Using Projects Scoring Rubrics to Assess Student Learning in an Information Systems Program

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ABSTRACT

This paper is about using projects for assessment of student learning in different courses of an Information Systems (IS) program. An overview of the role of educational projects in student learning is presented. The various aspects of defining standardized rubrics across an IS program are discussed. A methodology for the use of such rubrics in assessing student learning in interrelated courses is proposed and is illustrated by example involving two Information Systems courses.

Keywords: Information Systems Education, Rubrics, Project Assessment, Program Assessment.

1. INTRODUCTION

Assessment as a term refers to the processes used to determine an individual's mastery of complex activities, generally through observed performance (Ewell, 2002:9). The topic of assessment is gaining importance in the field of education (see Banta and associates, 2002; Heywood, 2000; and others) and in the field of Information Systems Education. Insights about the overall process of establishing program assessment in an IS program may be found in Petkova and Jarmoszko (2004), Stemler and Chamblin (2006), Aasheim et al. (2006) and White and McCarthy (2007). Assessment activities in the IS discipline have been boosted by the work of the Center for Computing Education Research (See McKell et al., 2006).

An overview of academic program assessment methods is presented in Palomba and Banta (1999). They group program assessment approaches into the categories of direct and indirect methods. Direct assessment methods include:

- Exams, with multiple choice questions, essays, problem solving using local or national instrument
- Performance measures (demonstrating student competence in one or more skills), including oral presentations, projects, demonstrations, case studies, simulations and portfolios
- Juried activities with outside panels rating student work
- Internships, national licensure or professional exams.

Indirect methods include:

- Questionnaires designed to provide proxy information about student learning
- Interviews
- Focus groups.

Selection of assessment methods across an academic program is a complex process and involves multiple criteria reflecting the goals of the assessment exercise and the existing constraints. Possible selection criteria are the ability of these methods to address the necessary assessment questions and the ability to provide useful information that indicates whether students are learning and developing in desired ways. Other relevant selection criteria are: reliability, validity, timeliness, cost, motivation of the students to participate and ease of understanding and interpretation (Banta and Associates, 2002; Stassen et al, 2001).

Petkova et al. (2006) discuss the implementation of the assessment process in an IS program including these activities: curriculum mapping and syllabus analysis, course-embedded assessment, portfolio assessment and performance appraisal. It is evident that these activities relate to methods which can be classified as direct assessment methods that are usually considered more objective and preferred to indirect methods. Course level assessment in an IS program is often left to the preferences of the individual professor and typically includes quizzes, home assignments, exams and a team project. At the program level, several assessment approaches are applicable including:

1. A student survey of IS knowledge and expectations or a direct entry level test at the start of the student's studies in the first specialized courses of the program.
2. A senior survey of student experiences at the end of the capstone course.
3. Standardized exams.
4. Longitudinal assessment of student learning in the core IS courses.
5. Student web portfolios.

The development of instruments for the first two program assessment approaches above may be based on published work such as Kim and Pick (2000). Standardized exams are discussed in Reynolds et al (2004) and Landry et al. (2006), while their use to support program assessment is demonstrated in White and McCarthy (2007). Longitudinal assessment studies in IS are rare with few exceptions like the one conducted by Williams and Price (2000). Portfolios are widely used as an assessment method in education but there are very few reports on their usage in computing programs like Higgs and Sabin (2005).

Projects as artifacts demonstrating student performance play an important role in the IS program assessment methods. They correspond well to the practical orientation of an IS program as it prepares graduates for industry. Projects are often used for creating student portfolios and they can be included in single IS courses or they may continue through several courses over two or three years like in Jones and McMaster (2004). Sometimes projects may be the single major assessment outcome of a course as is discussed in Kurzel and Rath (2007). Hence the importance of having rubrics for their assessment that are derived from the overall IS program goals and have a standardized structure in various courses (on the development of such rubrics in an IS program see Petkov and Petkova, 2006).

Since project artifacts provide a direct measure for student learning, they are preferred to other indirect methods for program assessment (see Palomba and Banta, 1999), especially in a professional field like Information Systems. Measurement and comparisons of student performance in different courses through projects are unresolved issues in the fourth type of assessment methods listed above, involving longitudinal studies, as well as the last one, portfolios.

The relevance and importance of this research stems from the fact that using project rubrics for assessment of student learning across an academic program is linked to several yet unresolved challenges for IS educators like how to:

- measure student performance in a uniform and objective way and reaching consensus among professors;
- monitor students' performance in some areas that may be better assessed only after allowing the maturation of students' understanding of certain principles (this is especially relevant to techniques which are applicable to several interrelated courses; for example, consider Systems Analysis and Database Design or Systems Analysis and Project Management in the Information Systems (IS) program);
- demonstrate explicitly and in a comparable format the level of skills achieved by the student majority at different stages of the academic program through projects captured in an electronic portfolio.

Addressing these challenges would help utilize better the assessment results in subsequent actions on improvement of teaching and student learning.

The following discussion will concentrate on the use of scoring rubrics to assess student performance in projects in courses at various stages of an academic program. This paper extends the work of Petkov and Petkova (2006) and shows how rubrics for project assessment can be used in measuring student performance in courses of an IS program. The goal of the paper is to present a methodology for using standardized rubrics for measuring student achievement in interrelated courses in an academic program. To the best of the authors' knowledge this has not been reported before in the literature. The approach is demonstrated on a pilot implementation involving two interrelated courses in an IS program, Systems Analysis and Database Design. This research follows a conceptual design approach motivated by the discussion in Hevner et al. (2004) and Boland (2002). The paper continues with a discussion on the use of project rubrics for assessment of student learning, followed by a brief summary of the authors' previous work on the formulation of a standard set of criteria for assessment of projects across an academic program. Then a methodology for using project rubrics in interrelated courses is proposed and illustrated on a pilot implementation, which is followed by the conclusion.

2. SOME ISSUES IN THE USE OF PROJECT RUBRICS FOR ASSESSMENT OF STUDENT LEARNING

According to Heywood (2000:329) during an educational project a student is asked to plan, specify, make, test and evaluate an artifact or an idea. Past research on the topic of project work is reviewed in Brown et al. (1997:121-122). An instructor may choose for assessment from a variety of outcomes of project work:

- artifact created during the project;
- project report;
- poster presentation/exhibition of the project;
- project presentation;
- log book for the project.

The selection of a particular set of methods will depend on the nature of the project. Thus, in an introductory course on IS fundamentals it is usually the report that is assessed; while in a systems analysis or a database class, it is usually the design which is the artifact assessed as it documents the major learning outcomes for that course (Petkov and Petkova, 2006).

Jones and McMaster (2004) point out that they have used predominantly process oriented measures to assess student projects instead of the methods for assessing projects listed above. Student performance is assessed by them using a set of forms provided by the student team and also by the client for a particular project. Examples of assessment forms/devices include project reports, peer assessment reports and client feedback. Jones and McMaster (2004) justify their use of process measures by the diverse nature of projects (some being consulting projects and others leading to development of a particular product). The authors agree that process measures are applicable but believe that their methodology allows using both process measures and direct methods listed by Brown et al (2007) for assessing diverse projects.

Rubrics tell potential performers what elements of performance matter most and how the work to be judged will be distinguished in terms of relative quality (Wiggins, 1998:153). Scoring rubrics are descriptive scoring schemes that are developed by teachers or other evaluators to guide the analysis of products or processes of students' efforts (Moskal and Leydens, 2002).

Wiggins (1998) emphasizes the importance of the criteria/dimensions used to describe the traits central to a successful task performance. Two types of rubrics can be considered in describing these dimensions: holistic and analytic-trait (Wiggins, 1998; Mertler, 2001). An analytic-trait rubric isolates each major trait into a separate rubric with its own criteria while a holistic rubric yields a single score based on overall impression (Wiggins, 1998: 164). The richness of information provided by analytic rubrics is the reason the authors believe they are more appropriate for a multifaceted assessment of student achievement in an IS project.

According to Brualdi (2002:65) it is essential to define clearly the *purpose of assessment*. Questions that can be used to define the purpose of assessment are:

What am I trying to assess?
What should the students know?
What is the level?
What type of knowledge?

The above questions are related also to the role of the course in the particular IS program according to Bloom's taxonomy of student learning outcomes (Bloom,1956; and Gorgone et al, 2002). Hence it is essential that any IS program needs to define first the skill sets resulting as learning outcomes linked to the goals of the program (see Petkova et al., 2006, Aasheim et al., 2007 and White and McCarthy, 2007).

The answers to the questions listed by Brualdi (2002) serve as background information to the next step – defining the *criteria for assessing projects*. Without claiming that every student performance needs to be assessed against all five types, Wiggins (1998:168) suggests five categories of criteria to be used in rubrics, relating to the impact, the craftsmanship, the methods, the content and the sophistication of the performance. Further criteria are proposed in Brown et al. (1997).

Another important issue is the *distinction between rubrics assessing generic skills or specific subject matter* understanding. According to Wiggins (1998:176) reliability is no doubt served by using a rubric that is unique to a task and to the samples of performance that relate to that task. The authors use different criteria in an analytic rubric for the assessment of generic skills (like presentation abilities) and for the assessment of specific issues related to a subject like technical skills for example (e.g. see Appendix 1).

Very useful guidelines for designing rubrics can be found in Mertler (2001). The same author provides an example of an analytic rubric, where for every chosen evaluation criterion the same set of four possible *levels of student achievement* is suggested: beginning, developing, accomplished and exemplary. The authors have followed a similar distinction among the levels of student performance in the work reported here. While in some instances others have proposed single criterion holistic rubrics, the authors believe that analytic rubrics are more appropriate, as they provide rich information on student's achievements.

An important factor in assessing project outcomes is to separate the contribution of the students from that of the supervisor. The latter is unavoidable in the iterative process of refinement of the project deliverables. Brown et al (1997) quote an earlier suggestion by Black (1975) for minimizing this problem, according to which the weight is given for grades at different stages of the project as shown in Table 1:

Deliverable	Weight by Black(1975)	Our weight
Implementation stage	30 %	Combine 1 and 2
Log book	5%	20%
Draft report	50%	50%
Final report	15%	30%

Table 5: Weight allocation of deliverables in a project as percentage of the total grade (based partly on Black, 1975)

In the authors' opinion, the strong emphasis on evaluation at the implementation stage can be a source of subjective judgment by the professor. It would be more suitable to combine the implementation stage grade with the log book and give it a reduced weight of 20% to minimize the possible effect of subjective errors. The authors suggest that the final report is allocated a weight of 30%. The reason for the suggestion is that students will have insufficient motivation for improving the final product if its weight is only 15%.

Whether to assess a project against *absolute or developmental standards* is another important issue raised originally in Wiggins (1998). Absolute standards relate to excellent performance accepted within a particular field while developmental standards allow to judge as "acceptable" performance levels that are lower. The authors find this distinction to be very useful in understanding how similar rubrics might be applied for assessing projects in different courses at different levels of the curriculum. The development standards might be used in introductory and junior-level courses while absolute standards should be pursued at the level of capstone courses. The above discussion does not aim to be exhaustive on all issues related to the use of projects for assessment purposes and hence further details may be found in Brown et al. (1997), Wiggins (1998) and other sources. The next section deals with an issue that is a precondition for the development of the methodology discussed in this paper.

3. ON THE ROLE OF A STANDARD SET OF ASSESSMENT CRITERIA FOR PROJECTS ACROSS AN ACADEMIC PROGRAM

The work on using project assessment rubrics in different courses can be framed within the general assessment process in an IS program (see Petkova et al., 2006) and that process will not be discussed here. Having a standard set of criteria for assessment of projects in different subjects is useful in order to conduct a longitudinal study investigating how student learning develops over the course of the program along each dimension. Petkov and Petkova (2006) have developed a method for deriving uniform project rubrics in different subjects of a program that are aligned with the program goals and are derived from the existing literature on using projects in education. They have suggested a standardized structure for project rubrics for any course within an IS program. Petkov and Petkova (2006) have suggested the use of four criteria in assessing a project in an IS program. These dimensions are similar to those in the ACM/AIS/AITP curricular recommendations for IS programs (Gorgone et al., 2002). Table 2 shows how they correspond to the general assessment criteria of IS projects derived from the existing literature on the use of projects in education. As is evident from Table 2, the last two criteria are generic while the first two are specific for a particular course.

Following the procedure described by Petkov and Petkova (2006), criteria can be formulated for any courses in an IS program (e.g. for Systems Analysis see Table 2). An example of a rubric usable in a Systems Analysis and Design course is provided in Appendix 1. In a similar way one may define the criteria for a course in Database design. The criteria for both these courses are shown in Table 3. As is evident from Table 3, there are no differences between the two rubrics in the third and fourth criteria due to their generic nature. However the first two criteria are different in order to reflect the nature of the material covered in the particular course and the learning outcomes associated with the relevant technical and problem solving skills.

While assessing a project on the third criterion evidence may be found from the project recommendations and considerations for resources associated with it. Other evidence may be found from project logbooks, team member reports and other process oriented ways of assessing the project. The fourth criterion is associated in some projects with conducting presentations while in other projects completed in courses such as Systems Analysis or Database Design, presentations may be replaced with project walkthroughs.

Having a uniform structure for the criteria and sub-criteria of the rubrics (see Table 3) allows the measurement of students' progress through their studies in interrelated courses within a program.

Thus, for Systems Analysis and Design, the first two criteria would be defined in a way that fits the nature of the material covered in that course and the learning outcomes associated with these criteria:

- Ability to define user requirements of an information system and to design a system applying relevant techniques including UML.
- Ability to apply feasibility analysis, requirements analysis and a design process model in practice.

The rubrics for Systems Analysis and for Database Design discussed here were introduced in the fall of 2005 at University A. A similar type of rubric for the Database Design course was introduced at University B, and the authors are expanding the use of such rubrics in other courses as well. In the next section, the methodology for deriving and using project rubrics in interrelated courses is documented and a brief account of its application is provided.

General criteria for assessment of IS projects (derived from the IS2002 standard which is usually used also to guide the goals of a particular IS program)	Derived criteria from the literature
Technical level of proficiency demonstrated through application of the technical knowledge associated with the course.	Craftsmanship is the term used by Wiggins, 199).
Problem solving skills and ability to organize information, ability to compare a problem situation against best business practices or to select and justify the best alternative solution.	Method used in project, content (Wiggins, 1998).
Organizational, interpersonal and time management skills demonstrated in the execution of the project and its recommendations	Impact (Wiggins, 1998), Project management skills (Brown, 1997).
Communication skills, demonstrated through the organization of the project and its presentation	Sophistication of performance (Wiggins, 1998).

Table 6: Possible project assessment criteria across interrelated courses in an IS program (following Petkov and Petkova, 2006)

4. A METHODOLOGY FOR DERIVING AND USING PROJECT RUBRICS IN INTERRELATED COURSES AND AN EXAMPLE OF ITS APPLICATION

The adherence to the same number of criteria and sub-criteria organized in a uniform way is a precondition for comparison of student performance in different courses. The use of standardized rubrics allows deriving measures for improvement of student learning, for reaching a balance of emphasis among the four types of outcomes at the various levels of the IS program, and for curriculum improvement.

The use of standardized rubrics in different courses for obtaining evidence about student performance is justified by a principle related to the "absolute comparison mode" in a Multicriteria Decision Making approach called The Analytic Hierarchy Process (Saaty, 1990): a particular project is not judged with respect to another similar project but instead it is assessed with respect to the ideal level of achievement on a given criterion for a particular course. The absolute comparison mode allows the assessors to draw conclusions about whether students in a particular course have scored better or worse than those in another course with respect to the same criterion. The use of standardized rubrics in different courses with the same number of criteria and sub criteria as suggested in Petkov and Petkova (2006) allows a uniform way for evaluation of projects across particular subjects in an IS program as is shown here through the methodology presented in this paper. This is not only needed for comparison of student achievement in different courses across a program but it is also a necessary component for the successful implementation of student portfolios and it may

General Project Assessment Criteria	Systems Analysis and Design	Database design
Criteria	**Criteria and sub-criteria**	**Criteria and sub-criteria**
1. Technical level of proficiency demonstrated through application of the technical knowledge associated with the subject.	**1. Ability to define user requirements of an information system and to design a system**	**1. Ability to define user requirements of a data model and transform them into logical and physical design**
	1.1. Correct application of analysis and design principles and techniques including UML	1.1. Correct application of database design principles and UML techniques
	1.2. Appropriate requirements gathering	1.2. Appropriate data collection
	1.3. Is the final product relevant for a practical implementation of the information system	1.3. Is the final product relevant for a practical implementation of the database
2.Problem solving methodological skills and ability to organize information, ability to compare a problem situation against best business practices or to select and justify the best alternative solution	**2. Ability to apply feasibility analysis, requirements analysis and a design process model in practice:**	**2. Apply suitable data, database administration and UML process knowledge**
	2.1. How are requirements assumptions relevant	2.1. How is the sample data relevant
	2.2. Is there evidence of application of the analysis and design principles	2.2. Is there evidence of application of database administration principles
	2.3. Is there evidence of applying correctly the system life cycle model	2.3. Is there a consideration of UML process knowledge
3. Organizational, interpersonal and time management skills demonstrated in the execution of the project and its recommendations	**3. Execution and Recommendations of the project**	**3. Execution and Recommendations of the project**
	3.1. Have the main points to emerge from the project being picked up for discussion in the documentation?	3.1. Have the main points to emerge from the project being picked up for discussion in the documentation?
	3.2. Is there a consideration on the resources needed for the suggested system and the schedule	3.2. Is there a consideration on the resources needed for the suggested system and the schedule
	3.3. Was the project developed within the time allocated for the analysis and design phases?	3.3. Was the project developed within the time allocated for the analysis and design phases?
4. Communication skills, demonstrated through the organization of the project and its presentation	**4. Presentation**	**4. Presentation**
	4.1. Clarity of explanation and conclusions	4.1. Clarity of explanation and conclusions
	4.2. Visual impact of the project walk-through	4.2. Visual impact of the project walk-through
	4.3.Use of audio visual aids, body language	4.3.Use of audio visual aids, body language
	4.4. Response to questions	4.4. Response to questions

Table 3. An example of how the general project assessment criteria (developed as a synthesis of the IS program learning goals and the published research on project evaluation) can be transformed into a uniform set of criteria in two IS subjects: a course on Systems Analysis and Design and a course on Database design

allow tracking the evolution of student performance from one course to another or over a number of years. Steps in the methodology for deriving and using project rubrics in interrelated courses are given below.

Steps in the Methodology:

1. Identify how the learning outcomes for each course relate to the program's academic goals
2. Define a uniform set of criteria for assessment of student projects in selected courses of the program.
3. Customize the specific criteria and sub-criteria that reflect the nature of a particular course, while keeping the number and nature of sub-criteria the same across courses. The generic assessment criteria are essentially the same in every course.
4. Define appropriate degrees of student performance for each criterion in the rubric.
5. Communicate the rubric to the students at the start of the project.
6. Use the rubric for rating the achievement of each team on every criterion evidenced through the completed project artifacts.
7. Calculate the average rating on each criterion for all student teams and then sum the average ratings for all sub-criteria of a given criterion.
8. Use the total rating for comparison of each team's performance in a course and of student teams in different courses across the program and apply the results for improvement of student learning and teaching practices.

It is essential that the project rubrics across interrelated courses have similar structure and that the criteria of similar nature are ordered and grouped in the same way. This will allow the comparison of results across the courses. It is necessary to underline that student performance needs to be measured on every indicator with respect to the ideal for a particular course criterion since this condition justifies the comparison of achievement in different courses as pointed earlier. The assessment criteria need to be independent of each other. The mathematical foundations of the approach are based on the Simple Multiattribute Rating Technique (SMART), described in von Winterfeldt and Edwards (1986) which uses direct measurements as ratings in a way that is similar to the "absolute comparison mode" in AHP (see Saaty, 1990).

It is possible also to assign weights to the criteria and sub-criteria if their importance is are considered different within a particular academic program. Then before step seven in above methodology, one may include the calculation of the project rating on a sub-criterion as the multiplication of the weight of the corresponding sub-criterion and the rating on it. However, in the illustrative example (see Appendices 2 and 3) the weight of all criteria is the same, equal to 1.

The rubrics have been used by the authors since 2006. Assessment of projects from a fall 2006 class in Systems Analysis and Design and a spring 2007 class in Database Design at University A were used for the purposes of demonstrating the application of the proposed methodology (see Appendices 2 and 3). The suggested approach allows the flexibility of reflecting the specific features of a course through the specific sub criteria as is shown in Table 2.

Following Wiggins (1998), the authors applied developmental standards during the assessment of the student results in both courses. Due to the small number of projects in each class, these results are only for illustrative purposes and cannot lead to statistical generalizations on the students' performances.

Each sub-criterion was considered equally important. The average rating for all projects in a course on each sub-criterion and their totals are shown in the last two columns in Appendices 2 and 3. These measures allow comparisons between student learning in different courses provided that the nature of the group criteria in the rubrics for each course is similar and they have a similar number of coherent sub-criteria in a given group.

In three of the four groups of rubrics criteria, the Database course group did not perform as well as the Systems Analysis group. This may be due to the fact that three of the top students in the Systems Analysis course (or 20% of that class) did not proceed immediately that year to the Database course as they are part-time students. Another possible factor is that only eight out of the ten students in Database design had taken the prerequisite course in Systems Analysis while the remaining two were admitted to the course for contingency reasons. The negative differences between the average results for all groups in the courses, however, are relatively small. They were mostly related to the criteria requiring technical proficiency in the techniques taught in a particular course (group 1 in the rubrics criteria), organizational, interpersonal and time management skills during the execution of the project (group 3 in the rubrics criteria) and the students' communication skills (group 4 in the rubrics criteria).

On two occasions concerning sub-criteria associated with Problem solving skills (the second rubric criterion in Table 3) the Database design class performed better. Those were related to the understanding of the requirements assumptions/relevant data and also to the understanding of UML process. These improvements show certain development in the maturity of developing problem solving skills by the Database design class compared to the Systems Analysis class which is a positive outcome. Since the two courses are closely interrelated, it is indeed expected that the understanding of requirements analysis and UML will be better in the database design course that is taught after Systems Analysis.

5. CONCLUDING REMARKS AND POSSIBLE FUTURE WORK

This paper provided an account of a methodology for using project rubrics for assessment of student achievement in different courses of an IS program and showed how it was applied in practice. The application of the proposed approach provides insights to several significant questions which can guide further effort on improving teaching practices:

- Are we achieving improved levels of proficiency in a subsequent course on a particular criterion?
- What skills that the students exhibit at a particular stage of their degree require further attention in a subsequent course?
- Can we identify substantial negative deviations in student achievement along any of the four general criteria within a course that needs corrective action?

The use of standardized rubrics allows a uniform way of evaluating projects across different courses in an IS program. It is essential also for instructors to apply the same approach for assessing projects in courses with more than one section. It is important that faculty realize the need for having a common approach.

A limitation of our illustration of applying the rubrics in two courses was the small number of student projects due to the small size of the IS program at University A. Another potential limitation of the approach is that student populations in an academic program are usually not homogeneous as students progress in their degree studies at universities that do not have established learning communities of cohorts.

There are some unresolved theoretical and practical problems in using rubrics in assessment in general. The authors agree with Mertler (2001), who points out that a potentially frustrating aspect of scoring student work with rubrics is the issue of converting them to "grades." Other problems include the open question as to how precise an analytic rubric can be in comparison to a holistic one. A further open issue for research is the efficiency in using various types of rubrics.

The next steps in the authors' work on rubric design and implementation in various is courses are to:

- Continue gathering data on student learning in other interrelated courses through rubrics in IS programs at Universities A and B.

- Define benchmarks indicating the desired level of student learning for each criterion within each course in the program or at least in several courses.
- Explore the role of learning communities in promoting better student learning outcomes evidenced through projects assessed with similar rubrics.
- Expand the research on assessing student learning from projects in interrelated IS courses to overall longitudinal IS program assessment and the use of e-portfolios.

The research reported in this paper shows that the proposed methodology is applicable for assessment of student achievement in projects in interrelated courses or at particular key points of an IS program, which is useful for programs that are looking to quantify their assessment work based on rubrics.

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APPENDIX 1.
RUBRICS FOR PROJECT ASSESSMENT IN SYSTEMS ANALYSIS AND DESIGN

The criteria that will be used in the course Systems Analysis and Design need to reflect the four general criteria for evaluationof projects by measuring the learning outcomes covered in the course and the project specific goals:

1. **Ability to define user requirements of an information system and to design a system in the Unified Modeling Language (UML).**
2. Ability to apply techniques for feasibility analysis, requirements analysis and UML modeling in practice.
3. Ability to present the findings of the project within the report including time management issues
4. Ability to provide a convincing presentation.

Hence the following rubrics were defined for the evaluation of the project report:

Criteria	**Definition of rubrics and scale (1-4)**			
	Beginning 1	**Developing 2**	**Accomplished 3**	**Exemplary 4**
1. Ability to define user requirements of an information system and to design a system				
1.1. Correct application of analysis and design principles and techniques including UML	Inappropriate	Partial	Well-defined	Results analyzed
1.2. Appropriate requirements gathering	No evidence	Secondary	Interviews	Integrated sources
1.3. Is the final product relevant for a practical implementation of the information system	No evidence	Occasional	Good evidence	Evidence and good analysis
2. Ability to apply feasibility analysis, requirements analysis and a design process model in practice:				
2.1. How are requirements assumptions relevant	Initial	Developing	Very good	Very well justified
2.2. Is there evidence of application of the analysis and design principles	No appraisal	Occasional	Attempted minor errors	Critical appraisal no errors
2.3. Is there evidence of applying correctly the system life cycle model and the UML process model	No attempt	Somewhat	Attempted	Well defined
3. Project execution and findings				
3.1. Have the main points to emerge from the project being picked up for discussion?	No evidence	Occasional	Good evidence	Evidence and analysis
3.2. Is there a consideration on the resources needed for the suggested system and the schedule	No appraisal	Occasional	Attempted minor errors	Well defined - no errors
3.3. Was the project developed within the time allocated for the analysis and design phases?	No	Mostly on time	On time	On time and with no errors
4. Presentation				
4.1. Clarity of explanation and conclusions	Lacking	Developing	Very good	Excellent
4.2. Impact of the presentation/project walk-through	No	Only text	PPTS with color	Well designed
4.3.Use of audio visual aids, body language	Poor	Developing	Very good	Excellent
4.4. Response to questions	Poor	Developing	Very good	Excellent

APPENDIX 2.
ASSESSMENT RESULTS FOR THE PROJECTS IN A SYSTEMS ANALYSIS AND DESIGN CLASS (FALL 2006)

Criteria	Proj1	Proj2	Proj3	Proj4	AVG	Criteria Totals
1. Ability to define user requirements of an information system and to design a system 1.1. Correct application of analysis and design principles	3	3	4	2	3.00	9.25
and techniques Including UML 1.2. Appropriate requirements gathering	3	4	4	3	3.50	
1.3. Is the final product relevant for a practical implementation of the information system	2	3	4	2	2.75	
2. Ability to apply feasibility analysis, requirements analysis and a design process model in practice						9.00
2.1. How are requirements assumptions relevant	3	3	3	3	3.00	
2.2.Is there evidence of application of the covered analysis and design principles	3	3	4	3	3.25	
2.3. Is there a evidence of correct application of the systems life cycle model and the UML process model	2	3	4	2	2.75	
3. Project execution and findings						8.00
3.1. Have the main points to emerge from the project being picked up for discussion?	3	3	3	3	3.00	
3.2. Is there a consideration on the resources needed for the suggested system and the schedule?	3	2	4	2	2.75	
3.3. Was the project developed within the time allocated for the analysis and design phases?	3	3	3	2	2.75	
4. Presentation						13.00
4.1. Clarity of explanation and conclusions	3	3	4	3	3.25	
4.2. Impact of the presentation/project walk- through	3	4	4	2	3.25	
4.3.Use of audio visual aids, body language	3	3	3	3	3.00	
4.4. Response to questions	3	4	4	3	3.50	
Overall rating for the project:	37	41	48	33		

DEFINITIONS OF ACHIEVEMENT	Beginning	Developing	Accomplished	Exemplary
	1	2	3	4

N.B. Each sub-criterion was considered equally important. The columns on the right side contain the assessment evaluations of each project on every sub-criterion. Following the Simple Multi Attribute Rating Technique (SMART), the overall rating for a project would be obtained by adding all ratings in a column. If the weights of the sub-criteria were different, then the overall rating would be the sum of the multiplications of every rating by the weight of the corresponding sub-criterion.

We are calculating here the average rating for each sub-criterion and also the total of the average ratings for sub-criteria within each group, shown in the last two columns. These are useful measures allowing comparisons between student learning in different courses provided that the nature of the group criteria in the rubrics for each course is similar and they have similar number of coherent sub-criteria in a given group.

APPENDIX 3. RESULTS FOR THE PROJECTS IN A DATABASE DESIGN CLASS (SPRING 2007)

Criteria	Proj1	Proj2	Proj3	AVG	Criteria totals
1. Ability to define user requirements of a data model and transform them into logical and physical design. 1.1. Correct application of design principles.	3	3	3	3.00	8.67
1.2. Appropriate data collection	3	3	3	3.00	
1.3. Is the final product relevant for a practical implementation of the database	3	2	3	2.67	
2. Apply suitable data, database administration and security principles:					9.33
2.1. How is the sample data relevant	4	3	3	3.33	
2.2. Is there evidence of application of database administration principles	3	3	3	3.00	
2.3. Is there a consideration of UML knowledge	3	3	3	3.00	
3. Project execution and findings					8.34
3.1. Have the main points to emerge from the project being picked up for discussion?	3	3	3	3.00	
3.2. Is there a consideration on the resources needed for the suggested database and the schedule?	3	2	3	2.67	
3.3. Was the project developed within the time allocated for the phases?	3	3	2	2.67	
4. Presentation					12.00
4.1. Clarity of explanation and conclusions	4	3	3	3.33	
4.2. Impact of the presentation/project walk- through	3	3	3	3.00	
4.3.Use of audio visual aids, body language	3	3	3	3.00	
4.4. Response to questions	3	3	2	2.67	
Overall rating for the project::	41	37	37		

DEFINITIONS OF ACHIEVEMENT	Beginning	Developing	Accomplished	Exemplary
	1	2	3	4

N.B. Each sub-criterion was considered equally important. The columns on the right side contain the assessment evaluations of each project on every sub-criterion. Following the Simple Multi Attribute Rating Technique (SMART), the overall rating for a project would be obtained by adding all ratings in a column. If the weights of the sub-criteria were different, then the overall rating would be the sum of the multiplications of every rating by the weight of the corresponding sub-criterion.

We are calculating here the average rating for each sub-criterion. These are useful measures allowing comparisons between student learning in different courses provided that the nature of the group criteria in the rubrics for each course is similar and they have similar number of coherent sub-criteria in a given group.

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