Professional Development in Software Engineering

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ABSTRACT: This study discusses the evaluation process and techniques of Software Engineering Department of College of Technology at Fırat University. Specifically, the program information, mission statements of this department, resources, activities, outputs, and short-long term objectives are investigated and evaluated. The design of the evaluation, the discussion on data collection and analysis are explained, respectively. Work plan and budget issues are discussed and evaluated. Finally, some recommendations are offered in terms of increasing of the credibility of the department.

Keywords: Professional development, program evaluation, Software Engineering Department.

1. INTRODUCTION

The Software Engineering Department of College of Technology offers Software Engineering undergraduate and graduate program at Fırat University since 2010. This department has already more than 1200 undergraduate and graduate students. This department offers an education to enhance intellectual growth in the software engineering area. Aiming to maintain an active learning environment that encourages critical thinking; valuing diversity; and promoting life-long learning can be categorized as the main missions of the department. Specifically, the Software Engineering Department at Fırat University pursues its mission by:

- serving our diverse population of undergraduate majors in broadening their software area knowledge and integrating ethical and professional values within this crucial scientific discipline;
- preparing students for continued scholarship and positions of leadership in Software area;
- providing leadership in the uses of software development techniques to enhance the knowledge of the students, the university community, and society (Wholey, 2010); and
- promoting scholarship of the faculty by encouraging continuing professional development, research, grants-man ship, and professional presentations and publications.

1.1. Goals

The goals of the Fırat University’s Software Engineering undergraduate program are to:

1. Prepare students to function professionally as digital investigators.
2. Prepare students for graduate studies in information security and Cyber Crime areas.
3. Increase critical thinking and problem-solving skills of the Software Engineering students.
4. Prepare students for life long education.

1.2. Structure and resources

There are two types of universities in Turkey, public and private (foundation) ones. Software Engineering department is part of a public university, which is fully supported by Turkish government, particularly by Ministry of National Education (MNE) in Turkey. Specifically, all expenses of the department, including the salaries of the instructors and staff are paid by the Turkish government. Moreover, education is free for some students as well. That means the students do not need to pay any tuition for the program when they are enrolled in the primary teaching stream. The program accepts donation and uses it for scholarship purposes. The department does not have any direct Operations and Maintenance budget since these requests are fulfilled by the approval of the department chair, the dean of the College of Technology, and provost of the university via using the money provided by the government.

Currently there is one department chair, 14 full-time faculty members, and 3 administrative personnel dedicated for the department. The department has 4 labs for conducting hands on work on software investigation and also using 4 classrooms in Technology building for theoretical classes. Besides Software engineering classes, other core curriculum classes are offered by the university in variety of building across the two campuses of Fırat University.
1.3. Purpose of Evaluation

The chair of department, and the full-time faculty members who are still working in this department evaluate the program. Other stakeholders are current students, dean, provost, Higher Education Council of Turkey (HECT, 2015), Ministry of National Education (MNE, 2015), and MUDEK, Accreditation of Engineering Education in Turkey (MUDEK, 2015). Current and incoming students are the primary stakeholders because they will be educated at the Department of Software Engineering. On the other hand, chair, dean, and provost are responsible to develop this department and take care of improvement of curriculum, quality of study, and all activities relevant to the department.

Higher Education Council is another key stakeholder because of its mission (HECT, 2015). All universities including private (foundation) universities are accredited by Higher Education Council of Turkey (HECT). Without its permission it is not possible to establish a department, a university, any educational institution, etc. in Turkey.

The Ministry of National Education is also another key stakeholders of the department. All educational institutions such as primary, secondary schools, vocational and technical high schools, and universities are dependent on the budget supplied by the Ministry of National Education in Turkey (MNE, 2015).

MUDEK is comparable to Accreditation Board for Engineering and Technology, Inc. (ABET) in the USA. This Software Engineering program has been structured to address the student and program outcomes of MUDEK criteria to obtain its accreditation in the year of 2019. The evaluation results are extremely vital to get accreditation by MUDEK. Positive efforts and accreditation will increase the student retention, bring recognition from all high schools, and also increase the quality of the program.

Industry and institutions are other stakeholders of our program because the graduates from the department will work at the software investigation companies and in cyber-crime division of Police Academy in Turkey. The stakeholders would be interested in an evaluation because they will benefit from the outcomes of the program.

2. PROGRAM THEORY

The program can be broken down into its primary components. The inputs, activities, outputs, and outcomes for this program are illustrated in Figure 1. Each of these components are discussed in the subsequent sub-sections. Before providing the details on those, resources of the department are discussed below.

2.1. Resources

The resources of Department of Software Engineering can be counted as following. The first is human resources. Namely, current students and instructors. Currently we have more than 1200 students (Software, 2016). Members of Board of Department is another important human resource. The Board of the Department is formed by instructors who teach. All policies, regulations are governed by these 14 members of board. Chair of the department is another human resource who runs the department. All of them are responsible for implementing the rules and policies at the department. The knowledge of humans are considered as inputs that consist of valuable information for the department.

The second resources are office and management resources. Currently the department uses 4 labs and 4 classrooms. In these labs there are 5 write blockers, 2 evidence duplicators, another mac systems for mac related investigation and 120 computers for software investigation. There is no specific budget allocated for the program. Equipment, travel, student support, and resource requests are approved and paid by the dean/provost based on justification provided by the department chair. To make a reference point, for the 2014-2015 academic year, the department have used $37,000 for operations & maintenance funds supplied by the dean’s/provost office.

Commercial companies and government offices can be counted as another resource, since our students will join trainings directly at the companies in the last semester of their studies. Software Engineering department has signed protocols with relevant companies for student. According to the agreement, the companies are responsible to create an environment where to the students conduct hands-on practice. The companies that have agreements with the department should provide hardware and software to the department free of charge.

2.2. Activities

The program consists of three different area of courses, namely, theory based, system related, and application oriented. Theory based courses starts from fundamentals of computers and digital investigation and then provides more detailed and deep theory on knowledge acquisition, intelligent data processing, etc. System related courses
heavily focus on variety of hardware/software systems that can be a part of a digital investigation. Application oriented courses, such as digital forensics tools course, let the students explore tools for the recovery of information on regular, protected or damaged hardware for the purpose of providing evidence of a crime. Overall, exams in courses, student presentations, comprehensive exams, developed technology/software, and exit surveys are the parts of activities conducted during a course of study. All collected data from students and instructors should be evaluated by the members of the Board where Department Chair observes all processes. The Board of Department is responsible to create up-to-date regulations and policies using collected data. Updating of regulation and policies will help to improve the quality of the education.

2.3. Outputs

The outputs of the Department of Software Engineering are the skills that the students are gained during the education. Specifically, the number of graduated students that has certain skills and capacities will be a direct indicator for the output.

2.4. Short-Term Outcomes

Short-Term outcomes of the program are services gained by students and the department. For the students of Department of Software Engineering, learning new skills and knowledge in digital investigation are the major outcomes that the participants will benefit from. Moreover, an ability to analyze a problem, and identify and define the computing requirements appropriate to its solution will be other student outcomes. Including these, we can look at the statistics on the number of students finding job in the field or starting graduate school in digital investigation area. For the department, quantitative results obtained from the student works would indicate the success and future direction of the program.

2.5. Long-Term Outcomes

Graduates should engage in successful careers in industry and/or graduate or other professional schools and should have improved economic, social, civic life standards. They should also demonstrate the technical skills required for the workforce including knowledge of digital investigation techniques and the ability to utilize this knowledge to analyze and solve problems. Moreover, the graduates will be active in professional development and acquiring new skills to remain relevant in the software engineering field. If the appropriate long-term outcomes from this program are gained, it would be proved that the logic model is functioning correctly.

Table 1: Description of Program Elements

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Activities</th>
<th>Outputs</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Short-Term</td>
</tr>
<tr>
<td>Current students, Instructors, Chair, and departmental resources</td>
<td>Exams in courses, student presentations, comprehensive exams, developed technology/software, and surveys</td>
<td>New skills of participants</td>
<td>Learning, knowledge, ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.</td>
</tr>
<tr>
<td>Higher Education Council of Education, Ministry of Education, MÜDEK</td>
<td>Orientation process, curriculum development</td>
<td>Decision makers,</td>
<td>Motivation</td>
</tr>
<tr>
<td>Companies and Institutions</td>
<td>Training the students, creating labs.</td>
<td>Lab design and planning</td>
<td>Practice, Technical progress</td>
</tr>
</tbody>
</table>
3. EVALUATION DESIGN

We evaluate the effectiveness and quality of the courses of the Software Engineering Department at Firat University via evaluability assessment. Specifically, a general exam will be given for the students registered to Capstone Project course, which covers important information security concepts to evaluate whether the student has the learning, knowledge, ability to analyze an information security problem, and identify and define the computing requirements appropriate to its solution. This exam will consist of 20 to 30 questions. Besides evaluating their skills, certain questions to test whether enough course related materials were available to the students throughout the course and also if they had enough hand-on exercises during the course of the study will be asked in a survey form to the same students. Moreover, capstone group projects will be evaluated by a form of committee consisting of three faculty to see if the student has the ability to function effectively on teams to accomplish a common goal and has the ability to communicate effectively with a range of audiences. A rubric is designed to generate a score from 1 (Below Expectations) to 4 (Outstanding). Besides the above, we would like to analyze data that is related with the department’s technical supply for the program. Specifically, data will be collected from the students, via general exam/survey, and from faculty, via face-to-face interview to evaluate if the department is supplying necessary teaching instruments and software/hardware tools related with digital investigation, such as EnCase, FTK (Forensic Tool Kit), and write blockers.

4. DATA COLLECTION

For our evaluation we need data from students and instructors. For general exam, the data is collected via online exam platform from every senior student who is close to finish his/her degree plan and registered to Capstone Project course. Questions test general knowledge and skills question in Software Engineering area. Online collection method is selected since this method is cheap, flexible, and collected data can be automatically evaluated and stored as an electronic data. Blackboard (Blackboard, 2015), SurveyMonkey.com (SurveyMonkey, 2015), or LimeSurvey.org (Limesurvey, 2015) can be used to create general exam questions and surveys. The templates that are released on these websites are user-friendly and easy to use. Sample questions that will be used to evaluate this program are shown in Appendix.

Second method is conducted in the Capstone project course when the students present their final projects. Three faculty members evaluate particularly student’s communication skills and their ability to function within a group. The evaluation rubric is shown in the Appendix.
There is another method that needs to be used for collecting data from instructors related with department’s support in software/hardware/technology for an effective and up-to-date teaching environment. Face-to-face interview method is used since there are only 14 instructors at the department who teach to students. The interview is done and recorded by the department chair. Sample questions can be located in Appendix.

Using the collected data, the chair of the department and board member can conclude how likely the program’s outputs are delivered to the students, and how likely the intended outcome occur. Finally, the board decides how program design and program implementation should be changed.

The collected data is stored and protected via encryption on separate portable hard disk without any identification information attached to the responses. Only the department chair has access to the data and has the knowledge of encryption.

5. DATA ANALYSIS AND INTERPRETATION

Evaluation findings is used by the chair and the board members of the department. The chair, board members of the department, and instructors should know the lacks and needs of the departments in order to take necessary measures. As soon as the information is evaluated, a logic model is created to eliminate short-comes and to improve activities, outputs and outcomes. A development chart is scheduled for the future of the department.

For data analyzing we select qualitative data analysis method. Good quality analysis of qualitative data needs identifying the standards. Standards are used to judge the quality and effective strategies to meet these standards. For multiple choice questions, the number of correct answers over the number of total questions would simple show us what are our strongest and weakest points in the curriculum. Since the face-to-face interview is going to be open-ended questions, patterns from the answers are checked out and also a visual representation is drawn to determine what action the results warrant.

For exam/survey and project presentation, we use descriptive statistics. In this point SPSS software is very useful. We do an initial coding of data using a relatively small number of important categories, identify further questions and we go back to the data to create additional coding. We document our analysis including the definitions of categories that are used for coding, insights and questions. Specifically, for multiple choice questions, we set a threshold value for 65% as accepted rating in average for the first cohort of the students. Throughout the years with the feedback we received from the students and taking actions from the faculty, this threshold value is adjusted accordingly. For student survey and project evaluations we set 3.0 out of 4.0 as acceptable result.

Selected strategies should meet the standards for quality analysis. Since we collect data from students using online survey/exam, we have to write a brief definition of each code. Interpretation of data is checked by a member. Ethical issues include not exceeding the competence boundaries of the evaluator. As an evaluator we have to act with integrity and trust. We use charts, tables and figures to represent data, specifically the percentage of correct answers received for each question. These displays will include evaluation reports to enhance readers’ understanding and enable them to tract our interpretations. We develop some form of display during the analysis process including timeline of key events.

The data collected only from the students at the end of their program would not be enough to evaluate a course. For instance, one can say without a pre-test it is impossible to test the gained knowledge. Therefore, the same test can be applied to all students got admission to the program and then comparison can be made at the level of their degree programs. We also describe other limitations of the exam/survey if any exists during the data collection. We encourage and try to increase the participation to the online survey/exam. To increase the contribution level, submission of these exam and survey can be added as a grading item in the Capstone Project course.

We have to also consider if the department supplies all materials and tools for teaching. Since information security course will be evaluated, some special software should be obtained by the department. The interview with instructors who have given cyber-crimes and information security courses are important because they have experienced the lack of tools, hardware and software. We will figure out the problems mentioned by the survey comparing with the interviews done with relevant instructors. Since the number of the instructors are 14 at the department, interviewing would be appropriate approach for evaluation.

Chair of the department and members of the board of the department are relevant people who are responsible for the improvement of the quality of the education of Department of Software Engineering. Therefore, members of board of Software Engineering Department and as an evaluators we involve in interpreting and justifying the conclusions together. We clearly explain our anticipations for improving of the quality of the cyber-crimes course.
6. WORK PLAN AND BUDGET

A work plan and budget for the Department of Software Engineering at College of Technology at Firat University are prepared. The detailed information is given below.

6.1. Evaluation Team

The exam/survey and presentation evaluations is created by the department chair and seven other faculties working in the department. Survey evaluations is implemented by the department chair. As shown in Table, the exam/survey is conducted by the instructor of Capstone Project course and presentation evaluations are conducted by three faculties. Since we are offering Capstone Project course both Fall and Spring, different set of faculty conduct the evaluation and collect the data. Survey is conducted by the department chair. At the end, all collected data is analyzed by the department chair.

Table 2: Evaluation Team and Assigned Tasks

<table>
<thead>
<tr>
<th>Name</th>
<th>Conducting of Exam/Survey</th>
<th>Observation of Presentations</th>
<th>Conducting of Interview</th>
<th>All Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Asaf Varol (Chair)</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Dr. Ibrahim Türkoglu</td>
<td>X (Fall semesters)</td>
<td>X</td>
<td></td>
<td>(Fall semesters)</td>
</tr>
<tr>
<td>Dr. Engin Avcı</td>
<td></td>
<td>X</td>
<td></td>
<td>(Fall semesters)</td>
</tr>
<tr>
<td>Dr. Resul Das</td>
<td></td>
<td>X</td>
<td></td>
<td>(Fall semesters)</td>
</tr>
<tr>
<td>Dr. Erkan Tanyildızı</td>
<td>X (Spring semesters)</td>
<td>X</td>
<td></td>
<td>(Spring semesters)</td>
</tr>
<tr>
<td>Dr. Murat Karabatak</td>
<td></td>
<td>X</td>
<td></td>
<td>(Spring semesters)</td>
</tr>
<tr>
<td>Dr. Fatih Ozkaynak</td>
<td></td>
<td>X</td>
<td></td>
<td>(Spring semesters)</td>
</tr>
<tr>
<td>Dr. Muhammet Baykara</td>
<td></td>
<td>X</td>
<td></td>
<td>(Spring semesters)</td>
</tr>
</tbody>
</table>

6.2. Timeline

The details on the timeline are shown in Table 3. Within the third week of that particular semester, planning and administrative tasks are conducted. Data collection of exam/survey and presentations are held just prior to final exam week, while interviews occur in the middle of the semester. After collecting all the data, the analysis is conducted after the final exams are over and the results are ready to share within one months of time. With the indicated timeline, one of the possible problem would be the allocated analysis time frame in Fall semester. There are only three weeks holiday between Fall and Spring semesters. That is why the analysis for the Fall data may span to early Spring semester.

Table 3: Evaluation Time Line

<table>
<thead>
<tr>
<th>Planning and Administrative Tasks</th>
<th>Exam/Survey</th>
<th>Presentations</th>
<th>Interview</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start 3rd week of the semester</td>
<td>Start 3rd week of the semester</td>
<td>Start 3rd week of the semester</td>
<td>Start 3rd week of the semester</td>
<td>Start 3rd week of the semester</td>
</tr>
<tr>
<td>Data Collection and Analysis</td>
<td>One Week prior to final exams</td>
<td>One Week prior to final exams</td>
<td>Mid- semester</td>
<td>After final exams</td>
</tr>
<tr>
<td>Information Dissemination</td>
<td></td>
<td></td>
<td></td>
<td>1 month after the analyzed results are shared</td>
</tr>
</tbody>
</table>
6.3. Evaluation Budget

We do not anticipate any cost of the evaluation budget other than printing the materials for the exam/survey, presentation evaluation, interview, and also license cost for the SPSS, which should be a one time cost. Table 4 reflects evaluation budget numbers.

Table 4: Evaluation Budget

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
<th>Yearly</th>
<th>One Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printing Materials</td>
<td>$150</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>SPSS License Cost</td>
<td>$2,530</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

8. CONCLUSION

This paper discusses about how to proceed when evaluating the Software Engineering Department at Firat University. The paper suggested to use a) Capstone Project course to conduct a comprehensive exams on the important concepts, b) a survey to evaluate the course and instructor, c) use Capstone Project course and evaluate student presentations to evaluate if the student has the ability to function effectively on teams to accomplish a common goal and has the ability to communicate effectively with a range of audiences, d) use interviews to discuss about shortages and challenges the instructors are facing when teaching a course in the program. The appendices in the paper contains all the rubrics that can be used for evaluation. The paper also presents the timetable and personnel that will be used for the evaluation. However, the evaluation rubrics/techniques and this findings need to be re-evaluated after analyzing the data for one year (two cycle) to overcome all of the outlined deficiencies.

9. REFERENCES


APPENDICES

General Exam Questions:
1. Crimes are divided into the categories of
   A. Criminal and civil crimes
   B. Accidental and Deliberate
   C. Crimes against persons and crimes against property
   D. Insider crimes and intrusion crimes
2. Crimes against computers can include which of the following?
   A. Attacks on networks
   B. Unauthorized access
   C. Tampering with data
   D. All the above

3. Which of the following has the most far-reaching effect for law enforcement concerning cybercrimes?
   A. FERPA
   B. CFAA
   C. CAN-SPAM Act
   D. USA PATRIOT Act

4. What type of program is available to delete and overwrite data on a computer?
   A. File-overwriting software
   B. File-deleting software
   C. File-wiping software
   D. All of the above

5. In order to be legally defensible, methods used in the recovery of data must ensure that
   A. The original evidence was not altered.
   B. No data was added to the original.
   C. No data was deleted from the original.
   D. All of the above

6. Which of the following does NOT affect the choice of forensic tool(s) for a case?
   A. The operating system
   B. State of the data
   C. Availability of an expert witness
   D. Domestic and international laws

7. The current best approach to powering down a suspect PC is to
   A. Simply power it down using the operating system
   B. Keep it running on an UPS
   C. Don’t power it down
   D. Pull the power plug

8. To protect original data from any alteration, you
   A. Use gloves when working with the hard drive
   B. Make a forensic copy of the original data
   C. Do your forensic work as quickly as possible
   D. Use the operating system to copy all relevant files

9. Which of the following is the preferred way to make a forensic copy?
   A. Copy the contents of the Operating System
   B. Produce a sector-by-sector copy
   C. Copy residual data only
   D. Make a back-up tape image

10. When you forensically wipe a hard drive, you
    A. Write over all areas of the disk with a single character
    B. Reformat the hard drive using standard disk utilities
    C. Delete all active data from the hard drive
    D. Use a forensic tool to physically clean the hard drive
Table 5: Other Evaluation Questions and Associated Data Collection Methods from the students

<table>
<thead>
<tr>
<th>Evaluation Question</th>
<th>Data Collection Method</th>
<th>Source of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How successful was the instructor in creating an environment that was conducive to learning?</td>
<td>Online Survey</td>
<td>Current students</td>
</tr>
<tr>
<td>2. How would you rate the overall effectiveness of the instructor’s teaching?</td>
<td>Online Survey</td>
<td>Current students</td>
</tr>
<tr>
<td>3. The instructor used social media such as Hangout or Facebook to answer questions of students out of the class.</td>
<td>Online Survey</td>
<td>Current students</td>
</tr>
<tr>
<td>4. The instructor presented content in an organized manner using modern tools of educational technology.</td>
<td>Online Survey</td>
<td>Current students</td>
</tr>
<tr>
<td>5. The instructor explained concepts clearly and deeply using simulation and animation.</td>
<td>Online Survey</td>
<td>Current students</td>
</tr>
<tr>
<td>6. The instructor was helpful when I had difficulties or questions.</td>
<td>Online Survey</td>
<td>Current students</td>
</tr>
<tr>
<td>7. The instructor provided clear constructive feedback.</td>
<td>Online Survey</td>
<td>Current students</td>
</tr>
<tr>
<td>8. The instructor encouraged student questions and participation.</td>
<td>Online Survey</td>
<td>Current students</td>
</tr>
<tr>
<td>9. The course was effectively organized on Blackboard platform.</td>
<td>Online Survey</td>
<td>Current students</td>
</tr>
<tr>
<td>10. The course developed my abilities and skills for the subject as my expectations.</td>
<td>Online Survey</td>
<td>Current students</td>
</tr>
</tbody>
</table>

Table 6: Interview Questions

1) Are the laboratories conveniently designed for students?
2) Are the labs and equipment maintained as you would hope for?
3) Are the software products suit the need for the program and the courses you are teaching?
4) Are the hardware products suit the need for the program and the courses you are teaching?
5) Any other suggestions you would make for improvement of the department and program?

Evaluator’s Name:

Project Topic or Group Name:

<table>
<thead>
<tr>
<th>Presentation Component</th>
<th>Below Expectations – 1.0</th>
<th>Evolving – 2.0</th>
<th>Proficient – 3.0</th>
<th>Outstanding – 4.0</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview Value: 20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction of presenters, appropriate problem definition, related work and methodology is described</td>
<td>No introduction or overview, related work or methodology</td>
<td>Introduction of presenters but awkward, sketchy or unclear related work and methodology</td>
<td>Confident and fluent introduction; clear related work and methodology, but could be more complete or polished</td>
<td>Confident introduction of roles and contribution; clear purpose, overview, related work and methodology</td>
<td></td>
</tr>
<tr>
<td>Presentation Component</td>
<td>Below Expectations – 1.0</td>
<td>Evolving – 2.0</td>
<td>Proficient – 3.0</td>
<td>Outstanding – 4.0</td>
<td>Grade</td>
</tr>
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</tr>
<tr>
<td><strong>Style</strong></td>
<td>Poor style (long pauses, reading speech, &quot;Umm...&quot;, and other mannerisms, poor eye contact, monotone, etc.)</td>
<td>Either fluent delivery but reading, or awkward delivery but spontaneous</td>
<td>Generally good delivery and spontaneity but could improve</td>
<td>Excellent style involving matching verbal and nonverbal style, good projection with inflection, spontaneous speaking</td>
<td></td>
</tr>
<tr>
<td><strong>Related Work Coverage</strong></td>
<td>Very incomplete, old material and not relevant</td>
<td>Either new material but biased, or incomplete and balanced</td>
<td>Generally up-to-date information, but needs more evidence or better sequencing for advantages or disadvantages</td>
<td>Thorough coverage of related work, including their advantages and disadvantages</td>
<td></td>
</tr>
<tr>
<td><strong>Methodology</strong></td>
<td>Little or no inclusion of techniques, application, or practices</td>
<td>Inaccurate or incomplete use of techniques</td>
<td>Generally good application, but lack polish, fluency, or originality</td>
<td>Strong application with good fit, rationale, fluency, and originality</td>
<td></td>
</tr>
<tr>
<td><strong>Graphics</strong></td>
<td>No graphics (may be appropriate in some cases)</td>
<td>Graphics present but poor quality (illegible, inconsistent, etc.)</td>
<td>Well done graphics but too much or too little, and not on key points</td>
<td>Well-designed and attractive graphics that simplify or summarize key ideas; original graphics</td>
<td></td>
</tr>
<tr>
<td><strong>Reflection</strong></td>
<td>Little or no reflection</td>
<td>Ask for feedback; some defensiveness</td>
<td>Ask for feedback and clarify responses; generally non-defensive</td>
<td>Request feedback, clarify responses and link to performance changes; positive &amp; curious</td>
<td></td>
</tr>
</tbody>
</table>