On the Design and Development of WEBSEE: A Web-based Senior Exit Exam for Value-added Assessment of a CIS Program

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ABSTRACT

Higher education institutions are becoming increasingly engaged in assessing their programs in order to enhance student learning outcomes. States, accreditation bodies and various organizations are calling upon institutions to buildup their accountability towards student learning. Accordingly, multiple assessment methods (both direct and indirect) are being used to gather program assessment data. The paper outlines the framework that has been undertaken to design and implement a Web-based Senior Exit Exam (WEBSEE). This exam is being used as a major direct assessment instrument for an undergraduate program in Computing Information Systems (CIS). The assessment framework is deemed important to enhance the validity of the exam, making it more appropriate for measuring what it tries to measure. The paper also shares some guidelines that have been used to generate reliable and valid exam questions which are directly mapped to program outcomes. The exam questions have been designed to span across a range of IS knowledge areas, knowledge depths and difficulty levels. Our research also outlines the importance to integrate the exit exam in the credit-bearing curriculum to drive students' learning through motivation. The assessment data collected has uncovered some deficiencies that when addressed will help improve student learning. The collected data will also be used as a reference baseline to historically track achievement of program outcomes over the next semesters. The approach and research methodology presented in this study can be useful for IS departments planning to administer similar kind of locally-developed exit exams in future.

Keywords: Assessment, Senior exit exam, Major field test, IS education

1. INTRODUCTION

Since the late-1980s, with the emergence of the so-called "assessment movement", there has been a growing need for IS departments to develop comprehensive assessment and continuous improvement plans for their programs. This requisite has also been stipulated by accreditation bodies such as ABET (www.abet.org) and AACSB (www.aacsb.edu) which require that institutions use a documented process incorporating relevant data to regularly assess their educational objectives and program outcomes, and to evaluate the extent to which these are being met. The business community, as well as national and international organizations, has also called on higher education to increase its "accountability" (Schneider, 2002). For this purpose, many IS departments today are allocating resources and are engaging various stakeholders to design and implement formalized program assessment processes. An assessment process is an ongoing cycle that typically consists of three main steps, namely planning, implementation / monitoring, and continuous improvement. In the planning phase, Program Educational Objectives (PEOs), corresponding expected Program Outcomes (POs), and assessment instruments are articulated (Martell and Calderon, 2005). In the second phase, the assessment instruments are used to collect assessment data, which is subsequently analyzed. Actual outcomes are also compared with expected outcomes and results are disseminated. Finally, the continuous improvement phase will close the assessment loop by developing a list of program strengths and weaknesses and by introducing the appropriate changes in curriculum design, teaching methods and/or program objectives. These changes are also used as a feedback mechanism for the next planning phase.

A key step in the program assessment process is the establishment of formal assessment techniques to measure POs. These techniques can provide answers the classical question “What do our students know, and how can we prove that knowledge has been gained?” (Buzzetto-More and Alade, 2006). For this purpose, IS departments have been experimenting with various assessment instruments, both direct and indirect. Direct assessments provide for the direct examination or observation of student knowledge or skills against measurable program outcomes. These can provide evidence that students can demonstrate knowledge or a skill that is directly linked to specific performance criteria that define the program outcomes. Indirect assessments tools, on the other hand, ascertain the perceived extent or value of learning experiences. They usually assess opinions or thoughts about student knowledge or skills and are subject to self-bias. As evidence of student learning, indirect measures are generally not as strong as direct measures. As a result, accreditation bodies are paying special attention to evidences in using direct assessment instruments to help identify and implement program improvements.

Among the direct assessment instruments, the usage of the senior exit exam (known also as Major Field Test or MFT) has received considerable attention since it has the potential to provide a direct measure of student learning. Further, senior exit exams enable summative evaluation for judging the worth of a program at the end of the program activities. This is opposed to formative evaluation for judging the worth of a program while the program activities are forming (in progress). While formative assessment methods focus on process, the summative methods, including senior exit exams, on the other hand focus on outcomes by checking if the objectives have actually been met and by judging the value or worth of these objectives (Kirkpatrick, 1994). Figure 1 highlights our process flow of using the senior exit exam as a tool to assess the extent to which Program Outcomes (POs) are being met.

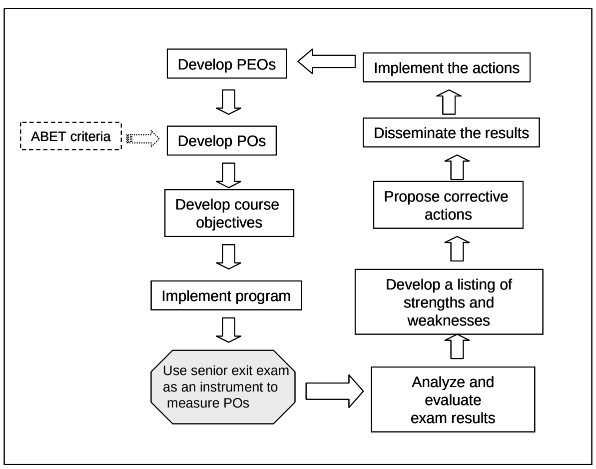

Figure 1. Using Senior Exit Exam to Assess POs

In addition to their usage as instruments to measure students' achievement of expected outcomes at the conclusion of their major, senior exit exams provide departments with:

- Record of substantiated and documented evidence of performance and continuous improvement over time for program accreditation purposes;
- Feedback on students' cumulative gains in learning specific knowledge/skill areas. This can pinpoint which learning material students have and have not mastered, and which material still causes them difficulty. When fed back into the curriculum, such findings can further improve teaching effectiveness (Reynolds et al, 2004);
- Input to review, assess and refine the existing curriculum; and
- Opportunity to track students' achievement over a complete assessment cycle and monitor progress.

Senior Exit exams are also being used by graduate school admission offices and fellowships organizations to assess the qualifications of applicants in specific fields of study. They also provide students with immediate feedback on their cumulative acquired knowledge.

The above advantages, in addition to our ongoing involvement with the ABET accreditation of our CIS program, have motivated us to develop and administer a senior exit exam to all final year students registered in the CIS program, prior to graduation. In doing so, we had two choices: either identify a nationally or internationally recognized exam or develop a local test internally. Though specialty tests, developed by organizations such as the Graduate Record Examinations (GRE) Board and the Educational Testing Service (ETS), are available in many areas such as business and computer science, standardized tests for IS curricula are scarce. To date, the only standardized test for IS programs, which we are aware of, is the Information Systems Analyst (ISA) exam, developed by the Center for Computing Education Research (CCER) (http://www.iseducation.org/isadmin/). However, taking into account our unique curriculum-specific courses and associated objectives, we have opted in this first phase to develop a local exit exam, which is customized to our program objectives. In the next phase, we plan to conduct a pilot study to experiment with the ISA exam and explore how it can be used to complement our locally developed exam for the purpose of program assessment. Developing a customized exit exam will enable us to directly match the exam questions to our own CIS program outcomes. Obviously, with this decision, we had to incur the cost associated with the planning, development and maintenance of the locally developed exam. Fortunately, the major time investment occurred this year, as we expect very minor changes in the exam questions for the three years remaining in the current assessment cycle.

2. RESEARCH METHODOLOGY

This section outlines the methodology that has been followed in the design and usage of WEBSEE as a direct assessment instrument for learning outcomes. Our general methodology is inspired by the steps of quality assessment process, as outlined for instance by Parker et. al (2001). These four steps consist of:

- Developing guidelines in the design of WEBSEE such that it serves the purpose of assessment. We have designed WEBSEE based on an outcome-driven approach, as it is likely to lead to increased learning (Diamond, 1998). In particular, we have mapped WEBSEE questions to specific program outcomes for the purpose of assessment.
- Designing assessment methods, based on appropriate criteria in order to provide a sense of direction and communicate expectations to students.
- Collecting information about students' performance in the exam and using the results to evaluate the extent to

which students are successful in achieving program outcomes.
- Reporting and disseminating assessment findings, including strengths, areas of improvements and insights.

2.1 WEBSEE Knowledge Areas

Each WEBSEE question has been designed to relate to one of the 8 knowledge areas shown in Table 1, below. These areas are tightly coupled to the core knowledge areas covered in the 2002 IS model curriculum (Gorgone, et al. 2002).

Table 2 highlights the mapping between the 8 knowledge areas depicted above and the "participating" courses from our CIS program.

2.2 Mapping WEBSEE Questions to Program Outcomes

An important design aspect of WEBSEE was the need for a solid framework to enhance the validity of the exam, making it more appropriate for measuring what it tries to measure. For this purpose, since the main objective of WEBSEE was to provide a direct measure to assess the degree to which expected program outcomes are being met, the exam questions have been developed so as to cover most of these POs. Our CIS program outlines nine expected POs, as shown in Table 3.

Since the above POs are the results of the college's PEOs, then the success of the CIS program in fulfilling its educational objectives can be assessed by the degree to which the intended outcome of each objective is being achieved. The mapping between WEBSEE questions, the POs (a-i), the eight knowledge areas (1-8) and the individual course objectives is shown in figure 2, below. As may be seen, though the use of WEBSEE is geared towards assessing specific program outcomes as opposed the specific course objectives, it is always possible to trace assessment results back to specific course objectives. The department has developed a questions-to-program outcome matrix, highlighting which WEBSEE questions contribute to which program outcomes, as indicated in Table 4. Note that PO ***f*** (Communicate effectively with a range of audiences) is not assessed by the exam.

Knowledge Area	% of Questions
1. Fundamentals of IS (IS concepts, IS management, IS in organizations, IS planning and strategic use)	**15 %**
2. System analysis, design and development	**15 %**
3. Programming fundamentals (including data structures, algorithms, object-oriented programming and web development)	**15 %**
4. Information management (databases, data modeling, relational models)	**15 %**
5 Networking (including network security)	**10 %**
6. Business and management	**10 %**
7. Quantitative analysis & discrete mathematics	**10 %**
8. Others (critical thinking, global, economic, social, professional and ethical issues of IS)	**10 %**

Table 1. Knowledge Areas Covered by WEBSEE

	Knowledge Area	CIS courses
1.	Fundamentals of IS	Introduction to Information Systems, Strategic Issues in IS
2.	System analysis, design and development	Systems Analysis and Design, Software Project Management
3.	Programming fundamentals	Internet Applications, Introduction to Programming, OOP, Web Design and Development
4.	Information management	Database Management Systems
5.	Networking	Principles of Networking, IS Security
6.	Business and management	Management and Organization Behavior, Principles of Marketing
7.	Quantitative analysis & discrete mathematics	Quantitative Methods for Business, Math for Science I & II, Discrete Mathematics
8.	Others (critical thinking, global, economic, social, professional and ethical issues of IS)	Critical and Creative Thinking, Introduction to Information Systems, Strategic Issues in IS

Table 2. Knowledge Areas & Corresponding Participating Courses

a	Apply knowledge of computing, information systems and mathematics.
b	Analyze an interdisciplinary IS related problem, identify and define the computing and information systems requirements appropriate to its solution
c	Design, implement and evaluate a computer-based system, process, component, or program to meet desired needs.
d	Function effectively in teams to create a project plan to accomplish a common goal.
e	Understand professional, ethical and social responsibilities.
f	Communicate effectively with a range of audiences
g	Analyze the impact of computing on individuals, organizations and society, including ethical, legal, security and global policy issues.
h	Use current techniques, skills, and tools necessary for computing practice.
i	Understand the processes that support the delivery and management of information systems within a specific application environment.

Table 3. CIS Program Outcomes (a-i)

For instance, from table 4, we can see that PO g (Analyze the impact of computing on individuals, organizations and society, including ethical, legal, security and global policy issues) is being assessed by questions 6.5, 6.6, 8.1 and 8.2. For the purpose of assessment and for simplicity, we have also assumed that each question (mapping to given PO) contributes with an equal weight.

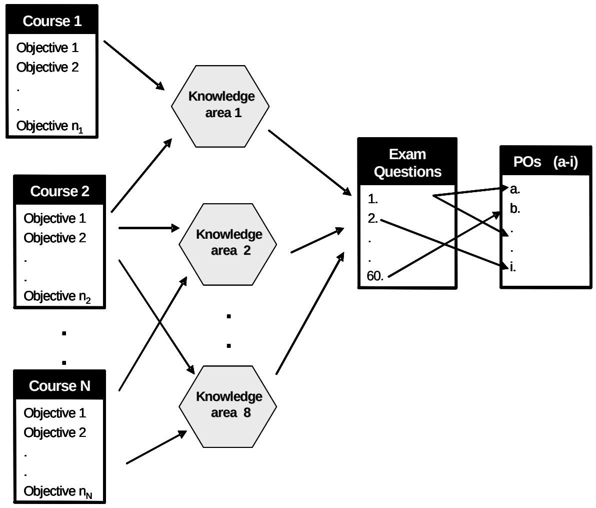

Figure 2. Mapping WEBSEE Questions to POs (a-i)

2.3 WEBSEE Knowledge Depth

It was important to design WEBSEE questions so that they go beyond testing student ability to recall accumulated knowledge, to cover other areas such as (1) demonstrating mastery of concepts related to the core knowledge areas of the 2002 IS model curriculum (Gorgone, et al. 2002), (2) applying significant concepts, theories and frameworks, and (3) analyzing and solving problems. In addition, to embrace some of the principles of value-added assessment, it was important to design questions that probe outcomes which are considered important for proactive participation in the economy (Schneider, 2002).For this purpose, WEBSEE questions were also designed to probe student ability to (1) translate skills and knowledge to new domains and new kinds of problems, (2) take context and contingencies into account in resolving problems, (3) integrate learning from different contexts, and (4) take others' views productively into account in solving real world problems (Schneider, 2002). Further, in our case, the depth of knowledge metric used is based on three levels, which are traceable to Bloom's (1984) six level hierarchy of educational objectives. As shown in figure 3, the three levels consist of knowledge and comprehension, application and analysis and synthesis and evaluation (Ekstrom et.al, 2006). The knowledge depth metric is used to give a sense of direction in writing the questions and to communicate expectations.

According to Wright (2004), it is important that assessment goes beyond probing students' knowledge (imbedded into the lowest layer in figure 3) to cover higher aspects that reflect the learner-centered outcomes of an academic program, such as critical thinking skills, and ability to make choices based on reasoned arguments. These are reflected in the upper layer in figure 3. As objective tests,

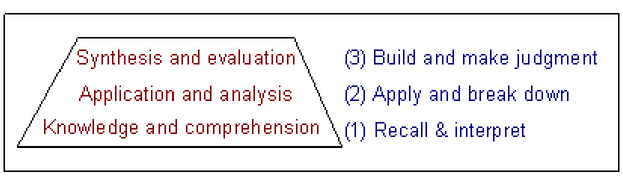

Figure 3: Three-level Knowledge Depth Hierarchy

Subject Areas	a	b	c	d	e	g	h	i
1. Fundamentals of IS								
Questions 1.1-1.3, 1.5-1.6 & 1.8								✓
Question 1.4	✓							
Questions 1.7, 1.9	✓							✓
2. System Analysis & Design								
Questions 2.1, 2.4, 2.6-2.7 & 2.9		✓						✓
Question 2.2								✓
Question 2.3			✓					
Question 2.5		✓						
Question 2.6		✓		✓				✓
Question 2.8	✓							
3. Programming Fundamentals								
Questions 3.1-3.5 & 3.8-3.9	✓		✓				✓	
Questions 3.6-3.7	✓							
4. Information Management								
Questions 4.1-4.9			✓					
5. Networking & Communications								
Question 5.1	✓	✓					✓	
Question 5.2	✓							
Questions 5.3, 5.5								✓
Questions 5.4, 5.6	✓							✓
6. Business & Management								
Question 6.1				✓				✓
Questions 6.2-6.4								✓
Question 6.5						✓		
Question 6.6						✓		✓
7. Mathematics & Quantitative Analysis								
Questions 7.1-7.6	✓						✓	
8. Others								
Questions 8.1-8.2					✓	✓		
Questions 8.3 & 8.5					✓			
Question 8.4				✓	✓			
Question 8.6								✓

Table 4. Questions to Program Outcome Matrix

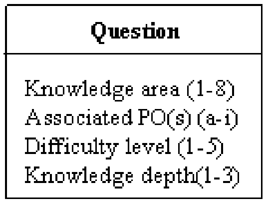

Figure 4. WEBSEE Question Attributes

Multiple Choice Questions (MCQs) and its variants can be properly developed to test all the three learning levels depicted in Figure 3 (McBeath, 1992). Accordingly, the questions' difficulty level ranged from quite easy, easy, moderate, difficult, to fairly difficult. With this in mind, each WEBSEE question has four main attributes, as shown in figure 4, below.

2.4 Exam Construction Process

WEBSEE was designed to cover sixty multiple-choice questions (MCQs) and its variants (including matching and assertion-reason questions). We also decided not to extend the exam period beyond two hours, since doing so will probably expose students to eyestrain and boredom (Catteral and Ibbotson, 1995).

While using MCQ questions has many advantages, including versatility in covering several topics, non-subjective automated marking, and significant cost savings, it is being criticized for its low reliability due to random effects such as guessing (Burton, 2001), and lack of authenticity which discourages higher order thinking and promotes surface learning (Wiggins, 1990; Paxton, 2000). We have attempted to address some of these limitations in the design of WEBSEE, as summarized below. This however required additional load on faculty to construct good and reliable questions that aim to probe higher-order thinking.

First, to provide a strong credibility to WEBSEE assessment results as direct indicators of learning outcomes, it was very important to engage all faculty members in the design of the exam questions and specifications. The authoring and validation of high quality MCQ questions required a considerable amount of time, compared to generating descriptive written exams. It was even harder to generate good questions with appropriate distracters to assess higher order cognitive skills that go beyond knowledge and comprehension. We have consulted the pertinent literature (such as Park University faculty resources quick tips (http://www.park.edu/cetl/quicktips/multiple.html) and the references cited therein) for general guidelines and best practices in developing well constructed multiple-choice questions that are clear, reliable and valid. To further validate the questions, we have also sought the unbiased second opinion of an external IS specialist.

Second, several design considerations were imbedded into WEBSEE in order to minimize the effect of random guessing which would contaminate the assessment results. We have raised the number of choices in each MCQ from 4 to 5. Clearly the higher the number of distracters, the less likely it is for the correct answer to be guessed (providing all alternatives are of equal difficulty). For instance, if all the answers are selected randomly, and independently from question to question, then the students' scores will follow Binomial distribution. The corresponding probability mass function, depicted in Figure 5, clearly shows that with 60 questions, each consisting of 5 choices, the effect of random guessing is not significant.

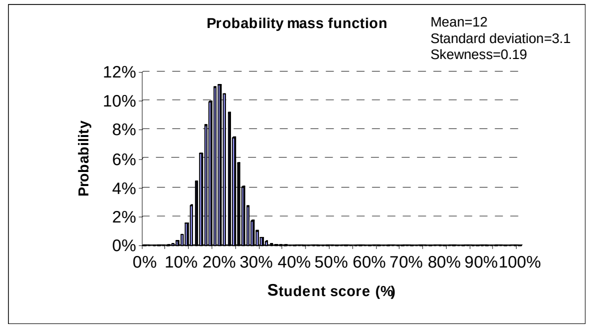

Figure 5. Probability Mass Function of Student Scores with 60 Questions & 5 Choices per Question (Assuming Random Guessing)

Third, we have envisaged the option to implement negative marking as a corrective scoring technique against guessing. With negative marking, students are not penalized for skipping a question, but they do get penalized for providing wrong answers. The option to implement negative scoring strategy in the exit exam was debated among faculty members because of its potential undue psychological impact on students (Brown, 2001). The majority was against such practice, since it was felt that having 5 choices in each question would be enough to protect against score inflation due to guessing. It was finally decided not to use corrective scoring for the moment, though WEBSEE will support this feature as an option which is disabled by default. This is also inline with the recommendation of Valenti et. al (2002), which suggested that a Test Management System (TMS) should support both regular as well as negative marking schemes.

Fourth, in addition to standard multiple-choice questions, we have also included other variants of MCQs, such as Matching Questions (MQs) in which students need to match a series of stems or premises to a response or principle and Assertion-Reason Questions (ARQs). ARQs combine elements of multiple choice and true/false question types, and allow a higher level of reasoning. A typical ARQ consists of two statements, an assertion and a reason. The student must first determine whether each statement is true. If both are true, the student must next determine whether the reason correctly explains the assertion. Williams (2006) conducted an experiment that showed that, when appropriately structured, ARQs can be better substitutes for MCQs, in the sense that they promote higher-order thinking that goes beyond recall on the part of students. The study also suggested that ARQs expose students to a higher intellectual challenge than traditional MCQs, allowing students to identify relationships and explore cause and effect. Statistical analysis also showed that ARQ test performance was good predictor of student performance in essays; the assessment instrument of choice to probe reasoning and deep learning (Connelly, 2004). Since students were not familiar with ARQs, it was important to conduct a short training session to help them become comfortable with this type of question format. Samples of WEBSEE ARQs and MQs are provided in Appendices A.1 and A.2, respectively.

According to Wiggins (1990), there are great advantages in making assessment authentic or based on real world simulation. As a result, we have incorporated many questions in WEBSEE to assess students' abilities to apply learning into realistic scenarios (see sample question in Appendix A.3).

The current intent is to 'freeze' most of WEBSEE questions for the next three years, so as to provide a full assessment cycle for the department to collect comparable historical data and monitor progress. We have also allowed a maximum of 15% of these questions to be changed over the course of the current assessment cycle, to accommodate for potential replacement of questions that reveal to be inappropriate or to accommodate for minor changes in the program itself. In that case, all proposed changes will undergo another round of revision.

2.5 Post Validating the Exam Questions

Despite all the efforts and precautions taken to construct valid and reliable MCQs, one can always anticipate some flaws in the process. As a result, a post validation of exam questions was deemed necessary. Two performance metrics have been used for this purpose, namely facility and selection frequency (Brown, 1997). Facility measures the difficulty level of a given question. It is defined as the ratio of the number of correct answers divided by the total number of students who took the exam. Questions having a facility above 0.9 (low difficulty level) or below 0.2 (high difficulty level) are flagged for re-examination. Selection frequency is defined as the ratio of the number of times a given distracter has been selected divided by the total number of students who answered the associated question. Again distracters with zero frequency are automatically flagged for potential substitution.

2.6 Setting-up Benchmark Indicators

To enable WEBSEE to provide a direct measure of actual achievement of expected learning outcomes it is important to outline a benchmark indicator to check if POs are successfully met. In our case, for each PO, we have set an over-all mean score of 60% as the minimum benchmark indicator of successful achievement. Accordingly, assessment data related to the percentage of students achieving a program outcome with at least 60% ("passing rate") is used to evaluate the degree to which this outcome has been met. In the absence of national/international comparative exam scores, we will be mostly interested to know how would the test scores of a given exit exam compare to those of previous exams administered during the same assessment cycle. Any improvements made in this regards will be satisfactory, while negative historical trends would require further investigation.

3. INTEGRATING WEBSEE IN THE CIS CURRICULUM

Like other departments, administrating similar kinds of exit exams, we were faced with various alternatives to induce students to take the exam seriously. This is very essential, given that the exam results are used as direct measures of meeting program outcomes. One option was to make the exam a mandatory requisite for students' graduation without dictating a 'pass' criteria (Brandon and Wade, 2002). A second option was to prescribe a minimum score in the exit exam for students to graduate. A third option was to reflect the exit exam score (along with the associated percentile rank) in the student transcript. Another option was to integrate the exit exam in the capstone course and incorporate the student exam grade in the over-all grade of this course. We opted for the last option and made the exit exam account for 20% of the capstone course final grade.

The above decision is consistent with the attributes of an effective value-added assessment, which according to Schneider (2002) must be embedded within credit-bearing courses, and has weight in determining student grades. The rational behind this decision is triggered by our desire to provide the highest incentive for students to take the exam seriously; especially that the capstone course is the only six credit-hours course in the curriculum. According to Schneider (2002), there is strong evidence that graduating seniors will not apply their best efforts to an assessment that does not count. Many won't even take it at all. Further, since the exam "sweeps" on skills and knowledge accumulated over the course of the program, we also wanted to send a strong message to existing and new students that cramming by trying to memorize few days or weeks before the exit exam will not generally pay-off. By doing so, we are hoping to further sensitize students to become life-long (as opposed to surface) learners, taking more responsibility for their own learning and use WEBSEE as an assessment tool to drive students' learning through motivation (Race, 1995). This is also aligned with the concept of "Assessment backwash" (Biggs, 1999), which stipulates that student learning is largely determined by the assessment and not by the teaching or the official syllabus (Zepke, 2003, Bostock, 2004, Roberts, 2006, Brown et al, 1997). Bishop (1998) also observed that when only a pass-fail grade is generated by an exit exam test, many students pass without exertion and therefore are not stimulated to greater effort by the reward of passing.

4. RESEARCH FINDINGS AND DISCUSSIONS OF RESULTS

This section discusses the detailed assessment results of the senior exit exam, administered to 41 students who were registered in the spring's 2007 capstone course. Due to the lack of time needed to conduct a thorough validation of WEBSEE software specifications, it was decided at that time to administer the exam in a paper and pencil format. The main assessment results are summarized in table 5, below. For each assessed PO, the second column outlines the "pass-rate", while the third and fourth columns show the statistical averages and standard deviations of students' scores, respectively. As may be seen, the "pass-rates" varied from 9.8% to 53.7%. These were deemed below the department's expectations. Students' average scores in each PO also varied from 38.7% to 54.9%. These are again not sufficiently high, as we were expecting an average of at least 60% in each assessed PO.

Program Outcome	PR	AVG	SD
(a) Apply knowledge of computing, information systems and mathematics.	**19.5%**	**43.8%**	**15.8%**
(b) Analyze an interdisciplinary IS related problem, identify and define the computing and information systems requirements appropriate to its solution	**17.1%**	**43.5%**	**15.9%**
(c) Design, implement and evaluate a computer-based system, process, component, or program to meet desired needs.	**17.1%**	**45.3%**	**19.3%**
(d) Function effectively in teams to create a project plan to accomplish a common goal.	**31.7%**	**39.0%**	**28.8%**
(e) Understand professional, ethical and social responsibilities.	**53.7%**	**53.2%**	**24.3%**
(g) Analyze the impact of computing on individuals, organizations and society, including ethical, legal, security and global policy issues.	**36.6%**	**54.9%**	**24.5%**
(h) Use current techniques, skills, and tools necessary for computing practice.	**9.8%**	**38.7%**	**17.1%**
(i) Understand the processes that support the delivery and management of information systems within a specific application environment.	**31.7%**	**49.8%**	**14.3%**
PR = "Pass Rate". This is percentage of students achieving a program outcome with at least a 60% average AVG = Over-all average. This is the arithmetic mean of students' scores related to a given program outcome SD = Standard Deviation			

Table 5. Summary of Students' Achievement in Each PO

To further probe the most troublesome questions and to assist course-coordinators take the appropriate remedial actions, we plot in figure 8 the students' mean scores in each of the sixty questions. These have been organized according to the corresponding eight knowledge areas. These statistics were deemed very useful in assisting course coordinators and instructors scrutinize problem areas and continually improve their course delivery. It was also instructive to track the extent to which each individual student has achieved each program outcome. This is illustrated in figure 9.

Statistical data to post-validate the exam questions were also generated. Figure 6 illustrates the "facility" metric of each WEBSEE question, which reflects the corresponding difficulty level, as discussed in section 2.5. Note that only one question (number 47) had a facility above 0.9 (low difficulty level); while questions 2, 12, 22, 49 and 50 had facilities below 0.2 (high difficult level). These questions will be re-examined in future. In addition, the "selection frequency" of each distracter, as previously defined in section 2.5, has been computed. Twenty-five distracters with zero selection frequency have been spotted as shown in table 6. Since these distracters have never been selected, they will be replaced by better substitutes in future.

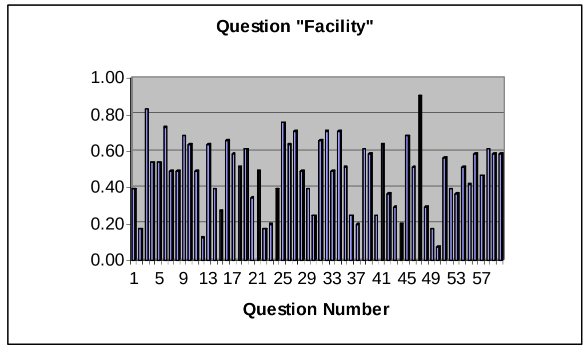

Figure 6. WEBSEE Question "Facility"

Question No.	3	6	10	12	16	17	20	25	31	34	35
Distracter(s)	d & e	a & d	a	a	a	a	e	c	b	a & e	a

Question No.	36	38	39	41	45	47	51	47	51	55	59
Distracter(s)	c	c	e	d & e	a & d	a	a	a	a	a	e

Table 6. Distracters Tagged with Zero "Selection Frequency"

We were also interested to know if the students' performance in the exit exam is an indicator for their cumulative academic performance, as reflected by their CGPA. For this purpose, we plot in figure 7, each student mean score against the corresponding CGPA. The correlation analysis shows a correlation factor of 0.72. This seems to indicate that there is a strong correlation between students' CGPA and their performance in the exit exam results. Students with high CGPA tend to outperform the remaining students. This is clearly indicated in figure 7. Also note the clustering of data points in the region corresponding to CGPAs between 2 and 2.3 & average scores between 25% and 55%. This also suggests that this category of students needs more support in terms of better advising and class-assistance.

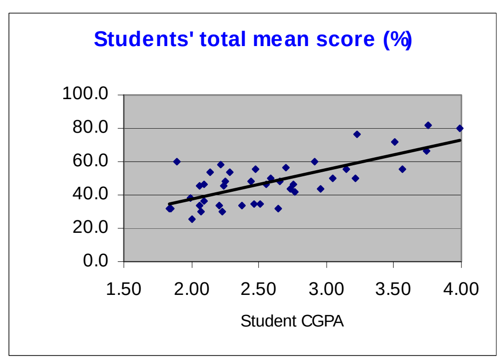

Figure 7. Relationship between Student Performance and CGPA

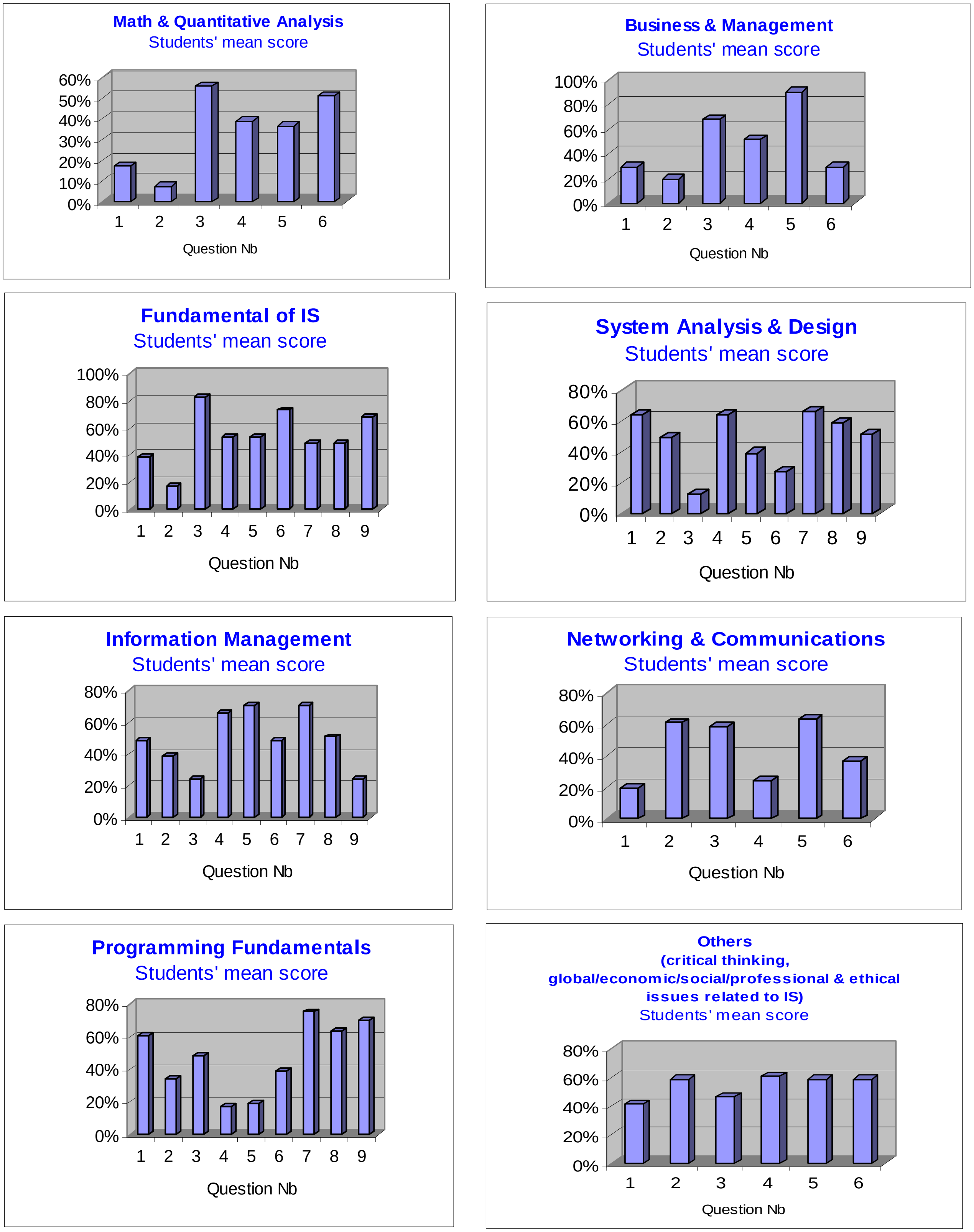

Figure 8. Students' Mean Scores across the Eight Knowledge Areas

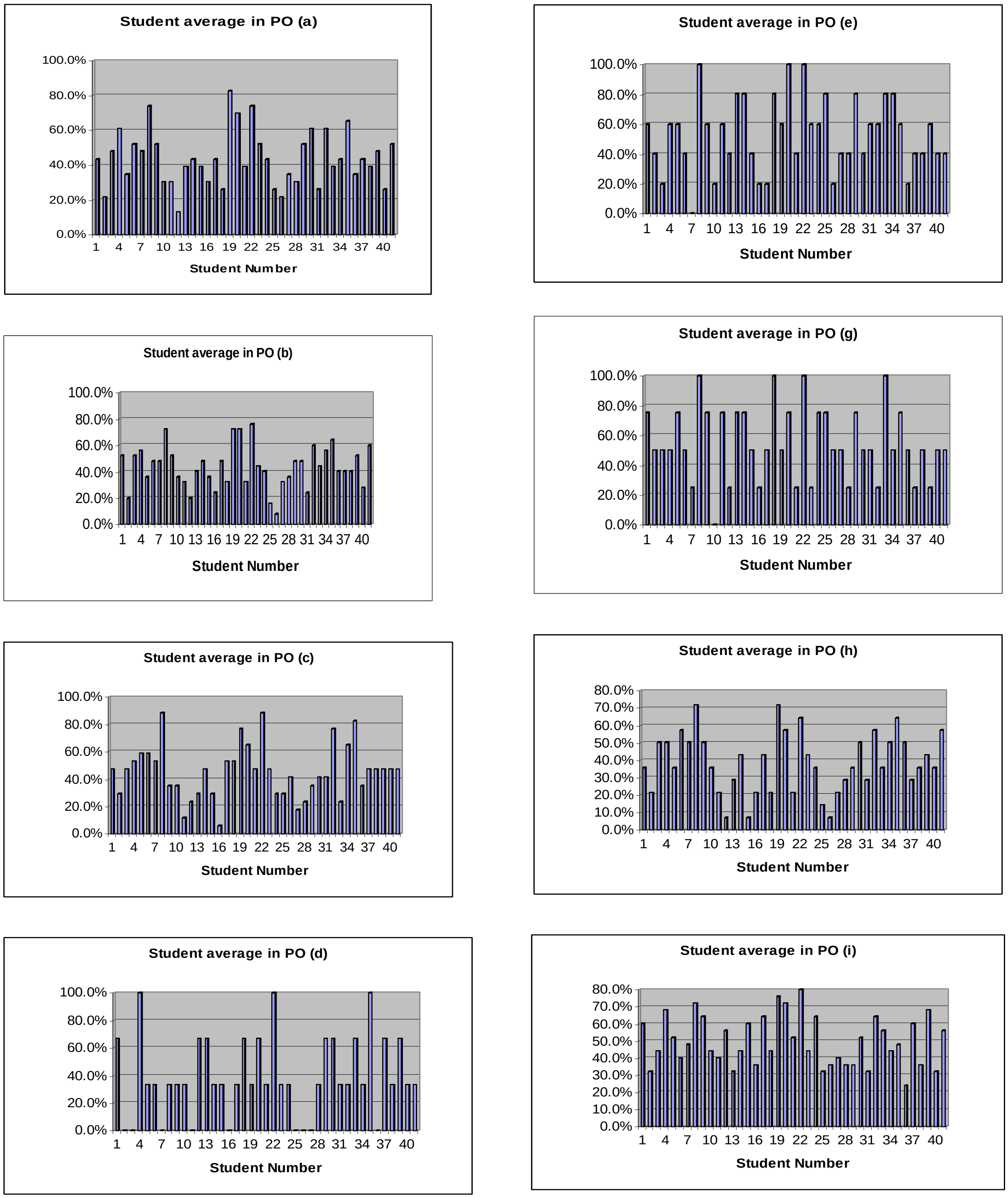

Figure 9. Students' Mean Scores across Various POs

Though the above assessment results were below expectations, it was more important to use these results for the purpose of continuous improvement. This will enable us to close the assessment loop (Maxim, 2004) by the end of the current assessment cycle, as reflected earlier in figure 1. We will also use the above results as a baseline against which we can benchmark students' performance over time.

WEBSEE has been instrumental in highlighting a list of potential deficiencies in program delivery, which can be traced back to individual courses in the curriculum. In accordance to the process flow of figure 1, the department assessment committee has compiled an assessment report to summarize the main findings of the exit exam. A special faculty council meeting was held to discuss the assessment findings and propose an action plan for future improvement. For each assessed program outcome, an action plan related to specific courses in the curriculum is outlined. The plan also specifies the date of implementation, as well as the people responsible for its execution. A sample action plan for program outcomes b and c is shown in table 7, below.

PO	Action Plan
b	***b.1*** ***Systems Analysis & Design*:** Reemphasize to students the different nature and distinct purpose of decision tables, DFDs and ERs diagrams. ***b.2*** ***Project Management*:** Among the skills to be developed in the course, emphasis should be on analysis skills, whereby students apply their learning to analyze a given simulated scenario and suggest solutions. Ensure that this is reflected in the course syllabus and incorporated in the course in the form of quizzes, tutorials and/or projects. ***b.3*** Extend the above recommendation to the ***Strategic Issues in IS*** course.
c	***c.1. Programming Fundamentals:*** - Provide more coverage for array structures. This action is expected to be facilitated by the adoption of Java as the programming language for the course, instead of VB.NET. - Also for next exit exam, edit the programming questions to remove any dependency on specific programming language (use pseudo code instead) ***c.2*. Database Management Systems**: Provide more coverage and examples related to unary many-to-many relationships in dBase relational models. Also include more examples and exercises on logical dBase design, including proper usage of primary and foreign keys.

Table 7. Action plan to further enhance POs (b & c)

The assessment committee also made a number of noteworthy observations based on WEBSEE assessment data. These are summarized below:

1. The majority of students who wrote the exam have CGPAs below 2.5/4. This can also explain some of the low scores recorded in the exam. The recent increase in the minimum admission requirement will potentially produce higher caliber graduating students.
2. Language barriers might have contributed to some of the low scores registered, as students who cannot fully understand the question are unlikely to get the right answer.
3. Students' relative weak performance in the Assertion Reason Questions (ARQs) might be attributed to their lack of exposure to such types of questions. The same thing applies to scenario-based questions which aimed towards probing higher-order thinking. These will be addressed starting Fall 2007/2008, based on the action items identified by the assessment committee.

5. IMPLICATIONS AND CONCLUSIONS

In this era of assessment and accountability, the usage of exit exams as a tool to provide a direct measure of a program becomes invaluable for IS departments. This research outlined a framework to design a senior exit exam for a CIS program. It shared the guidelines that have been adopted to generate reliable questions which are directly mapped to program outcomes. These questions have been selected to "sweep" a spectrum of knowledge areas, knowledge depths and difficulty levels. Such a meticulous selection could not be achieved without the direct involvement of all faculty members. Our research has also underlined the importance to integrate the exam in the credit-bearing curriculum in general and in the capstone course in particular.

The collected assessment data has pinpointed several discrepancies between students' actual achievement of program learning outcomes and the department's own expectations. Several actions have been taken to address some of these discrepancies. Most importantly, the collected data will be used as a reference baseline to historically track achievement of program outcomes over the next semesters. It is hoped that the corrective actions adopted this semester will address some the spotted weaknesses.

6. LIMITTIONS AND FURTHER STUDIES

Like many other empirical studies, this study is not without its limitations. The senior exit exam is just one (among the many other) assessment instrument that can be used to evaluate POs. It would be interesting to integrate the gathered WEBSEE assessment data with other assessment data (such as those coming from course-level assessments) to come up with a consolidated view of PO achievement.

One area of further study is to conduct a bi-serial correlation to investigate, for each assessed PO, the strength of the relationship between a given question and the score on that PO. This enables us, for instance, to investigate the extent to which the question is contributing to what the associated PO is trying to measure.

Another area of improvement we are currently working on is the enhancement of the report generation capabilities of WEBSEE. Our aim is to enable WEBSEE to automatically generate all the statistical reports described herein, without the need to export the assessment data to other spreadsheet applications for further processing. In-depth testing and validation of the software at the system level is also required, with a particular focus on robustness and security testing.

One more open research issue is to integrate WEBSEE into a more comprehensive assessment data management system that will capture the results of other assessment tools, generate comprehensive assessment reports and make these available online to various stakeholders (Dhir, 2005). The support for embedded multimedia options is also another area for further study. Incorporating multimedia, such as video clips, interactive graphics and Java applets, can be useful in simulating a scenario, based on which students are asked to answer some related questions. Enrichment of WEBSEE with other capabilities such as support for external hyperlinks and essay questions is also being investigated.

Another area of ongoing investigation explores the opportunities for joint partnerships with local institutions that offer similar CIS programs to cooperate in the development of a national external exit examination. This will have the additional advantages of providing cross-comparisons of achievement, across multiple national institutions. We are also planning to experiment with the CCER's ISA exam to gain new insights which would help us benchmark our students' performance across students in similar programs in other international IS schools.

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His main research areas include, scheduling problems and timetables, simulation and modeling,, and Information Systems Education. Professor Salim has been involved in many program outcome assessment projects at the College of Information Technology.

APPENDIX A
Samples of WEBSEE Questions

A.1. ARQ Question

Assertion Reason Question (ARQ):

Assertion:

IP is considered a 'reliable' protocol

because

Reason

TCP allows for the retransmission of lost packets, thereby making sure that all data transmitted is (eventually) received.

☐	**a**	**True, True, Correct reason**
☐	**b**	**True, True, Incorrect reason**
☐	**c**	**True, False**
☐	**d**	**False, True**
☐	**e**	**False, False**

A.2. Matching Question

Matching Question:

Match each of the following IS career title to its corresponding function/role:

1) Chief Information Officer (CIO)

2) Chief Technology Officer (CTO)

3) LAN administrators

4) Applications Programmer

5) Systems Analyst

a) Has a far greater involvement with the business aspects of the system and has far more to do with the people who will use the system and many of whom will have contributed to its design.

b) Set-up and manage the network hardware, software and security processes. Also isolate and fix operations problems.

c) Has the job of designing each program, coding it in an appropriate programming language, testing and fully documenting it.

d) Responsible for the corporate-wide policy making, planning, management and acquisition of information systems.

e) Typically works under a CIO and specializes in hardware and related equipment and technology

A.3. Scenario-based question

An IT company has 3 potential projects to consider this year. Managers of this company must decide which projects to pursue and how to define the scope of the projects selected for approval. The company has decided to use a weighted decision matrix to help in project selection, using criteria that map to corporate objectives.

You have been selected as part of the team to analyze proposals and recommend which projects to pursue. Your team has decided to create a weighted decision matrix using the following criteria , weights and scores:

Criteria	Weight %	Project 1 Score	Project 2 Score	Project 3 Score
1. Enhances new product development	20	10	20	25
2.Streamlines operations	20	20	10	40
3. Has good NPV	25	5	10	0
4. Has good pay-back period	35	40	30	35

Based on the above, which project will be selected?

a **Project 1**

b **Project 2**

c **Project 3**

d **Either project 1 or project 2**

e **Project 2 because it has the highest NPV**

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