantial setback as the difference of the new total score with the original score may be very large and thus create confusion for the user, especially the students. Secondly, all the methods are wholly based on expert opinions without offering the possibility of making direct use of information gathered from data. Newly developed fuzzy approaches should look into ways of avoiding, or at least reducing such disadvantages. The following section proposes such an approach.

5.1 Data-driven Fuzzy Rule Based Approach

Reasoning based on fuzzy approaches has been successfully applied for the inference of multiple attributes containing imprecise data; in particular, fuzzy rule-based systems (FRBS). FRBS implemented in LPU provides intuitive methods of reasoning in solving real-world problems. Recent developments in this area also show the availability of FRBS which allow interpretation of the inference in the form of linguistic statements whilst having high accuracy rates.

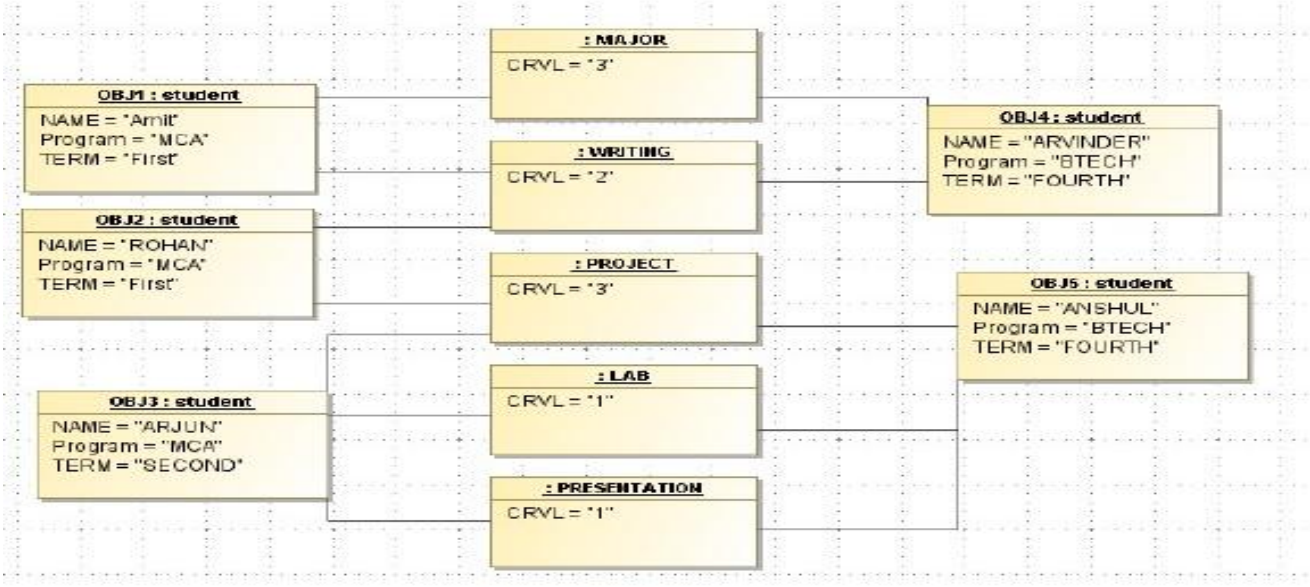

Figure 3: Object diagram showing students enrolled for courses at particular instance of time.

The above diagram(Figure 3) is object diagram in Unified Modeling Language(UML) that shows a complete or partial view of the structure of a modeled system at a specific time.

As shown in the diagram, students of different program get enrolled in different courses as guided by IDSS. They have chosen the subject according to their interest and fulfilling the required credit value (CRVL) for that term.

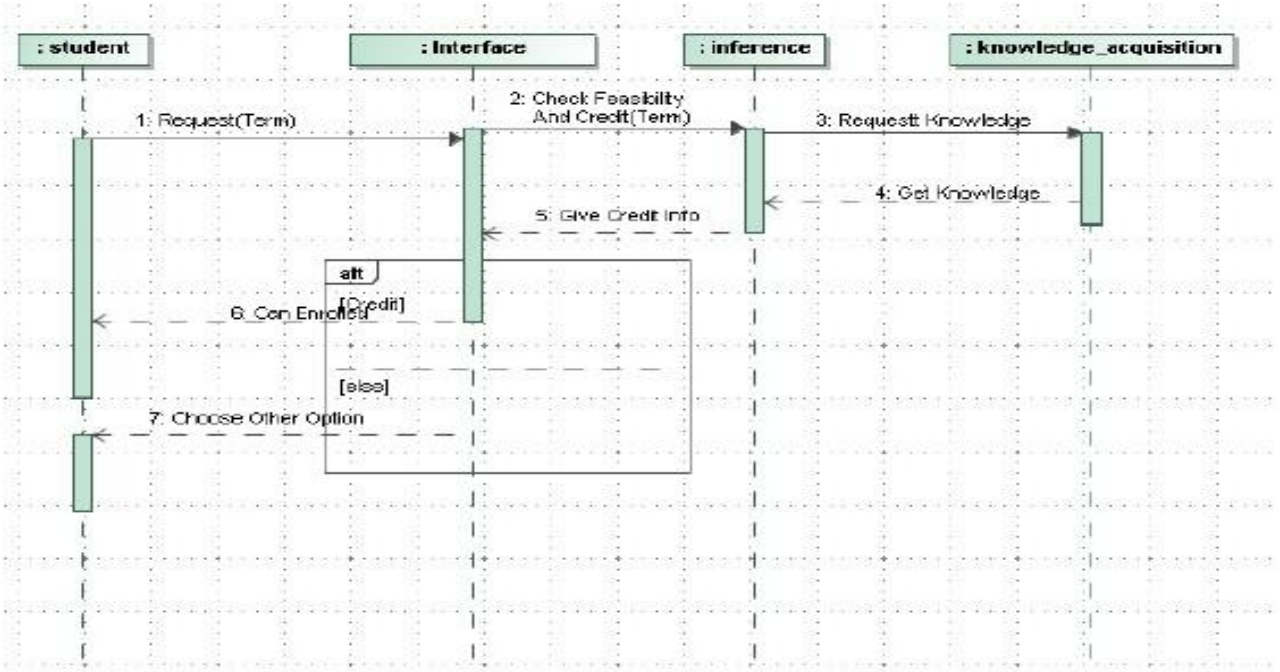

Figure 4: Sequence diagram for students getting enrolled in the term

A sequence diagram (Figure 4) in Unified Modeling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart of a flexi system.

The use of linguistic rule models such as "***If Exam is very poor and Continuous Assessment is average then the final result is poor***" helps capturing the natural way in which humans make judgments and decisions. Furthermore, historical data that is readily available in certain application domains can be used to build fuzzy models which integrate information from data with expert opinions. It is also important that the designed fuzzy models are interpretable by, and explainable to, the user. This section describes a newly

proposed data-driven fuzzy rule induction method that achieves such objectives, and shows how the method can be applied to the classification of student performance.

6. IMPLEMENTATION

AI techniques can be applied for implementation of online experimentation framework to get useful information about the student skill and knowledge level for providing help when necessary and assessing his/her performance. Human computer interaction field deals with enhancing the ways in which users interact with one or more computational machines through design, evaluation and implementation of interactive computing systems. There is a strong need for an intelligent interface for a framework for a student remote access through the Internet. The two main reasons for that are:

1.) The need for intelligently coaching the student to achieve his/her goals.
2.) The need for evaluating student's performance in an organization in various fields.

Student evaluation, the first main issue mentioned above, is one
of the key issues for a remote experimentation framework. Students who are carrying out the experimentation, online without a human assistant or a teacher, should all be evaluated according to their varying success levels. The interface should possess suitable intelligence to categorize the student according to his or her performance during the course of the experiment and possibly to evaluate whether an increase or decrease in performance is present according to the past performance of the users. Necessary grades can then be given to those students according to the performance category in which they tend to fall.
Students, while doing the experiments online by themselves should be coached just as in the case for a traditional laboratory work where the coach is a human assistant or a teacher. They can be given useful directions and recommendations in the form of messages on the interface. Another aspect of coaching is to adapt the level of the complexity of the experiment to the level of the student. Skilled students can be excluded from some parts of the experiment, where unskilled students or students showing a poor performance can be directed to finish the fundamental parts or repeat the unsuccessful parts of the experiment.

This idea coincides with the aim of using adaptive hypermedia for intelligent web-based tutoring tools, where the content of the tutor is changed adaptively to suit the student's individual needs
and interests. There are also other key aspects for a successful interface, which are:

- Having a layout that provides the student with all the necessary information about the objectives and the states of the experiment, and visual displays for aiding the users to see the state of the robot and the experimental setup.
- Providing a security mechanism that prevents unwanted and unauthorized access to protect the system from possible malicious use.

Another issue for the robot-supported online experimentation is providing a scenario for the experiment. The experiment should involve a useful scenario that is relevant to the educational context that it is applied to and which must have tasks that have different levels of complexity to be accomplished. By this way, using an intelligent interface for an online robot-supported experimentation will be justified. The educational contexts to benefit from remote experimentation can be range from mechatronics laboratories to chemistry laboratories. According to the scenario, the students can be directed to complete the levels of the experiment according to their skill level and be coached without the actual presence of a human assistant or a teacher.

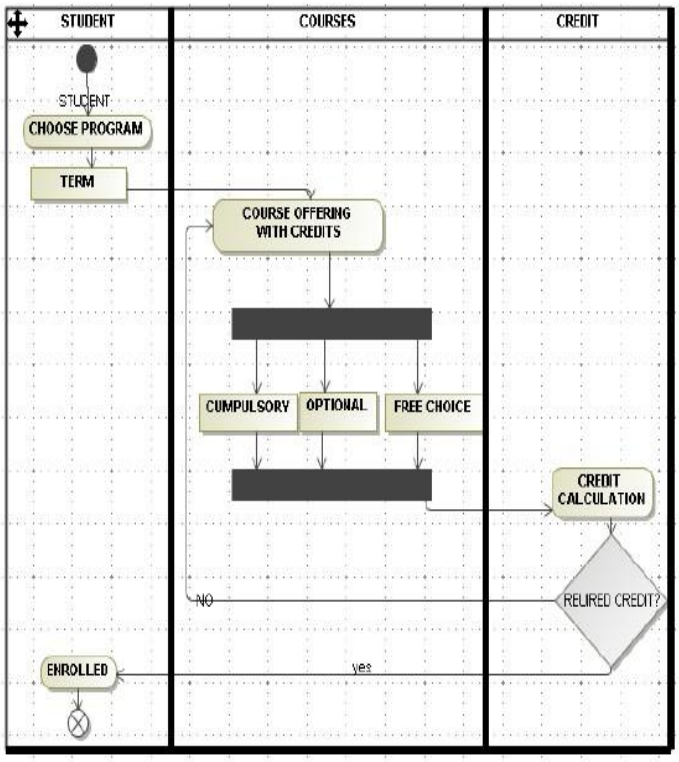

Figure 5: Activity diagram of a student selecting courses meeting the credits requirement of a term

Figure 5 further Elaborate process of IDSS, after choosing a program, IDSS guides the students through various course offering available. IDSS guide the student to opt from compulsory, optional and free choice courses. Credit calculation id done by the inference and if the required credits matches then the student is responded to enroll with the selected courses for that term and if the credits are not appropriate, then students can again give choice for the courses.

7. GOALS INTENDED TO BE ACHIEVED

From the nature of the Internet, the system serves to a diverse number of students each having different knowledge and skill levels. The system is adaptive to these different levels and provides each student with enough assistance for accomplishing the desired experiment and getting the necessary knowledge
and experience. The major goals include:

- Assistance provided to the student is in the form of generated messages or mandatory commands such as the repetition of a previously failed step of the experiment.
- Students are assigned experiments having different

complexity levels according to their past and present performances.

- The system grades students according to their performances, and stores grades and student profiles in
a database.
- The system has an authentication module to ensure security and to recall a previous user from the database.

The other major aim of this work is to propose new directions and methodologies in order to employ this assessment framework for the different fields of educational context where remote experimentation through the Internet is beneficial. From this point of view the necessary requirements for the framework
are:

- The proposed experimentation scheme must correlate with the educational requirements of the respective field in order to enhance student practical knowledge. In other words, the remote experimentation framework should provide whatever the conventional experimentation in laboratories provides to the students.
- The framework should be extensible to support a variety of educational context ranging from mechatronics to chemistry and whichever field that requires a practical experimentation that follows a path of tasks that should be done in the correct order.

8. CONCLUSION

To conclude, we have proposed a new learning structure with supporting Intelligent Decision Support System on Learning (IDSS) which can successfully guide the students to choose the subjects based on their interest and help to achieve sky-high success in life. It provides the user friendly interface. There is no need to take help from any professional to understand the concepts. If user wants any kind of information regarding course then he/she has to enter the course code. Therefore, Flexible learning approaches can give students choice about where, when and how they learn; recognize the wide diversity amongst our students in terms of the times they have available to study, their other commitments (family and work); respond to the learning needs of our students; Promote e-learning, which refers to computer-enhanced learning, web-based teaching materials, CD-ROMs, web sites, discussion boards, collaborative software, e-mail, blogs, wikis, text chat, mobile technologies; Promote blended learning, which is learning that is facilitated by the effective combination of different modes of delivery, models of teaching and styles of learning, and founded on transparent communication amongst all parties involved with a course.

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