

Development of an Expert System for an Academic Evaluation: A Case Study of the University of the East

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Abstract: An expert system that emulates the expertise of a human academic evaluator was developed taking into account the functionalities and features of the current system being utilized in the University of the East. The said system enables students to self-evaluate their academic performance in a faster, convenient and accurate manner anytime, anywhere. Several weaknesses of the current system was revealed and, thus addressed, resulting to an expert system that: 1) validates academic records of transferees, 2) advise students what courses to enroll and 3) allows student self-evaluation. Result of no significant difference between student credit units evaluated by the current system and the expert system underlines the fact that the proposed expert system is as effective as the time tested current system.

Key words: Expert system • Academic evaluation • Current system • Self-evaluation

INTRODUCTION

The academic credit system started from most of the European higher education institutions (HEIs) in Europe during the 1800s [1, 2] and eventually followed by the American higher education systems. This system was then transferred to the Philippines. This system allows accumulation of academic units in order to award a certain degree. Students taking up different degrees with different number of units make the task of managing and monitoring these units a very tedious job.

Academic evaluation is the process of tagging or matching the courses the student has taken based on his course curriculum. Results of evaluation inform students on what courses they had taken and courses they still need to take to finish their chosen degree program. This process is a pre-requisite for graduation. Student academic evaluation is usually done manually in most schools and universities.

Record keeping, organizing and managing wide array of student information manually is a tedious and time consuming task. The current academic evaluation system in the University of the East uses an evaluator's module which can be accessed by the college evaluators on their own terminals only. The system provides the student's copy of grades for evaluation purposes. However, the

number of human academic evaluators per college is not proportional to the college's student population; thus, the release of the much needed student evaluation, the process of enrollment is delayed, not to mention the accuracy of data generated. Students would normally go back after five working days to receive the evaluation.

Another point of consideration of this study is the non-existence of a module or system that could validate and credit the courses of transferees and shifters. For these cases, the current academic evaluation system of the University of the East is done manually as the transferees and shifters handed their official Transcript of Records to the college academic evaluator as they visited the college.

With an effective frame of reference, an online interactive expert system that would address the concerns of higher educational institutions in academic evaluation was proposed. The proposed expert system targets the in-campus students, transferees and college academic evaluators as end-users and it advocates replacing the current academic evaluation system. Functionalities and features of the current academic evaluation system were considered in the development of the proposed expert system which was determined through interview method of data gathering, knowledge acquisition, document sampling and evaluation. Data flow diagram, visual table

of contents and input-process-output were utilized in the analysis of the system. Internet would be the core means of accessing the proposed expert system to allow student access anytime, anywhere.

The proposed expert system is expected to perform the following tasks: 1) validates academic records of transferees, 2) advises students what courses to enroll and 3) allows student self-evaluation.

Objectives of the Study: This study evaluated the proposed expert system if it truly emulated the academic evaluator of the current system. Comparison was also conducted to test for similarities or differences between the number of academic units evaluated and credited by the two systems.

Review of Related Works: McKinney [3] reviewed several advising systems implemented on different colleges in the United States. Advising and Retention Information (ARI) was one of the systems reviewed. This system was implemented at the Florida Community College. Students were required to submit ARI information that included questions on the students' goals and field of study [4] before an admission was considered complete. This data was entered into the "A Learning Enhancement and Retention Tracking" (ALERT) system and made available to faculty for each enrolled student at the beginning of each semester. The faculty member tracked the academic progress of the student. Assistance was given for those students who needed to improve importance and retention [5].

Portland Community College (PCC) conducted a pilot test of its ADVISE program in 1990 [6]. The system allowed advisers to utilize transcript and course offerings information to help students plan their schedules for the upcoming term. The goal of the system was to increase the academic success and retention of at-risk students. One hundred (100) volunteers were assigned either to a test or control group. It was revealed that there was no significant difference between the two groups in terms of General Point Average (GPA), number of credit hours completed and appropriateness of courses taken based on major and placement test scores. PCC blocked the students who failed to complete 50% of their courses each term or whose GPA falls between a 2.00. As a result, this requires at-risk students to seek guidance from their advisor.

Academic Alert (AA) was the third system reviewed by McKinney [3]. AA was implemented at Miami Dade which was designed to provide students with information

about their progress midway through the semester [7]. According to Kramer *et al.* [8], Miami Dade was one of the first community colleges to utilize computers to assist in advising functions. Reports were gathered from faculty and were fed into a computer. Individualized progress letters were then sent to students and counselors for advising purposes. Majority of the faculty members (76%) perceived that students would already know the latter's performance even without AA while 36% of students thought the same. Furthermore, students use the information generated by AA as an impetus to seek help and improve performance.

Meanwhile, Distance Education Report [9] described an online academic advising at the Computer Science Department of California State University-Dominguez Hills (CSU-DH). The advising system at the Computer Science Department of CSU-DH was developed using JavaScript, Pearl and rule-based technology. The system aimed a) to provide complete, accurate and timely information of the academic program, b) to assist students in selecting courses to complete a chosen field of study based on their abilities and interests and c) to assist students in monitoring and evaluating their academic progress. It was reported that approximately half of the department's 220 majors had used the system. It was also disclosed that students got the advice they expected, the system worked well and it was convenient to use.

On the other hand, there were also systems developed locally. One system that was being implemented at the University of the East (UE) was the "Information Kiosk". This information system was installed in three touch screen terminals allowing students to view their individual grades in all taken courses. As the faculty posted the students grades using the system for encoding the final grades, it automatically updates the Department of Registration and Records Management (DRRM) student record database; thus, giving the student access with the updated student academic records [10].

The study entitled "UE-CCSS Online Student Academic Evaluation" [11] is an evaluation of students' records allowing the students to view and print their academic evaluation result by themselves. The proposed system is a LAN-based system and was installed at the UE College of Computer Studies and Systems (CCSS) server. Students could access the system at the CCSS computer laboratories. The report generated was not complete because the matching of courses' equivalent and tagging of the credited courses were still to be done by the college evaluator.

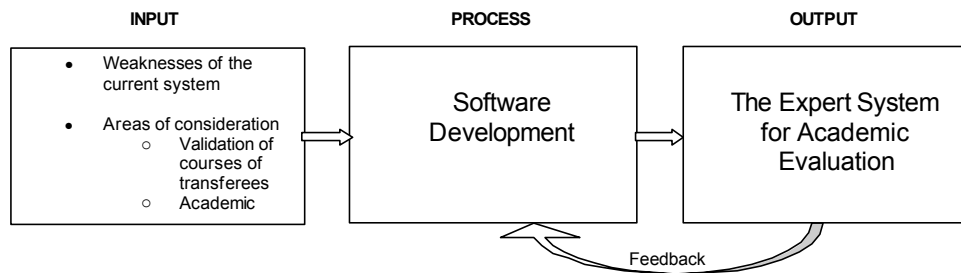


Fig. 1: Conceptual Framework

Printing of evaluations results could only be done at the CCSS Server Room. Official/final evaluation had to be issued by the college evaluator and would be marked candidate for graduation for those fourth year students who had satisfied all academic and DRRM entrance credentials requirements. The study helped the CCSS college evaluator simplify her work especially during enrollment. It was proposed only for the IT students. Thus, its functionality was limited.

In the study conducted by Lopez *et al.* [12], a computerized system was developed in ranking fourth year Computer Science Graduating students through their general weighted average. This helped the DRRM and the College to determine the Latin honors on a particular batch.

Another undergraduate study entitled “UE College of Computer Studies and Systems Grade Inquiry 2001” of Burley *et al.* [13] was designed to inform the CCSS students about their individual grade in all courses taken. The system did not present other information other than the grades. With the system, posting of students’ final grades at the bulletin boards was eliminated. Instead, students would be allowed to access the system installed at the CCSS laboratories so that they would be informed about their grades.

Conceptual Framework: The foregoing review of related literature and works served as bases in the formulation of the conceptual framework given below.

As shown in Figure 1, functionalities and features of the current academic evaluation system were considered in order to come up with the proposed system. The weaknesses of the current system, if any, served as inputs and were addressed in the development of the system. Furthermore, areas of consideration in the development of the system were identified to make the system effective.

The areas of consideration were explained as follows.

Validation of Courses of Transferees: This allows transferees self-evaluation to validate courses they had taken from their former school. It gives transferees information about the credited courses/units before they enroll in the UE-BSCS program. The college evaluators were also allowed to do the matching/tagging of the courses on behalf of the transferees.

Academic Evaluation: This provides students complete information about their academic records.

Students Advising: This provides students information what course to take the following semester with full consideration to course pre-prerequisite.

The system validated the courses of the transferees and shifters by letting them self-evaluate so they would know what courses/units were given credit as they transfer and enroll in the Computer Science program. Likewise, the system provides UE students the ease of acquiring temporary or final evaluation and deficiencies anytime, anywhere.

Feedbacks were gathered to ensure that the developed system conformed with the needs of the students and college evaluator. Thus, the objectives of the system would be achieved.

Research Methodology: Research Locale, Sources of Data and Data-Gathering Procedures.

The study was conducted in University of the East, specifically considering the B.S. Computer Science program of the College of Computer Studies and Systems (CCSS). Face-to-face interview were conducted to the different college evaluators and students who were involved in the process of academic evaluation to identify weaknesses of the current system. Ideas were gathered from the respondents as to what functionalities and features were needed to incorporate in the proposed expert system.

Furthermore, series of interviews between the researcher and the domain expert (i.e., the college evaluators) were conducted. Through these interviews, the demonstration of the current evaluation process, the classifications of courses in the BSCS curriculum, the considerations of priority courses, the possible courses' equivalent and the questions frequently asked from the students for further validation of the courses were gathered. Relevant documents such as Form IX or Academic Evaluation Form, BSCS curriculum template, course curricula of different departments, academic evaluation sheet and university enrollment policies and rules were also gathered. These documents were considered to ensure that the reports generated by the system would conform to the university's approved format.

System Design: A webpage menu-based design was considered in illustrating the modules of the system prototype. The University of the East opening site was utilized as the front screen design and the Expert System for Academic Evaluation as one of its links. The system has two (2) main developed modules.

Student Module: This allows all registered UE students, BSCS students or shifters and college evaluators to view and print the academic evaluation result. Since UE is using a standard coding for general courses, determining the course equivalent for shifters was easily obtained. However, courses with different descriptions/titles would be expertly validated. Outgoing students were marked as candidate for graduation.

This module considered a database of students' academic record being kept and maintained by the Registrar's office. These records included all courses taken, individual course units and grade. The database also included the student information like student number, student name, password to gain access with this module, course, college where he belong and credential requirements.

Self-Evaluation Module: This allows transferees to self-validate the courses they have taken from their former school. Validation of courses was done one at a time as the user matched the courses with the BSCS program courses in the curriculum template. Transferees were provided with the complete evaluation result. The system's generated reports were considered factual

if the transferee's printed copy of encoded grades was alike with his transcript of record as presented to the college for dean's approval.

In both modules, the system provided the students the Computer Generated Evaluation List (CGEL) and the Computer Generated Course Advising List (CGSAL). The relevant information on their academic records displayed on the evaluation list such as Total Units Required, Total Units Passed/Credited, Total Units Incomplete, Total Units Currently Enrolled, Total Units Credited from Other School, Total Units with Equivalent Course, Total Units Computer, Computer Generated Year and General Weighted Average.

The advising list in the current system provides the students with the list of possible courses they could enroll the following semester. The proposed system simplified the proceedings for academic evaluation for the college evaluators. However, evaluators need to access the system for the reason that the final evaluation for all graduating students was needed in their respective student jacket as required by the DRRM.

The students' records and all data needed for validating the courses of transferees are stored in a database. The knowledge was inferred from the existing facts through the rules of thumb. The **rules of thumb** used for validation is shown in Figure 2

Development Phase: The proposed expert system for academic evaluation was optimized to run under Windows XP environment with Internet Information Server (IIS) 5.0 and Microsoft SQL Server to achieve the expected performance of the system. The system could be run in any web browser. The proposed expert system prototype was coded using Active Server Programming (ASP), HTML and Java Script as front-end, Sequel Server (SQL) as the back-end for databases, Adobe Photoshop 7.0 for image manipulation, Crystal Reports for computer-generated outputs and Macromedia Dream Weaver MX and MS FrontPage for layout or interface design.

The proposed expert system could be executed in any suitable computer connected to the Internet. Intel Pentium 4, SGVA color monitor (800 x 600 display), 32-bit display adapter, 128Mb memory, Internet connection and printer were the hardware and resource requirements in the implementation of the system.

System Testing and Implementation: There were two types of system testing conducted – unit and integration testing. *Unit testing* was performed consistently on every

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IF the course is earned from other school or college
  AND has equivalent in BSCS curriculum program
  AND as a general education course
  AND is on the list in one classification of Set1 Category
  AND the course unit is >= to the units of the equivalent course
  THEN that course is credited and all courses earned with equivalent but taken
  ahead of the prerequisites are automatically matched and credited.

IF the course is earned from other school or college
  AND has equivalent in the BSCS curriculum program
  AND is not general education course
  AND is on the list in one classification of Set2 Category
  AND the course unit is >= to the units of the equivalent course
  THEN that course is credited and all courses earned with equivalent but taken
  ahead of the prerequisites are automatically matched and credited.

IF the course is earned from other school or college
  AND has no equivalent in the BSCS curriculum program
  AND is for three 3 or more units
  THEN that course is credited as Free Elective.
    
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Fig. 2: Algorithm for Validating Courses

completed part of the design of the new system. *Integration testing* was done using actual test data executed by the researcher and the prospective users of the system. Results were tabulated and coursed to statistical analysis. This was made possible to check if the proposed expert system prototype conforms to the system requirements.

Testing was done to assess the effectiveness of the proposed expert system as to the validity and accuracy of the results. The study did not involve students from the different universities and colleges in testing the effectiveness of the system since the outcomes of the evaluation results were ultimately dependent on the approval of the college evaluators.

Student Module: The UE students' academic records were obtained from the students' database maintained by the Registrar's Office. In the system prototype, the student database included only records of some BSCS students and students from other colleges (shifeters). The courses of shifeters and electives of the BSCS students are matched or tagged automatically.

Users should login using their student number and the assigned password. The system would then provide the Form IX and the Evaluation Viewer. The Form IX displayed the copy of grades of all taken courses, whether from UE or from other university or college and the Evaluation Viewer permitted the user to view the result of evaluation.

The following steps were carried out to test the software.

- The CCSS college evaluator was provided a copy of grades of the individual students and the academic evaluation sheet.

- Evaluator evaluated the students manually. The results were then examined and compared to the outputs of the system prototype.
- Afterwards, evaluator checked the proposed expert system prototype if it followed the guidelines, rules and policies of the university especially courses that should not considered due to lack of units.

Self-Evaluation Module: Copy of grades served as basis in validating the courses of the transferees. In the actual setting, students were asked to encode their earned courses and perform the self-evaluation procedure to generate the desired results. Matching of the courses was done one at a time. The procedures below were followed.

- The courses of transferees were pre-evaluated by the researcher using the proposed expert system prototype for academic evaluation. The prospectuses collected from the different universities and colleges and the transferees data forms were used as test data.
- Since the accuracy of the system was purely reliant on the college academic evaluator, the copy of grades was provided to him and was asked then to evaluate the courses manually. A request was forwarded with copy of grades and academic evaluation sheets as attachments.
- The returned evaluation forms were subsequently compared with the proposed expert system results and were carefully examined if the output was acceptable if not totally equivalent.
- An interview with the evaluator was set to know the reasons behind the observed discrepancies in the results. Observations and comments were duly noted.

- The college evaluator checked the system if it follows the guidelines, rules and policies of the University especially courses that should not be considered due to lack of units.

Statistical Analysis, Sampling and Sample Size: Each interface module was tested based on *The Number of Units Computed*. It was hypothesized that there is no significant difference between the current system and the proposed system in terms of the number of units credited by the college evaluator and the proposed expert system.

In Student Module, a big percentage of student population was not considered because the process done in one student was basically the same with all the rest of the students. Furthermore, the student records are already kept in the database and not as input data. Hence, ten (10) test data would be sufficient and this was utilized for the test run.

On the other hand, there were 212 transferees from S.Y. 2003-2004 which came from the 76 schools. The number of schools served as the population of the study since different schools have different course codes and descriptions. Using Sloven's formula ($e = 0.10$), a test data of 43 was computed to represent the entire population. This sample size was utilized in testing the self-evaluation module. An independent *t*-test was carried out to determine if there is a significant difference between the total the number of units credited by the college evaluator and the proposed expert system. A 0.05 level of significance with 95% reliability was utilized to determine the significance of the findings.

RESULT AND DISCUSSION

Weaknesses of the Current System: In order to determine the weaknesses of the current system, interviews were conducted with twelve college evaluators. The results of the interviews are shown in Table 1. As can be seen in Table 1, the evaluation process is extremely tedious on the part of the college evaluators. It is revealed that the number of college evaluators is not in proportion with the number of enrolled students (1 college evaluator per 1,811 students). College evaluators are also required to evaluate graduating students. As a result, the evaluators could only evaluate 5 to 20 students in a day. Mostly, it takes at least 21 minutes to evaluate one student and not all requests could be accommodated during the enrollment period. It would take at least three days to release their evaluation.

This slow process of evaluation resulted to delayed students' enrollment. There are also reports that evaluation results are not accurate due to inconsistent data. As a consequence, the office of the Dean receives students' complaints.

It can be argued that the current system of academic evaluation is ineffective and resulted to its weaknesses. The weaknesses of the current system are summarized as follows.

Inaccessibility of the System: Students are not allowed to do evaluation by themselves.

Table 1: Survey Results

Questions	Choices/Responses			
How many students can you evaluate in a day?	5 – 10 5	11 - 15 6	16 - 20 1	21 or over -
How many minutes used for evaluating one (1) student?	5 - 10 1	11 - 20 3	21 - 30 4	31 or over 4
When do you release the evaluation to student?	after a day -	after two(2) working days 1	after three (3) working days 9	after a week 2
What are the common problems or instances have you encountered as you do the process of evaluation?	Inconsistency of data 8	Not being able to accommodate all students especially during enrolment 6	The need to render overtime just to meet the deadline for evaluating graduating students 11	Not being able to recommend a student for graduation 5
Is there a circumstance that the student complain because of the occurrence of the problems mentioned above?	Yes 9	No 1	No Response 2	
Are you required to evaluate the graduating students?	Yes 12	No -		
What percentage of the total units of the course would be credited?	25% -	50% -	60% -	75% or over 12

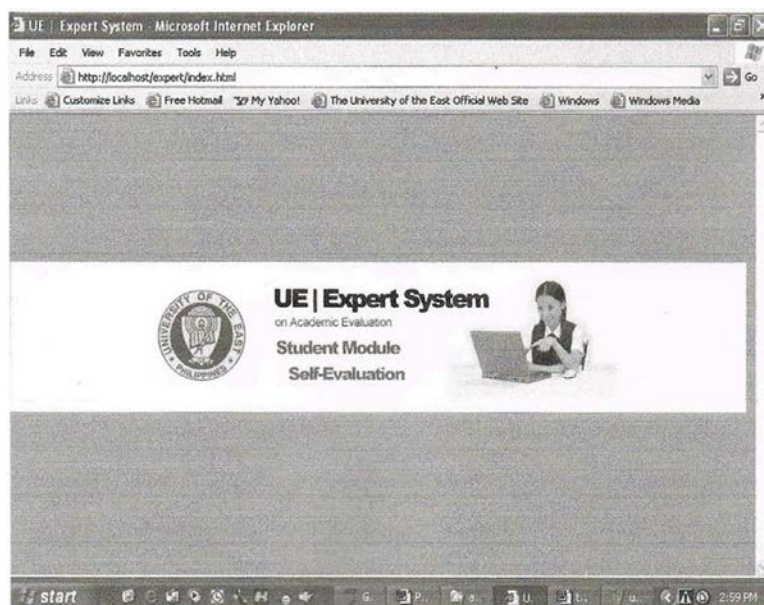


Fig. 3: Home Screen of the Proposed Expert System for Academic Evaluation

Limited Personnel: The number of college evaluators is not adequate to do evaluation proceedings which cause the delay of the evaluation result.

Inconsistent or Non-Standard Scheme of Evaluation: Evaluators, though experts in this field, are still human and can commit errors which turn out to unreliable evaluation result.

Slow Response: Evaluation is not readily available when needed. Request for evaluation must be filed first to the college evaluation section. The evaluation result is released after three (3) working days or a week.

Non-Validation of Transferees' Courses: There is no current system for validating the courses of the transferees. It is purely being managed manually as they presented their transcript of records during their visit.

The Developed Software: The proposed expert system for academic evaluation (Figure 3) is specifically designed to validate courses of transferees and shifters concept and to provide all students with the complete evaluation result in accordance to the current system/standard of the university on academic evaluation. Furthermore, it resolves the weaknesses of the current system. The end users of the system are UE students, the transferees and the individual college evaluators. The software can be accessed anywhere and anytime as long as a computer is linked to the Internet.

As shown in Figure 3, the proposed expert system prototype homepage shows the two (2) interface modules. The first module is the Student Module. This allows UE students and college evaluators glimpse the Form IX and Evaluation Viewer and print the academic evaluation result once the student enters his student number and password. Those candidates for graduation would be marked as such. A screen shot of Student Module is shown in Figure 4. (The name and student number of the student were hidden to protect the privacy of the student.)

The second module is the Self-Evaluation Module (Figure 5). It allows transferees to validate the courses they have taken from their former school by themselves. They will be informed about the courses credited before deciding to enroll in the UE-BSCS program.

The Self-Evaluation module includes the following features:

Information Entry: This includes capturing of student name, the course to be evaluated, from what school the course was taken and the school grading system.

Course Entry: It is necessary for the transferees to enter the precise data on their transcript of record or the earned courses for validation. Entries include the course code, the course title/description, the units and the grade. Entries are automatically deleted as the user change module or close the program. Users are, therefore, advice to print their CGEL and the copy of encoded grades so as to have bases for their transfer process.

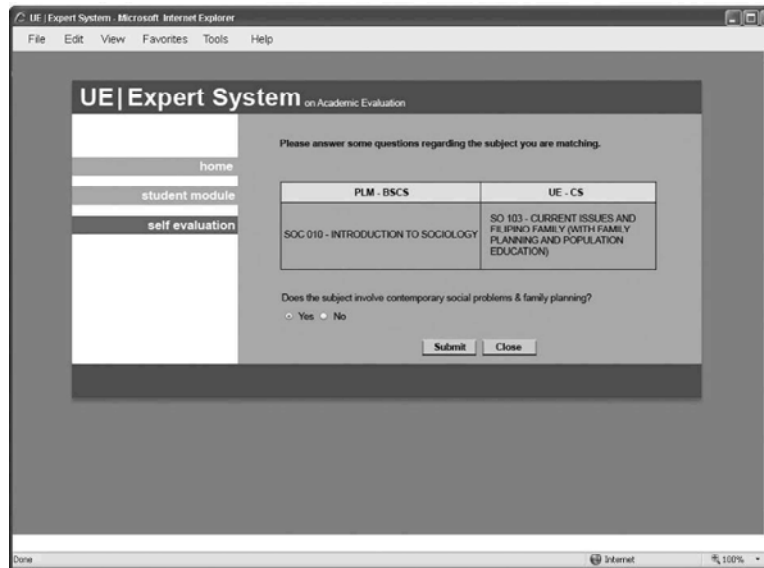


Fig. 4: A Student Module

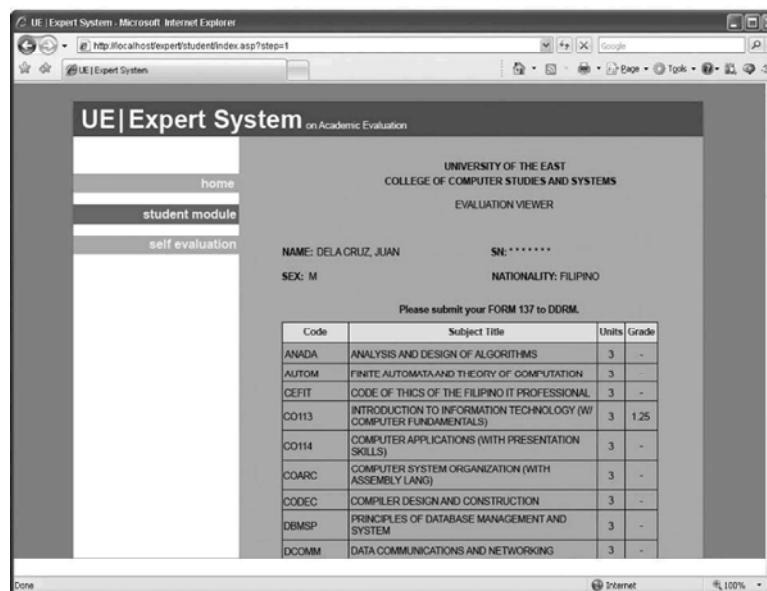


Fig. 5: Self-Evaluation Module

In both modules, the college evaluator is permitted to do the evaluation on behalf of the students. Likewise, students would be advised on the possible courses.

Only registered users have an access with the system. This allows privacy and security of data. The college evaluators and UE students are the only users of the Student Module. On the other hand, anyone who is interested to self-evaluate his course for validation can access the Self- Evaluation module. Computer Generated Reports, the CGEL and CGSAL and copy of grades of transferees, can be viewed and printed for users' copy.

Difference between the Numbers of Units Evaluated by the College Evaluator and by the Proposed Software:

The proposed expert system prototype is tested based on the number of units computed as examined and compared to the results of the evaluator using the current system for academic evaluation. A big percentage of student population is not considered because the process done in one student is basically the same with all the rest of the students. Furthermore, the student records are already kept in the database and not as input data. Hence, ten (10) test data is sufficient and this is utilized for the test run.

Table 2: Test Data for Student Module

Student	Earned Units Plus In-Progress Courses	Total Units Computed by the Evaluator	Total Units Computed by the Expert System
1	176	176	176
2	133	133	133
3	112	112	112
4	88	88	88
5	42	42	42
6	67	54	54
7	89	67	67
8	160	142	142
9	136	133	133
10	54	48	48

Table 3: Table of Difference between the Number of Units Credited by the College Evaluator and the Expert System

Group	Mean	Difference (d)	t-value	df	Sig.
Evaluator	35.81	0.00	0.00	84	1.00
Expert System	35.81				

As can be seen in Table 2, all units computed by the proposed expert system are the same with the computation of the college evaluator. This finding reveals that the developed software is capable of computing efficiently the total units earned by the students. It also serves as a counter-check to the computation of the evaluator.

Meanwhile, Table 3 shows the table of difference between means of units credited by the evaluator and by the proposed expert system. It shows that the proposed expert system turns out to have the same results with that of the evaluator. The difference between the total units computed by the evaluator and by the proposed expert system is zero (mean = 35.81, d = 0, t-value = 0.00, df = 84, p -value > 0.05) for all test data which proves that the proposed expert system is accurate and reliable for it totally emulates the knowledge of the expert (i.e., the evaluator).

The findings discussed above showed the strengths of the proposed software. It is shown that the acquisition of academic evaluation of students could be done by the students themselves. In order to execute the requests, the software logically matches course equivalent, observe courses priority and prerequisites, free electives and the maximum number of units to be credited by the university. Therefore, the accuracy of evaluation results, CGEL and CGSAL are ascertained.

CONCLUSIONS AND RECOMMENDATIONS

Based on the findings presented, it was revealed that the developed software could compute the total number of units effectively. It was also shown that the null

hypothesis (H_0) stating that there is no difference on the units computed between the current system and the proposed expert system is accepted. Thus, it can be concluded that the proposed expert system for academic evaluation addressed the current system's weaknesses. It also provided a standard scheme of evaluation for the reason that the expert knowledge is intact, consistent and objective.

The proposed expert system for academic evaluation proved to be very useful in delivering valuable information to the students within or outside campus in terms of academic evaluation. Hence, it would support the university in its implementation of cost cutting measures.

In consequence, the proposed expert system for academic evaluation is highly recommended for possible adoption to all universities and colleges specifically at the University of the East. The implementation of the system would attract incoming freshmen or transferees to enroll considering the education delivered by the school in utilizing the technology that is prominent globally.

Furthermore, it is recommended that further study be conducted considering validation of CHED courses, all offered courses in the University and courses of the degree holders. Lastly, it is recommended that data entry through scanning of transcript of record be considered.

ACKNOWLEDGMENTS

The authors are greatly indebted to the University officials, Bert Sarzata, Thess L. Toribio, Rex P. Bringula, Rea Aborot, Sean Amador and to all those respondents of the study. This paper is partly funded by the University of the East.

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