ISSN:2278-7690

Practical Methods of Preparing a Systems Analyst

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ABSTRACT: Systems Analysis and Design (SAD) is a course commonly taught in almost all MIS programs. It is recommended as a required course by all standard curricula of undergraduate and graduate programs. Most students do not recognize the significance of this course until they enter the workforce. The theoretical nature of the course does not lend itself to hands-on activities readily encountered in courses such as programming or database; however, it requires prior knowledge on these subject matters. Thus making this course appealing to students is a difficult task. In this paper, we present a project-based methodology of teaching systems analysis and design that focuses on the development of system documentations that keeps students engaged in key activities of the Systems Development Life Cycle. Engaged in key project activities and production of required documentations help develop true knowledge of a systems analyst required by the IT industry.

Key Words: Systems Development Life Cycle, SDLC, Systems Analysis and Design, SAD, Teaching, Curriculum, project-based learning, collaborative learning, cooperative learning

Council for Innovative Research
Peer Review Research Publishing System
International Journal of Research in Education Methodology

Vol.3, No.3
editor@ijrem.com
www.cirworld.com, www.ijrem.com

INTRODUCTION

Systems Analysis and Design (SAD) is commonly taught as a capstone course in almost all MIS programs. It is part of a core curriculum suggested by all standard curricula for undergraduate and graduate MIS programs (Noll, et al., 2002; Gorgone et al., 2000). This course is also equivalent to the Software Engineering course commonly taught in a Software Engineering Program. Most students do not understand the significance of this course until they enter the workforce. Due to its theoretical nature, the course is usually uninteresting to students and therefore it is a difficult task to engage them. Furthermore, the course does not lend itself to synchronous hands-on activities encountered in common courses like programming or database; however, it requires prior knowledge on these subject matters. Thus teaching systems analysis and design requires innovation.

Teaching SAD through cases, projects, and role-playing received significant attention in the past decade. Many textbooks provide a running case problem at the end of each chapter to provide a business scenario and further clarification to the subject matters (Shelly et al., 2006, Dennis, et al., 2006). Instructors have been using group projects and role-playing in a variety of ways to engage students and convey necessary knowledge that a systems analyst should posses. For example, Sullivan (1993) emphasized project management aspect of software development projects through role-playing between instructor and students. Adams (1993) stressed on project management documentations while students acted as reviewers of documents and prototypes created by each other's group. Kirs (1994) describes teaching SAD through role-playing between instructor and students, while they acted as personnel of a software development company. Baram and Mandviwalla (1996) used a bulletin board to improve students' communication skills. Nance (1998) used group projects to improve students' soft skills such as teamwork, group development, and project management. Omland (1999) used videotaping of group project meetings to critique students who have participated in the development of an information system. In teaching project management, Lowe (2000) focused on students' role-playing as project manager and milestones for deliverables. Kovacs and Rowell (2001) focused on the development of an end-product such as a web-based project. Ramiller (2002) used e-mails as a medium to communicate between the instructor and students to role-play between the manager and other team members of a software consulting firm. Chau et. al. (2003) focused on the end product development such as building a web search engine.

It should be clear from the above discussions that instructors have been trying to develop innovative ways to address many knowledge areas that are covered in a SAD course or that reflect the job description of a multi-tasking systems analyst. On the other hand, it is found that most of the instructors focused on a particular aspect of knowledge such as team building, project management, role-playing, deliverables, or end-product development. Research also shows that most instructors in the Systems Analysis and Design course focused on teaching "soft-skills" such as role-playing, communication, and team management (Kirs, 1994; Baram et. al., 1996; Granger and Lippert, 1999; Killingsworth, et. al., 1999; Russell, et al., 2004), whereas those in the software engineering course focused on "hard skills" such as real-life projects, team leaders, project management, software life cycle, project deliverables, and tools (Perkins, 1980; Dodani, 1992; Lowe, 2000; Fernandez and Williamson, 2003). However, recently there is a paradigm shift where instructors in SAD courses are moving towards teaching hard skills by incorporating real-life projects in classrooms. The explosion of Object-Oriented Design methodology and collaboration between MIS and Software Engineering teachers helped this paradigm shift (Surendran et. al., 2002; Fernandez and Williamson, 1993).

In teaching the SAD course, we adapt a group-project methodology that requires students to perform all steps or activities prescribed in various phases of the SDLC and develop key documents at the

end of each of the activities. By performing the prescribed activities and producing required outputs in a group environment, students go through the experience of a true systems analyst found in industry. This paper describes the course setting, the group project methodology, and other course-related activities that make our course well-rounded in making a systems analyst for today's workforce.

PROJECT-BASED LEARNING

Project or Inquiry-Based Learning is an instructional method that uses complex, real-life projects to motivate learning and provide learning experiences; the projects are authentic, yet adhere to a curricular framework (PBL1, 2006). It allows teachers to create tasks whose complexity and openness mimic problems in the real world. (PBL2, 2006). Projects that have depth, duration, and complexity will challenge students and motivate them towards construction of knowledge. Project-based learning provides a cross-collaborative learning environment which enhances student learning through interaction with each other (Nance, 1998). It provides improved understanding of subject matters, helps develop communication, planning and teamwork, and provides opportunities to take responsibility or charge. Teams outperform individuals acting alone or in a larger group, especially when performance requires multiple skills, judgments, and experiences (Wells, 2002).

Successful learning through a group project requires organization in the following key areas:

- **Types of group project:** Depending on the learning objectives of a course, a group project may live only during a class period or it may be stretched over a semester. Teaching unrelated concepts of a course may be suitable in the former case, while teaching related concepts such as that in the SDLC is suitable for a semester-long project. A semester-long project may be a fictitious or published case problem or it can be a real-life problem. A realistic project that represents today's business environment and implements necessary activities of cross-functional areas of a business domain is suitable for a group project. Real-world problem stimulate students' interest and motivation (Killingsworth, et. al., 1999). Some of the criteria to be considered in selecting a project include: the project must be large enough to require a high degree of interaction between individuals working on different components, the project must be doable during the time of the course, and a preferred project is report-driven than data-driven (Perkins, 1980).

- **Selection of the project:** One can select a project in a number of ways. It can be selected by the instructor or by the students, and all students may work on the same business problem or on different problems. Multiple business problems can foster more knowledge and class participation than a single problem.

- **Selection of project group or team:** A project team may be organized in various ways as well (Wells, 2002). Depending on the type of the project selected, an entire class may act as a project team (Fernandez and Williamson, 2003) or a class can be divided into multiple groups (Dodani, 1992). Wells (2002) suggests a group of 2 - 5 students. For smaller groups, there are many different ways a team may be organized. The instructor may assign the team members or the members may organize themselves in a group (Granger and Lippert, 1999). The groups can be homogeneous or heterogeneous depending on knowledge, gender, ethnicity, cultural background, and socioeconomic background. Ideally, a successful project team should reflect a real-world business team and that should be manageable. A successful team should also posses some characteristics such as: a small size, complementary skills within the group,

commitment to goals and objectives, and accountability of each team member's work (Wells, 2002).

COLLABORATIVE LEARNING

A collaborative classroom provides an interaction of the teacher, the pupil, the materials, and the context. The interaction may occur between the teacher and the students as well as that between the students themselves. In this method, students gain knowledge in key areas of the subject matter through active participation with the teacher and amongst themselves.

Granger and Lippert (1999) introduced collaborative learning where they assigned a small exercise to small in-class groups after the introduction of a key concept in the classroom. Nance (1998) introduced "within-course" and "cross-course" collaborations, where students in one class worked on a case problem as a group on a weekly basis while students from another course acted as project managers for the group.

TOTAL MANAGEMENT OF PROJECT-BASED LEARNING

Project-based learning when implemented in a collaborative learning environment can produce even better understanding of key concepts of the subject matter. This context of total management of project-based learning is based on some of the characteristics of a collaborative classroom discussed by Tinzmann,et. al. (2006). Some of the concepts of the total management of learning environment are:

- **Planning for the course:** Success in a project-based teaching requires a good planning for the course. It requires establishing a classroom climate that facilitates learning (Killingsworth, et. al., 1999). The climate can be set by defining course objectives, course activities, schedule of activities, expectations from students, and grade distribution. The project activities should address all areas of knowledge and skills that will be taught in the classroom.

- **Setting Goals and Expectations:** Like traditional teaching, the teacher still sets goals and objectives of the course and expectations from students. However, thoughtful planning by the educator ensures that students can attain those objectives in a timely manner through knowledge gained from the overall course activities.

- **Provide students with choices:** Although educators still set goals and expectations for students, they often provide students with choices that require critical thinking and challenges. For example, giving the choices of selecting a project concept or team members of a group might provide more interest to the project than forcing a project or team members to a team. These choices stimulate competition among project groups, thus providing a richer learning environment.

- **Sharing of knowledge among teachers and students:** In traditional teaching, the instructor acts as an information giver and knowledge flows only one way from teacher to student. A collaborative classroom provides an environment of shared knowledge. The teacher has vital knowledge about content, skills, and instruction, and still provides that information to students. However, collaborative teachers also value and build upon the knowledge, personal experiences, language, strategies, and culture that students bring to the learning environment.

- **Maintain two-way communication:** A collaborative classroom is alive with two-way communication. A major mode of communication is dialogue, and a major goal for teachers is to maintain this dialogue. Collaborative teachers typically start with a high-level of talk and maintain interactions when a whole class engages in discussion. They guide students' search for information and help them share their own knowledge.

- **Monitoring and Control of Tasks:** While teachers make overall plans for learning objectives and associated tasks, students assume much more responsibility in carrying out the activities. Monitoring and control of related tasks is necessary to achieve overall objectives of a course. Monitoring can be checking one's progress towards set goals. Adjusting refers to changes to planned tasks based on monitoring, in what they are doing to reach their goals. For example, a scheduled presentation on a group project may be rescheduled depending on the progress of another group. Project groups learn from each other, which helps better understanding of key concepts.

COURSE ORGANIZATION

We design our course curriculum on the framework of the project-based learning in a collaborative environment. The course is organized to provide multiple areas of knowledge through lectures, group projects, group presentations, documentations, research papers, classroom writing, and discussion. Over the years, emphasis on lectures has been reduced by placing all lecture notes in a course web site. The web site also serves as a central repository for all course-related resources such as syllabus, presentation schedule, research paper assignments, as well as past presentations and project documentations.

Like many other instructors of the SAD course, we focus on some of the important skills or knowledge a systems analyst should have. They are: SDLC, process modeling, use cases, data modeling, program design, user interface, CASE tools, communication, and interpersonal skills. We provide these skills to our students by incorporating various modes of learning and sometimes one skill may be covered through multiple course activities. For example, verbal communication is incorporated in the group project through team interaction and group presentation, while written communication is incorporated through documentation development, research paper writing, and classroom writing.

In-class writing can be used to reinforce students' knowledge on the content areas and to stimulate class discussion. There are multiple objectives of writing research papers: (i) writing formal papers following IEEE or APA style, (ii) understand the current job market for systems analysts, (iii) researching journals and magazines to gather knowledge in the subject area, and (iv) to provide aptitude for higher studies.

The main focus of this paper is the group project. While the students work on their group projects by implementing the activities of the SDLC, the instructor applies a project management style in planning, monitoring, and controlling overall students' activities in the course. The course plan is set through defining deadlines for specific course activity such as making of groups, scheduling group presentations, setting deadlines of research papers, and defining dates for tests and submission of final project binder containing all project documents. A copy of the current syllabus and other resources can be found in the course web site (https://mis.uhcl.edu/rob/Course/SAD/SAD.htm).

ISSN:2278-7690

The course delivery method very much follow the activities in various phases of the SDLC in a waterfall methodology, except some topics such as database and network concepts are not covered in detail in class, as these are covered in detail in other courses. However, students are given assignments on these topics at the beginning of the semester to refresh their memory. Similarly, user interface is not covered in the test, but students develop them as part of their project documentation. Other activities are shown in Figure 1.

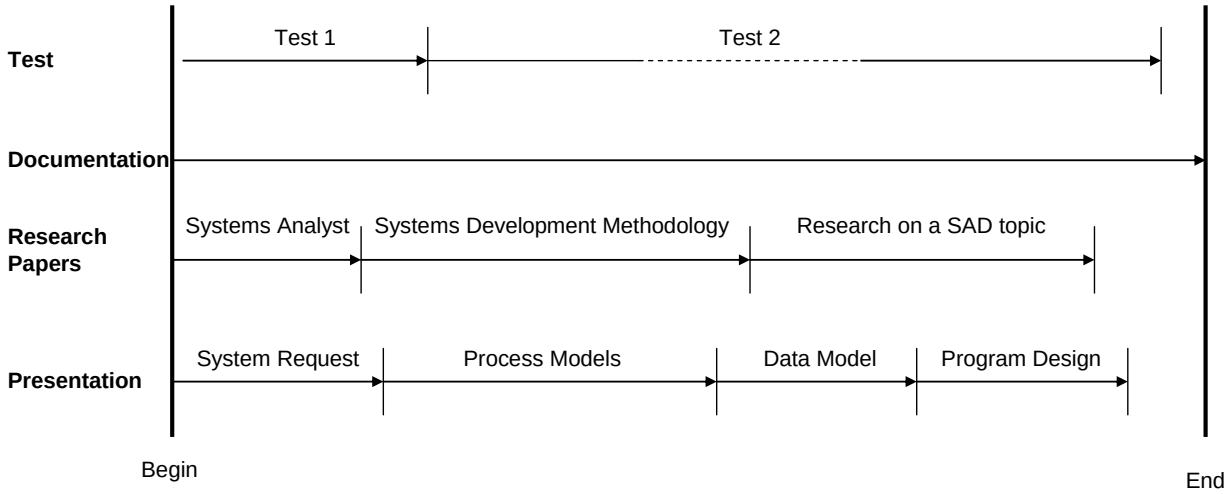

Figure 1: Timeline of student activities in the course

At the beginning of each class period, the instructor goes through the lecture topic drawing on students' past knowledge on the subject matter or detailing a parallel scenario experienced by most students in their daily lives. For example, in discussing the development of a project plan, students are asked how they would go by to build a house or plan a wedding. Generally, students will be given the concept of the scope as well as the tasks involved in completing the project. Then the tasks would be sequenced. By defining the tasks and sequencing them in various possible ways, students are given the knowledge of breaking a large project into smaller tasks and develop a project plan. They are then asked to apply the knowledge in their own project through the development of necessary documentation. By the second or third week, project groups are formed and presentation schedules are completed and posted on the web site. Students are expected to develop each of the documents that are covered in the previous lecture and be prepared for presentations. However, some adjustment to the presentation schedule occurs during the weeks of presentations. This is intentional and expected due to the reasons described below.

The Group Project

The purpose of the group project is to offer first-hand knowledge to each of the activities of the SDLC as well as to provide some experience on soft skills such as communication and team building. In the first few years of teaching, our focus was to go through the SDLC activities and develop a system prototype; however, in subsequent years, emphasis was placed mainly on the planning, analysis and design phases of the SDLC. This is driven by three factors: (i) the nature of the course as well as all the coverage of all SAD textbooks, which mainly focus on the first three phases of the SDLC, (ii) the concept that a well-designed system will produce a better product; and (iii) students already have experience of developing system prototypes through courses such as database or web development.

ISSN:2278-7690

Our group project activities fit the model of team development proposed by Wells (2002), which suggests four stages of team development: *forming, building, management, and assessment*. Students are given the opportunity to select their own projects, and it is found to work successfully in our classroom; possibly due to the availability of a blend of employed and mature students. Our purpose is that the students select a system of sufficient complexity and detail that both challenge and enhance their systems development knowledge and skills. Depending on the size of the class, a group consists of 2 - 3 students. As the majority of the group project activity is outside the classroom, it is found that for a larger group, the number of communication channels increase – and thus many times a group member fails to participate effectively due to poor communication or schedule conflicts.

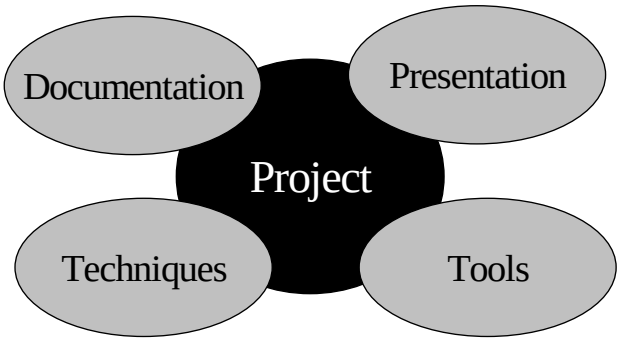

Figure 2: The constituents of a group project

In order to ensure that the students go through the activities of the SDLC in a successful manner, we focus on several aspects of the course that are implemented through the group project. They are: models or techniques (covered in SDLC), presentations, tools, and documentation. Refer to Figure 2.

Models and Techniques

Students are expected to gain substantial knowledge on the models and techniques covered in the SDLC. These include system request, feasibility study, project plan, data-flow diagrams, data dictionary, entity-relationship diagram, program design, and user interface design. Students go through the activities of developing documentations and make presentations on key concepts to master these models and techniques.

Tools

In the workplace, an analyst is expected to use many different tools to complete project documentations and to communicate with all stake holders. As such, students are required to use tools such as Microsoft Visio, Visible Analyst, Microsoft Project, and other Microsoft Office tools such as Word, PowerPoint and Access to develop system models, project plans, presentations, data dictionary, user interfaces, and system prototypes.

Presentation

Communication is one of the most important skills a systems analyst must have. A systems analyst has to interview customers to obtain systems requirements, develop all system-related documents, and present those to customers in both written and verbal manner. There are four presentations during the semester. See Figure 1. They are focused on the key models or techniques covered in the SDLC such as system request, process models, data models, and program design. The presentations are scheduled only after the completion of the topic in the class, and they serve as milestones to monitor the progress of the project activity. The first presentation is meant to initiate the project and is focused on the definition of the problem. Each group develops a system request document and

makes a PowerPoint presentation. Each group member must participate in the presentation. The instructor then provides suggestions as to whether the project is too simple or too complex, or whether the proposed system covers all components of a system such as inputs, outputs, database, and processing. The class is then asked to provide comments and suggestions.

Repetitions or rescheduling of some presentations is to be expected, especially that of the process modeling, which is the most important modeling tool learned through this course. Groups learn from each other's presentations and they are required to modify their presentations until the expected knowledge is found to be acquired. To accommodate all project groups, a particular presentation runs for about 2-3 weeks. Figure 3 shows the sequence of all four presentations. As shown, the last two presentations may be combined due to time constraints at the end of the semester. The course web site (https://mis.uhcl.edu/rob/Course/SAD/SAD.htm) contains many sample presentations.

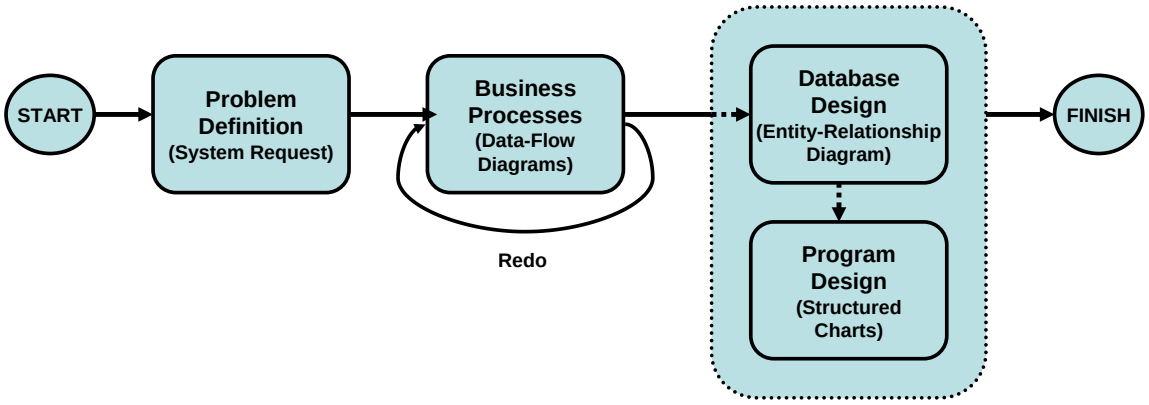

Figure 3: The sequence of presentations on the key models or techniques

Documentation

The ultimate goal of a systems analyst is to develop all system-related documents, leading to the design specification for the to-be system. A well-designed specification leads to the successful development of a system. Thus our main focus of the group project is to develop all documentation by the students as they go through each of the activities of SDLC in a waterfall methodology. Dennis et. al. (2006) provides a listing of the activities as well as the documents to be produced at the completion of each of the activities. Figure 4 shows a similar listing from the course syllabus that the students are required to develop in various phases of the SDLC. Through the development of documentation, students also develop mastery in their written communication skill.

Project Title

Table of Contents
Project Summary

Systems Planning
- Identify problems and define proposed solutions (System Request)
- Feasibility Analysis (hardware/software inventory, cost-benefit analysis, etc.)
- Project Plan
  - Size Estimation and Work Breakdown Structure (WBS)
  - Work Plan (Gantt chart/Pert diagram)
  - Staffing Plan
  - Risk Assessment

Systems Analysis
- Requirements Gathering (interview and questionnaire documents)
- Data Flow diagram
  - Context-level diagram
  - 0-level diagram
  - Next-level diagrams (some up to level 2)
- Data dictionary
  - Data flow with data structure (at least 5)
  - Data storage with data structure (at least 5)
  - Data input and data structure (at least 5)
  - Data output and data structure (at least 5)
  - Data element description (at least 10)
  - Process description (at least 2)

Systems Design
- Database design (E-R diagram)
- Input screen design (at least 5)
- Output reports/screen design (at least 3)
- Menu system design
- Program design (at least 2)
- Test scenario design (at least 2)

Systems Implementation
- System architecture
- Database (screen capture of tables and queries)
- Program codes
- User interface (screen capture of forms and reports)
- Program testing results

Appendix

Figure 4: List of documents to be produced for the project

These documents are organized and posted in a web site by each group for each semester. Refer to https://mis.uhcl.edu/rob/Course/SAD/StudentProjects/SADstudentProjects.htm. Figure 5 shows an example home page of a group project. These websites serve as learning tools for future students in the course.

ISSN:2278-7690

Figure 5: Sample home page of a web site created by students to store online documents for a group project

Assessment

Although not clearly identified, the first three stages of team building activities, namely the *forming, building, and management*, within the group project have been discussed above. The fourth stage or *assessment* has not been done in the past; however, during spring 2006, we have done a survey on the effectiveness of team building within the group project. The survey is also driven by the new requirement of *Assurance of Learning* by AACSB (American Assembly of Collegiate Schools of Business). Table 1 shows the survey questionnaire and the results. A total of 15 students worked on group projects and one student was absent during the survey. In addition to team building, the questionnaire also contained some questions on soft skills such as oral and written communications. A general observation of the results suggests that most students had a positive attitude towards learning the course materials and team building. It is worthwhile to mention that one member of a group complained at the end of the semester for non-participation of a team member. The strong disagreement of 7% in several questions might be due to the disengagement of this particular student

in that team, who happened to be a full-time worker and whose job required her to go out of town during the end of the semester.

Table1: Assessment questionnaire on team building and soft skills for the group project

Number	Question	Strongly Agree	Agree	Fairly	Disagree	Strongly Disagree	Total
1	The group project significantly helped me to understand the course materials	21%	43%	29%	7%	0%	100%
2	The group project helped me to improve my oral communication	7%	43%	36%	14%	0%	100%
3	The group project helped me to improve my written communication	7%	29%	43%	21%	0%	100%
4	The group project helped me to understand teamwork	14%	29%	29%	21%	7%	100%
5	I had fair participation in forming my team at the beginning of the semester	29%	57%	0%	14%	0%	100%
6	In general, members in my team participated fairly equally in all group activities	21%	57%	7%	7%	7%	100%
7	My team members took responsibilities of their task or work	29%	43%	14%	7%	7%	100%
8	My team members showed interest in initiating a task or work	29%	29%	29%	7%	7%	100%
9	My team members completed their portion of the task or work on time	36%	43%	7%	7%	7%	100%
10	My team members responded to my e-mails or telephone calls on time	43%	29%	21%	7%	0%	100%
11	My team members were helpful in resolving differences/conflicts between us	29%	36%	36%	0%	0%	100%

CONCLUSION AND DISCUSSION

We have described how group projects can be implemented in a Systems Analysis and Design course; especially it describes the activities of the course during the semester as well as management of group project activities. While the students work on their group projects by implementing the activities of the SDLC, the instructor applies a project management style in planning, monitoring, and controlling overall students' activities in the course.

Repeated presentations on some key knowledge areas of the course make students challenged and engaged throughout the course. Furthermore, actively going through the process of developing all documentations provide students with the first-hand experience of a systems analyst. Results of a survey performed in several semesters reveal that students have a significant positive attitude towards learning and team building.

In our MIS curriculum, teaching SAD through group projects is found to be more suitable for graduate students than that of undergraduates. Undergraduate students seem to work better with a well-defined case problem found at the end of each chapter of a SAD text (Shelly et al., 2006) as opposed to an open-ended group project. Maturity and motivation play important roles in the success of the group project in the graduate level. Graduate students are also found to have better understanding of required knowledge of database, programming and networking. Also the documentations created by graduate students are found to be better in quality than that of the undergraduates.

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