

IPRO 330

Final Report

Introduction

Chicago Public Schools (CPS) annually hold a science fair competition requiring all high school students to create and present a science fair project. At the onset of the science fair process, there are local school-wide science fairs. The best student science fair projects are chosen to go to the next level of competition, the regional science fair. The best projects from this level are then forwarded to the city-wide science fair. Those students whose projects are among the best of the city then go on to the national science fair. Of course, there are very few projects that go to the national level.

Although these projects are extraordinary, many of the projects that are created are at a less than acceptable academic level. Chicago Public Schools teachers, the Applied Mathematics Department at IIT, the Mathematics and Science Education Department at IIT, the IPRO department at IIT, and IIT students alike have recognized the need for an improvement to the current science fair system in Chicago Public High Schools.

IPRO 330 was created for the Spring 2007 semester in order to allow a group of motivated and passionate undergraduates, consisting of Applied Mathematics and other related majors, alongside willing faculty and supportive teachers in Chicago Public High Schools to work together to create a greater and more accessible science fair bank to improve science fair projects. This aspires to ultimately encourage interest in mathematics and science in CPS students.

Background

Interest in doing an IPRO project of this kind arose from the concern that overall Chicago Public High School students were not interested in pursuing careers in mathematics and science. Curiosity in doing a project of this type originated from Michael McCourt, an Applied Mathematics student at the Illinois Institute of Technology. He gained support from the Applied Mathematics department, the Mathematics and Science Education Department, and another Applied Mathematics student, Anthony Parrillo. They worked closely with the IPRO department in an attempt to make this IPRO project available for the Spring 2007 semester. In order to do this, the IPRO department and the Applied Mathematics department worked together with the science chair of Area 23 of Chicago Public Schools in the Fall of 2006, then Chris Dignam, and a number of other Chicago Public Schools teachers, namely Eric Williams and Tammy Butler, interested in pursuing a project of this type. The project was approved because of the overwhelming support from the Chicago Public Schools representatives.

No IPRO to our knowledge had the same goal as this IPRO would have. The findings and materials that this IPRO put together would directly affect the quality of the Chicago Public Schools science fair, so the students in the IPRO took it seriously even before the IPRO officially began. Near the end of the Fall 2006 semester, Anthony Parrillo and Michael McCourt went to Dyett High School to assist students with their science fair projects and also examine the current situation of the science fair program at an average high school. As the team leaders of the upcoming IPRO, they were able to create a vision for the upcoming project which would improve upon the current status of the science fair program, and they began to plan the upcoming semester. They decided that the most effective way of presenting the information accumulated throughout the semester was to harness the technology available and make it available on a website. This platform is the most effective way of distributing our work to the Chicago Public Schools students.

In the beginning of this Spring 2007 semester, our IPRO also judged the regional science fair and collected materials to see the criteria with which science fair projects are graded. Throughout the

semester, a major focus of our IPRO was to get constructive feedback from Chicago Public School representatives ranging from officials to teachers. There was a midterm meeting held over Spring Break in which our IPRO gained even more feedback. We felt that feedback was critical for the success of this IPRO, since this is the first attempt for this IPRO. The feedback helped us to address ethical issues such as how much information is adequate to give the students in creating their projects. We also sought feedback to make sure that the projects appealed to students of all cultural and socioeconomic backgrounds. This helped us to focus on creating projects where the materials were all accessible or could be easily gained for amounts of money less than \$5 to eliminate any type of discrimination through our projects. Obtaining feedback from the professionals greatly helped our attempts to focus on such issues as ethical concerns and varying cultural backgrounds.

Purpose

The purpose of our IPRO was first and foremost to determine some way of tackling the broad problem that has developed in the United States of decreasing math and science literacy among our elementary and high school students. The way we chose to tackle that issue was to develop fun and interesting science fair projects, as well as guides on how to gather data and present it in a sound scientific and mathematical manner. Our hope is that, by developing these projects with an emphasis on proper application of the scientific method and use of mathematical analysis to present data, we can get more students to participate in science fairs, do better in those contests, and ultimately grow in their understanding of math and science and their desire for further education in those areas. The only issue left was in how to present our projects and guides so that they may be easily accessible to a large number of students, and our answer was to develop a colorful, easy to navigate website on which to put our projects, guides, as well as links to helpful explanations of the scientific and mathematical concepts behind our projects and guides.

The projects should cover material from all branches of science (biology, chemistry,...) but also as many aspects of math as possible. One aspect our IPRO hopes to consider is an appropriate definition of a math-centric IPRO. Up until now, no sufficient definition exists, and it is our hope to develop enough math-centric projects to allow teachers to decide individually if a suggested project is appropriate. Skills which may not be taught in the classroom, but are nonetheless necessary for success at the science fair (and in life, more generally) are the focus of the Guides team. Their purpose is to produce guides, tutorials and how-to's for various topics. Some of the guides are focused on techniques in data analysis, some on effective scientific writing, and some on verbal presentation skills. Of course, all this is a moot point if the CPS students have no access to the material; providing this science fair archive to the students is the job of the website team. To be a success, the website must be both full of information and interesting enough to encourage students to read through it.

Obstacles

While our project ran well most of the time, there were a few problems that we had to overcome to get to this final step. For instance, there were times when certain members of the project and presentation subteams had other commitments that caused them to fall behind in their IPRO duties. We did a good job of picking up the slack for those members during those times, though, and did not let these setbacks pile up on us.

There was also a particularly hot point of contention as to how much information we should provide to the students. Finding the right balance was hard, but we initially developed a standard format for our projects that the members of our IPRO agreed was neither too much nor too little information provided. We also planned to provide extra material that only teachers could view as supplemental information to the projects, but we actually found that many of the teachers we met with thought that that would be unfair to the students, as it was withholding potentially helpful information from them. We ended up scrapping that idea and working in the necessary information into the project

itself.

Ethically, one obstacle we faced dealt with the appropriateness of project topics for high school students. The coin game project in particular was based on the idea that one would unfairly have an advantage as the first player. While this seemed innocent enough to us, it was brought up that the project potentially encouraged gambling, as it had to do with money and unfair advantages. However, the mathematics behind the project were interesting and engaging enough that we decided to keep it in our list of projects and do our best to downplay any gambling connotations. Even so this required us to consider the fact that these projects have practical consequences in addition to their scientific merit. As such a science fair project about building a bomb would probably be deemed inappropriate.

Research Methodology

The first step to a successful science fair archive is to actually see for ourselves the state of CPS science fair projects. To this extent, we spoke with CPS science and math teachers and attended the CPS science chairs meeting to speak with as many science fair administrators as possible. We also worked with students on their projects to try and understand the broad spectrum of ability among CPS students. Later we judged a science fair in which these and other students participated. One important consideration is the interdisciplinary nature of our IPRO team. This allowed us to approach science fair projects from a variety of angles, and make sure that no one project is overly complicated or lacking in depth. We also spread out the IPRO team members by major between the subteams so that there would be logical input from each major in each subteam.

- *Website* - The website team took the results of the other subteams and posted it on the internet. This consisted not just of creating a site to house the projects, but a delivery tool to make the website as appealing as possible. At every point throughout the site, this team tried to remind students that they are capable of successfully completing a science fair project. Another important aspect of the site is that links are present to connect CPS students from our material to material already dispersed throughout the internet.
- *Project* – The project team had the job of developing the project to be posted on the site. They had to provide the website team with the write ups of the project, as well as personally carry out each project so that they can provide pictures. As many math-centric projects as possible were designed so that we could use the sum of them to describe an acceptable math-centric science fair project. It was determined that any project which explores a branch of math (geometry, numerical, calculus, probability,...) using the scientific method is an acceptable project.
- *Guides* - Because presentation of the results is also important to a successful project, the guides subteam designed skills guides which help impart material which is not directly covered in the all classrooms. This included guides about methods in statistics appropriate to analyze data (regression, hypothesis testing, goodness of fit,...), techniques for writing scientific papers, and verbal/visual display conduct to effectively present results. After judging the science fair it became apparent to us that some of the projects covered interesting material, but were presented poorly which prevented them from succeeding in the science fair.

Assignments

	Mike	Kai	Deep	Tony	Beags	Brian	Chad	Jane	Kevin	Shayne	Tom
Project Plan	X			X	X	X		X	X	X	
Midterm Report	X			X		X				X	
Meeting Minutes	X				X						
Judging Science Fair	X	X	X	X	X	X	X	X	X	X	X
Final Report	X			X					X	X	

Final Presentation	X	X	X							
Abstract	X				X					
Posters							X	X		X
March 15, CPS Meeting	X					X				
Website Team	X				X	X				
Projects Team		X						X	X	X
Guides Team			X	X			X			X
Purchasing Materials	X								X	X
Meeting Agendas	X			X						
Team Slacker			X							
Science Fair Student Discussion	X			X						
Communication with CPS	X			X						

Results

This semester, our IPRO group developed a functional website with fourteen projects and twelve guides on it to this date, complete with picture demonstrations for most of the projects and picture and video demonstrations for some of the guides. We also found through our talks with CPS officials that they like our ideas thus far and are encouraging their students to visit our website, not only for science fair projects, but also for learning basic data analysis techniques and other concepts from the guides we have developed. They are so impressed, in fact, that they are bringing around 150 high school students to IPRO day and making our booth one of their scheduled stops.

Research conducted this semester, including judging the science fair and discussions with CPS science teachers and administrators, has led us to design the project in its current form. Research conducted next semester will include input from CPS students who have used the website to help them complete their science fair projects.

Recommendations

We recommend that future IPROs continue to develop new and interesting projects for the website. It will be even more important next semester to continue discussions with CPS officials and teachers, as well as with CPS students if at all possible, to continue to receive constructive feedback which can be used to make the website, projects, and guides better. New additions to the project may include the addition of a rating system so that students can rate projects they have completed and give comment on the site to IPRO members and other CPS students. Also future teams may attempt to implement a forum on the site so that students may talk to each other and communicate about techniques for presenting their work or places to obtain materials. Next semester must take input from CPS teachers about the effectiveness of the math projects because the true definition of a math-centric project is still a topic of contention.

References

Area 23 Science and Mathematics Fair – 99 science fair reports by 2007 high school students

March 15, 2007 – Science department chairs meeting for CPS Area 23 high schools, headed by Kevin Hall

<http://www.neir.edu/~sfc/> - Recommended science fair site, mentioned at CPS meeting

<http://www.niles-hs.k12.il.us/jacnau/IJAS/> -Very thorough science fair site which describes judging criteria

Acknowledgements

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Judith Lederman: Assistant Director of Mathematics and Science Education at IIT. Gave departmental support by providing Chicago Public Schools contacts and assisted in supporting the beginnings of this IPRO.

Judith Zawojewski: Mathematics and Science Education Professor. Important contact liaison between our IPRO and Chicago Public School representatives.

Christopher Dignam: Area 23 Instructional Office, Science Instruction Specialist Chicago Public Schools. Instrumental in helping create this project by giving support from the Chicago Public Schools. He involved our IPRO as judges in the Regional Science Fair. Instrumental in giving us feedback to improve our IPRO.

Eric Z. Williams: Post-Secondary Specialist-Area 23, Chicago Public Schools. Also instrumental in forming this project and giving quality feedback.

Tammy Butler: Chicago Public Schools Representative. Gave support at the onset of this project and also supported us through feedback at one of our IPRO meetings.

Kevin Hall: Chicago Public Schools Representative. Gave constructive feedback at one of our IPRO meetings and also at our IPRO midterm meeting which occurred over Spring Break.

Della Leavitt: University of Illinois at Chicago Graduate researcher and High School teacher. Helped give important feedback at IPRO meetings and organized involvement of a field trip for middle school students on IPRO day.

Erin Washington: Teacher, Mark Sheridan Academy. Helped organize involvement of a field trip for middle school students on IPRO day.