IPRO 301

Researching, Designing, Testing, and Evaluating

IPRO Program Enhancements

Spring 2008 Final Report

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1.0 Objective

IPRO 301 has the following objectives:

- Find a relationship between problem context and reflective thinking in order to understand if service-learning projects promote reflective thinking more than other types of projects.
- Determine the effectiveness of groupware on learning outcomes through research, design, and data analysis.
- Determine the effectiveness of IPRO Games on team functioning.
- Create an IPRO enrollment forecast, with seasonality and regressional analysis, for the upcoming semesters.
- Evaluate and determine if the development of a Code of Ethics, by students, leads to the development of ethical behavior.
- Identify and develop an effective method to improve inter-rater reliability for IPRO Day judging at IIT.
- Develop the innovation and design learning objectives, as well as improve student attainment of said learning objectives.

2.0 Background

The IPRO program at IIT, since its inception in 1995, has become a signature program of the school for it not only benefits participating students but also the corresponding sponsors and prospective employers of IIT graduates. During a student's participation of an IPRO, he/she is engaged in a multi-discipline, team-based learning environment to solve a real-world problem proposed by industry sponsors and/or IIT faculty. Additionally, the program is designed to allow students to develop and apply their teamwork, project management, communication, and ethical behavioral skills. Each semester, the projects courses offered change depending on the emerging social and technological trends in today's world.

In creating a continuous effort in enhancing the program experience for its participants, seven issues associated with administering, analyzing and evaluating the program's effectiveness have been identified: 1) reflective thinking and its relationship to the problem context faced by individual IPRO project teams, 2) the effectiveness of groupware (i.e. iGroups) on team and individual achievements of learning outcomes. 3) IPRO games participation and its effect on team functioning, 4) IPRO enrollment and its dependency on seasonality and other factors, 5) IPRO program's enforcement of Code of Ethics and its relation to the level of ethical awareness amount participants, 6) the accuracy of IPRO day judge and subsequent methods to reduce inter-rater reliability, 7) effectively teaching and incorporating design methodology into the IRPO program through the establishment of learning objectives. With the amount of investments and resources made by IIT and related individuals and organizations, it is essentially that for the issues to be

tackled as the continual success of the program directly effects the school and IPRO office's reputation and the incoming of potential resources.

Created for the purposed of addressing and solving the seven issues mentioned, team IPRO 301 has been enlisting a variety of technology and science-related methods analysis to further identify and understand the problem. For instance, literature reviews have been conducted on information collected on various professional and scientific databases, such as PsychInfo, JSTOR, and ASEE, etc. Statistics related software such as SPSS have been used to support and conduct mathematical data analysis to accurately correlate the problem identified and the variables affecting it. Furthermore, various research methodology, findings, and intervention designs have been recorded, conducted and tested to foster the enhancement of the IPRO program.

Prior to the establishment of this IPRO in Fall 2006 (previously named as IPRO 400), the IPRO program only had four general learning objectives, inadequate literature reviews, and inconsistent learning objective study guides. Credits to the research done by the IPRO 301 team in Fall 2007 and by various IPRO scholars, a series of interventions has been carried out. Five new IPRO learning objectives have been formulated with one new learning objective customized for EnPros. A study text was also identified and applied for IPRO ethics with two semesterly presentations by the book's author. One of the five new deliverables mentioned is directly related to the team-collaboration in coming up with a code of ethics, which has proven to help IPRO project teams examine the ethical issues attached to their particular IPRO therefore can possibility results in a change of ethical awareness. Comprehensive IPRO games were designed to increase team effectiveness and communication in the critical first five weeks of IPRO. Project management workshop was set up to effectively help teams raise their project plan grades and students become aware of the importance of project management. Additionally, an end-of-the-semester feedback form was designed and implemented to stimulate reflective thinking in students. The functions on iGroups have also been continuously developing and improving to encourage intra-team communication and to document the progress of all teams.

During the process of intervention design, testing and evaluation, each intervention is continually assessed and modified using statistical analysis and pre- and post- measures such as student, faculty and alumni surveys. Therefore, interventions that have been assessed as unsuitable, such as the reflective thinking intervention, were subsequently abandoned.

An ethical concern of IPRO301 is the testing on human subjects. As a result, all parts of the research must be certified by the IRB and participant consents are collected. If a team chose not to cooperate, coercion will not be used to implement system assessment. Various student and faculty attitudes are also encountered and treated as a barrier by this IPRO team. For example, the collection of pre- and post-test

scores of the learning objective tests is essential in evaluating their effective. However, some faculty overlooks the importance of the tests and thus results indifference in the students taking them. Such a situation poses a difficult problem for the team and makes it impossible to assess the intervention accurately.

The IPRO 301 team of Spring 2008 aims to continue on the progress on implementing practical solutions for the seven programs stated. Further literature reviews will be conducted to verify and validate previous assessments and more appropriate interventions are expected to be designed and implemented. Thorough data analysis will be conducted when seem fit. The team will also research for similar solutions to the problem previously implemented and correspond with national and international organizations. The entire progress and complete results will be documented and served as record to future IPRO 301ers.

3.0 Purpose & Methodology

To best achieve the goals listed in Section 1.0, the seven subteams of IPRO 301 will apply suitable research methodology, which will vary slightly from subteam to subteam shown as follows.

3.1 Forecasting Subteam

It is very important for a program such as IPRO to have a good forecasting model in place to enable them to plan efficiently. The forecasting subteam is responsible for creating a forecasting model that will accurately predict IPRO enrollment for the coming years. The responsible subteam member, Hannah, will begin by performing a literature review to collect relevant information on how to perform forecast analysis.

The knowledge gained about the forecasting process will be used to create a program that will perform the desired mathematical processes on the data. This program will generate forecasting models for two academic years. The subteam will then collect the updated enrollment information and enter this information into the data bank. The forecast modeling program will then produce to desired forecasts using both seasonality and regressional analysis.

The forecasting subteam will also work on any relevant deliverables, including the midterm presentation. All of the information generated and any programs created will be store in igroups for future use. It will also be stored in the subteam member's IPRO notebook.

3.2 Groupware Subteam

The groupware subteam is examining if the use of groupware affects certain outcome measures, and, if so, why and by how much. The groupware suite being evaluated is iGroups, which was specifically built to enable undergraduate project teams to collaborate on multidisciplinary projects. However, the problem this subteam faces is how to determine the correlation between groupware suite and learning objectives in undergraduate project teams because there is a definite lack of research in this very specific area. From the groupware suite, iGroups, Angela will accumulate the usage data such as the number of e-mails sent and files uploaded by each student. This data has been collected for previous semesters and measures how often a student uses the suite. Then she will analyze the data and correlate it to each individual's IPRO performance. Angela will also do a substantial amount of research on groupware to learn of any past experiments and to establish its effects on individuals.

The correlation of whether the use of iGroups and each student's IPRO performance will determine the groupware's efficiency. Student opinions about iGroups and its effectiveness will be also assessed through surveys. This data will be correlated to objective attainment in other IPRO assessment measures.

All documents used in this researching process, including Angela's research on groupware, her literature review and data analysis, will be recorded in iGroups/iKnow for continuing semesters to access it at any time.

Analysis will be done through Microsoft Excel and statistical software such as SPSS with the aid of graduate students or the Psych Service Center. Informal colloquial opinions will also be solicited to compliment formal surveys and test results. This subteam is also responsible for generating the midterm report and will assist team members on any other formal IPRO deliverables.

3.3 Inter-rater Reliability Subteam

The problem faced by the inter-rater reliability subteam is the emergence of inter-rater reliability (IRR) when humans are utilized as the measuring instrument, such as that on IPRO Day. IRR is the extent to which two or more individuals/raters/judges view a same phenomenon/object but don't agree on the same opinion/score. It also assesses the consistency of how a rating system is implemented. Therefore, it is important for the IPRO program at IIT to develop a comprehensive enhancement on its IRR and thus allow an accurate measure of the program outcomes.

To solve this problem, this subteam will first become familiarized with the previous work done on IRR. Jonathon Beagley from Fall 2007 had already written an algorithm in calculating the IRR for the IPRO day judging data from Spring 2007. He also identified several key references in literature reviews to gain understanding of the concept of IRR. Using the existing algorithm, further data analysis will be conducted

on all existing IPRO Day judging data. The results from the analysis will be correlated to the type of past interventions attempted to enhance IRR in order to evaluate their subsequent effectiveness.

Secondly, the subteam will also conduct extensive literature reviews on possible methods of improving IRR. All researched methods will be thoroughly studied with the IRR analysis results to seek the optimum intervention for IIT's IPRO Day judging. The possible use of SPSS, the statistical software will be investigated to explore its function relating to IRR. And finally, the subteam will recommend and develop an intervention program to be implemented by IPRO personnel.

All research and analysis conducted will be documented and archived in two locations: iGroups/iKnow, allowing access to anyone who wishes to see the work that has been done, and the other being the subteam's project/research notebook, which would be electronically published and available in print. This subteam is also responsible for the team's meeting minutes, and will be helping with the final report.

3.4 Learning Objectives Subteam

The learning objectives subteam faces how to teach students the concepts of innovation or design during their IPRO experience. These learning objectives were recently added to the IPRO learning objectives (LOs) and do not currently have test banks, study guides, interventions, assessment measures, or grading rubrics. As part of this IPRO, Carolyn will use identified bodies of knowledge to produce question banks for these two LOs, pilot the questions during the LO pre- and post-tests, and make revisions as necessary. She will also write appropriate study guides for students to be posted on the IPRO website and begin work to develop an intervention aimed at increasing student performance on one of these learning objectives.

The LO test questions will be run as un-graded pilots during the pre- and post-tests to collect preliminary data on student performance. Based on the results, questions may be reworded, modified, or deleted as necessary. Statistical tests may also be run on the questions to determine if subtler effects are at work (similar work has been conducted during previous semesters of this IPRO). Study guides will be put through a peer review process and the intervention outlined in sufficient detail that a pilot test may be run either late this semester or next semester. Student opinions on the intervention will be assessed and surveys used. This data will be correlated to objective attainment in other IPRO assessment measures.

Analysis will be done through statistical software known as SPSS with the aid of graduate students or the Psych Service Center. Informal colloquial opinions will also be solicited to compliment formal surveys and test results.

All documents used in this research will be recorded in iGroups for continuing semesters. Completed test questions are integrated into the existing IPRO learning objectives test and study guides posted on the internet for student access. Interventions will be detailed and plans recorded and given to the proper facilitators. Additionally, compilation documents will be recorded on iGroups that provide quick access to where to find all of this information. This subteam is also responsible for producing the project plan and will assist team members on any other formal IPRO deliverables.

3.5 Reflective Thinking Subteam

The reflective thinking subteam addresses finding a link between reflective thinking and IPRO service-learning projects. Although there has been considerable research done on both service learning and reflective thinking, there is only a handful of empirical evidence to suggesting that one promotes the other.

If the literature search yields evidence that there is a positive correlation between service-learning and reflective thinking, then the reflective judgment scores of the students in the service-learning IPRO's should show that they have developed a higher level of reflective thinking than the students who were not enrolled in the service-learning projects. Professor Huyck and Elizabeth Howard, along with previous IPRO 301 students, have previously developed a written method for analyzing reflective thinking. The level of reflective thinking of the student is then analyzed and assigned a level of reflective judgment. If the analysis of the data concludes that there is a link between service learning projects and higher reflective thinking, then it will be suggested that there are more service-learning projects incorporated as soon as possible to benefit the student's reflective thinking skills. The subteam will keep a clear record of all of the data in both a written and electronic format via iGroups to ensure that the information can be passed along to the next researcher.

Analysis of the reflective judgment test results will be analyzed in SPSS software with help from graduate students if necessary. Our hypothesis is that there will be a positive correlation between participation in a service-learning IPRO and a student's reflective judgment test score. This would indicate that service-learning may be a more effective method of encouraging reflective thinking in students. If there is not a significant correlation, then service-learning would appear to be as affective as regular IPROs at encouraging reflective thinking; the suggestion might be made that service-learning projects need to re-evaluate their methods for approaching their problem contexts. This sub team is also responsible for one third of the midterm presentation, IPRO Day Exhibit, and assisting team members on any other formal IPRO deliverables. Formal tasks for IPRO Day deliverables have not yet been assigned to any subteam.

3.6 Teamwork Subteam

The problem of the teamwork subteam is that while we know that teamwork games improve teamwork, IPRO Games to not seem to have a long-term effect on the functioning of IPRO teams.

To solve this problem, Margaret will be conducting a review of the literature. This review will consist of mainly of articles and dissertations found on PsychInfo among other sources. In addition, Margaret will speak with experts in the field of organized team games. The purpose of this is not only for anecdotal information and strategies but also to gain more information and resources. This research, which will be done by midterm, will be documented in the form of a notebook and iGroups. The notebook will be given to the advisors at the end of the semester to be passed down to the next semester. It will contain all the information necessary to follow the path of the previous person, including search terms, potential sources, and articles. Articles obtained in digital format will be stored in iGroups. The results of Margaret's literature search and expert sources will be compiled into a report which will contain a recommendation to the IRPO Program on ways to improve IPRO Games.

The recommendation will be implemented into the Fall 2008 IPRO Games for testing. Margaret hypothesizes that her recommendations will be minute adjustments to the program and will not need extensive testing; they should fit into the current IPRO Games framework. Analysis of the implementations will be measured through current measures of teamwork functioning used by the IPRO Office. Because the implementation is outside the scope of this semester, there will be no assignments to the subteam regarding testing, implementation or conclusions.

IPRO deliverables for this subteam will be submitted in the form of a paper as well as contributions to midterm reports, final reports and IPRO Day events.

4.0 Assignments

Each team member was assigned a team task so that the work of IPRO deliverables was evenly distributed. The assignments are displayed below.

- Kristin Bryant - Midterm presentation, IPRO Day exhibit
- Angela Gandhi - Midterm report, IPRO Day CD
- Margaret Kibilko - Team leader, agenda maker, time keeper, code of ethics, final report
- Hannah Kolb - Midterm presentation
- Heling Shi - Project plan, minute taker, iGroups organizer
- Carolyn Wood - Project plan, master scheduler, resume compiler, final report, IPRO Day abstract

Some work was reorganized after one of the team members dropped the course. All IPRO deliverables were completed on time. Additionally, for all the major deliverables the work was further broken down. For example, although Carolyn was in charge of compiling the project plan, each team member submitted her goals, methodology, tasks, and proposed schedule. A similar strategy was adopted for the midterm report, exhibit, etc. The person in charge of the deliverable combined everything into on coherent document and was in charge of collecting information and submitting the assignment online.

6.0 Obstacles

As with any project on the level that we are attempting to accomplish, nothing goes according to plan. Thus, there are several barriers that have come up through out the study of our project. The following is a report from each subteam on the obstacles that they have encountered.

6.1 Forecasting

The main obstacle faced by the forecasting subteam was the lack of documentation by previous semesters subteam members. It is important when creating a reusable model that one documents their work carefully and completely, so that future people can understand their work. Unfortunately, the information left behind was poorly written and hard to follow.

6.2 Groupware

The main obstacle encountered by the groupware subteam was the lack of research done in the field of interest. This made the literature review very difficult to complete because, when using search terms, there was not an easy way to eliminate research that was not relevant to our project. The best way these obstacles were resolved was by reading or at least skimming through the different articles relating to groupware and learning outcomes, and to go through the references from those articles in hopes of finding more relevant articles. Another obstacle this team faced was deciding which learning outcome was the best to use in determining the effectiveness of groupware use on team and individual achievements.

6.3 Inter-rater Reliability

The main obstacle faced by this subteam was to determine a standard method to evaluate interrater agreement. Originally, the evaluation method developed by the subteam from the previous semester was used to analysis the interrater reliability level of IPRO day judging. However, after further literature searched conducted by the current subteam, it was discovered that the method used was based on

outdated research and the most recent terminologies and evaluations for interrater agreement and interrater reliability have been reestablished. Therefore, the updated method had to be implemented to evaluate the level of interrater agreement. This resulted in demands of extra time and resources. The current subteam overcame this issue by pulling through and the re-evaluation of all data.

6.4 Learning Objectives

The first main obstacle encountered by the learning objectives subteam was after the body of knowledge and the test questions for innovation and design had been developed. We then realized that the developed questions could not be added to the existing learning objectives (LO) test due to length constraints.

The other main obstacle encountered by this subteam was that the LO test, due to outside factors, was under risk of elimination. This spurred the main movement to dramatically change the style and length of the old test to address faculty and student criticisms, as well as incorporate the new material in a limited format.

6.5 Reflective Thinking

The largest obstacle encountered by this subteam was with the literature search. The majority of literature published on the topic of service-learning and reflections are descriptive papers without any experimental data or analysis. The only way to resolve this issue is to work around it. The issue was combated by following references from the few studies we had that did have an experimental design. Another obstacle encountered during the reflective thinking research involved the design of the experiment. Because we cannot do any random selection or assignment, the scope of the results of the research is limited. There is no way to use random selection or assignment when working in this type of academic setting; however, it is acceptable to run an experiment such as this and report the results as relevant as long as the limitations are stated.

6.6 Teamwork

The first obstacle encountered by the teamwork subteam was the lack of literature on teambuilding games. It was difficult to find peer-reviewed articles, so the subteam had to result to books. While these books are informative, and generally written by respected experts in the field, they are not the same as a peer reviewed article in a journal. Future semesters should do a wider review of the literature that would result in the obtainment of articles not easily found online, such as dissertations and unpublished

materials. By being informed of what needs to be done, future members will have more time, which was the main barrier for the current team.

The other obstacle encountered by this subteam was the lack of knowledge about the current database and the lack of experience in data analysis. The problem was reduced through reading materials on data analysis and using SPSS, as well as meeting with Lizzy and Prof. Huyck. Future semesters could attend a tutoring session arranged for the team, as this seemed to be a recurrent problem for all subteams.

7.0 Results

6.1 Forecasting

After I created the first forecasting model, I realized that the forecasting could be done in such a way that another student need not spend an entire semester forecasting. I then created a forecasting program specifically for the use of the IPRO program. It remembers past data, so in future semesters another student will simply have to input the new data.

6.2 Groupware

After analyzing the data from fall 2006 and spring 2007, the results were very inconsistent between semesters with team and individual achievement on learning outcomes. If one semester a learning outcome was significant, it wouldn't be in the following semester. For example, the percent of mean files uploaded, percent of mean emails sent and the sum of both means for individuals in fall 06 and spring 07 were correlated wit, final report scores. These results indicated that final report scores are significant with all three independent variables for fall 06 but in spring 07 they were only significant with the percent of emails sent and the sum of both means. This type of results was shown for other learning outcomes as well. Therefore, our next steps are to do more data analysis for another two semesters.

6.3 Inter-rater Reliability

Data analysis was done to determine the interrater agreement level of the exhibit and presentation judging on Spring 07 and Fall 07's IPRO day. A comparison of the data showed that the exhibit scores from Fall of 07 had a much lower agreement level than the previous semester. The results were related back the interventions done and it was concluded that the decrease in agreement level was caused by the change from a high scale to a lower scale. Certain criteria/questions were identified to be the target in judges discussion for they have below threshold agreement levels.

6.4 Learning Objectives

As a direct consequence of the second obstacle encountered, the LO test underwent dramatic revisions. The new test is 40 questions long instead of 65 and contains the most conceptual rather than definitional questions. Faculty approval was obtained for the new version and some past serious critics are now strong advocates for the new version of the test. Additionally, a student-driven effort to improve communication between the IPRO office and the student body through TechNews has been started. A document with full documentation and explanations, as well as suggestions for future team members will be created and uploaded to iGroups.

6.5 Reflective Thinking

The results of the Reflective Thinking and Service-Learning research from this semester include an extensive literature review on reflective thinking work as it applies to service-learning projects. The second half of the semester, this subteam produced an analysis of the reflective thinking data to see if there was a relationship between service-learning and reflective thinking. The statistical analysis of the Fall 2006 and Spring 2007 data showed that there was no correlation between service-learning projects and higher reflective thinking skill level. The data analysis of IPRO students' individual reports confirmed the literature in this area. Another result of the data is that the reflective thinking activities were not increasing the reflective thinking levels of students. This may be because the activities are not well integrated into the course. Other results of the research indicate that the positive outcomes of service-learning courses do not match the IPRO objectives.

6.6 Teamwork

The findings of the literature review done by the teamwork subteam yielded two overarching themes, motivation and learning. It was found that students are more motivated to participate in an activity, like the games or peer reviews, when they are informed of the purpose and the benefits, such as learning outcomes. It was also found that students will feel as though the intervention is useful if they can take something away from it that will be useful for the future of their team; this will also increase their motivation. Lastly, the literature revealed that peer reviews should be behaviorally anchored, which means that for each expected behavior there is a range of possible behaviors that the students could choose from. Students should base these ratings on observable instances, as opposed to subjective judgments.

The analysis of my data showed that there is no significance between the groups who sent two or more people to the games versus the groups who did not. This semester I correlated outcome measures such as peer reviews, teamwork and trust survey, and IPRO Day data to see if there were any statistically significant data to suggest that teams who sent two or more people to the games scored higher than those who sent one or less. There was data to suggest that there could be correlations; however, this would take careful and more in depth analysis than was possible this semester.

8.0 Recommendations

6.1 Forecasting

I recommend that IPRO utilize the program I created. If it is updated every semester, new forecasts can be created in about 10 minutes. By keeping the data up to date, it will not be necessary to spend a lot of time entering data that has already been entered by me.

6.2 Groupware

This subteam recommends further data analysis to see if we can find consistencies between semesters. We recommend the continued use of the iGroups survey, as this is an important tool in finding out who uses the program and for those who do not, it could help to identify why and how we can improve it.

6.3 Inter-rater Reliability

Based on the results from the data analysis conducted so far, it is recommended that the judging scale should be changed back to 1 – 10 instead of 1 – 5. Additionally, based on literature searches done for this project, the IPRO program should be focused on providing judge training, promoting post-judging, prioritized discussion, and matching the judges to their expertise if possible.

6.4 Learning Objectives

This subteams recommendation, backed by the increased amount of faculty and student support, is two-fold. First, keep the LO test strongly contextual and avoid questions with synonym-like answers. Questions that are directly relevant to the student IPRO experience are received the best; and examples would be: “what is a feasibility study?” and “why is it important to take meeting minutes?”
Second, the IPRO office should strengthen its communications with the student body. Every revision to the IPRO program has strong reasons behind the change, but this is seldom if ever communicated to the

students or faculty who see only a new set of rules. Explaining why and what make a huge difference to the perceived usefulness of each change. Regular TechNews articles, as well as keeping a vocal IPRO301, are key steps in keeping this channel of communication open.

6.5 Reflective Thinking

If the IPRO Program would like to impact the reflective thinking skills of its students, this subteam recommends the integration of reflective thinking into the course itself. In addition, if there is to be continued analysis of student's reflective thinking skills, it should not be correlated with their involvement in service or non-service learning IPROs, as this correlation is not significant as determined by the literature and our data analysis.

6.6 Teamwork

The first recommendation of the teamwork subteam is to improve our current peer review instrument. To do this, we recommend behaviorally anchoring the scales, as well as asking students to rate fellow team members based on observable instances rather than subjective judgments. Lastly, we recommend informing the students as to the purpose and the benefits of participating in the intervention, as this will increase their motivation, which will help to obtain a better score.

Based on the team's research findings and conclusions, describe the recommended next steps for the sponsor or subsequent research teams. Recommendations are action steps that should be followed because you believe that more effective or less costly research results can be obtained if the recommendations are followed. The recommended next steps should relate back to the project problem and purpose and should describe how the team's findings can be used in conjunction with the recommended next steps to further research in the area. State the recommendations that the sponsor or IPRO teams should follow to improve future research projects generally or in this specific topic.

9.0 References

9.1 Groupware

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9.2 Inter-rater Reliability

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