

# Gemstone: Quality in Learning for a Collaborative Academic/Library Instruction Program

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## Abstract

This poster focuses on University of Maryland librarians' participation in an innovative, collaborative program where instruction extends beyond a typical library session, providing students with a quality learning experience over the course of four years. The program, called Gemstone, is an interdisciplinary honors research program and involves collaboration between librarians, faculty, program staff, and undergraduate students. During the first year of the program, the students attend classes that help them prepare for their research. After forming research teams, they spend the next three years designing and conducting a research project that focuses on the intersection of science and technology with society. This experience facilitates the development of research, teamwork, communication, and leadership skills, and culminates in the students' defense of their thesis, orally and in writing, to a panel of experts. Librarians are involved in the first year of the program through a class called GEMS 100. The librarians teach a session of the class where they introduce research tools and lead the students in critical thinking exercises to turn their potential topic ideas into research questions. During the remainder of the program, the librarians partner with a particular team. That partnership includes helping the students with research strategies on an informal basis, reviewing and critiquing proposals and presentations, and attending the Junior Colloquia and final Team Thesis Conference. By having librarians work closely with them throughout the research process, students further benefit from the advice, feedback, and expertise in research skills that the librarians provide. Thus, the librarians have the opportunity to provide quality, hands-on service over an extended period of time leading to an enriched learning experience.

## Introduction

The Gemstone Program at the University of Maryland (UM) is beginning its thirteenth year as of the writing of this paper. Nine graduating classes have received their Gemstone Citations in this four year undergraduate research program. In spring semester 2008, out of nearly 26,000 total undergraduates, [University of Maryland Office of Institutional Research, Planning and Assessment, 2008] 502 were in Gemstone and they had an mean grade point average (GPA) of 3.64 on a 4 point scale for the classes of 2008-2011 (see Figure 1). They must be Honors students, and be invited into Gemstone, and about 190 [University of Maryland Gemstone Program, 2008c] are chosen from 800 [University of Maryland Honors Program, 2008a] Honors students, who are first invited into Honors based on "...exceptional academic ability and promise." In fall 2007, these Honors Students had an average high school GPA of 4.28 (the inflated average is due to weighted courses) and SAT scores of 1400 out of 1600. [University of Maryland Honors Program, 2008b] (The SAT is a college/university admissions test used to measure verbal and mathematics skills.)

	GPA	TOTAL
Class of 2011	3.66	140
Class of 2010	3.63	135
Class of 2009	3.6	124
Class of 2008	3.65	103
OVERALL	3.64	502

**Figure 1. Average GPA of Gemstone Students, Classes 2008-2011**

*(Data provided by Angela Dawson, Gemstone Academic Advisor, May 19, 2008)*

One of the important characteristics of Gemstone is that it is multidisciplinary in nature, meaning that these students can come from any major. These Gemstone students conduct and present significant research that explores the interdependence of science and technology with society. Gemstone students will live and work together throughout their time at the University of Maryland and in the fourth year each team of students presents its project to leaders in the field in the form of a thesis. The projects provide the students with a “tangible sense of accomplishment.” [University of Maryland Gemstone Program, 2008a]

The Gemstone Program Mission says: *“We are committed to providing a challenging and rewarding team research experience. We are dedicated to the development of citizens, scholars, and leaders. Our efforts are focused on holistic student development, both inside and outside the classroom. We value qualities of mutual respect, intellectual excitement, collaboration, and diversity of thought. We strive to give our students the transferable skills valuable for wherever life will lead them.”* [University of Maryland Gemstone Program, 2008a]

The purpose of this paper is to highlight the unique qualities of this program and report on how, as partners in the program, librarians contribute to the students’ learning experience over the course of their college careers. In this program, librarians work with the students, as well as program staff and faculty mentors, to help students find and obtain the needed information resources for their classes and team research projects and to teach them research skills.

### **Gemstone Origination**

The idea for and the concept of the Gemstone Program was formally initiated in 1996 by Dr. William Destler, formerly Dean of the A. James Clark School of Engineering at the University of Maryland, later the UM Provost and Senior Vice President of Academic Affairs, and since July 2007, the ninth President of the Rochester Institute of Technology. Dr. Destler reported to us that “the term ‘Gemstone’ came from the old engineering tradition of having a senior ‘Capstone’ course where it was assumed that you could only do serious projects after three years of undergraduate study. I was (and am) unconvinced of this, and came up with the term Gemstone to trump the Capstone concept.” [W. W. Destler, personal communication, May 28, 2004] Also, according to Dr. Destler “the principal goals of the program were to a) encourage meaningful intellectual contact between students in widely varying majors, and b) to provide a thread that links students’ entire undergraduate career”. [W. W. Destler, personal communication, May 28, 2004] Some librarians learned about the program shortly before it was formally launched and saw a great potential for adding their formal participation to the program. The faculty starting the program welcomed the idea, but initially limited participation to two librarians.

Students invited to join Gemstone are selected from those already chosen by the UM Honors Program. Gemstone teams are, initially, comprised of eight to fourteen students and their research is to take into account societal implications as well as subjects related to engineering, science, and technology. A large pool of student suggested ideas from the late freshman year are utilized as these three year projects attempt to find gaps in current research where a technological solution is required to fill a societal need. Traditionally the largest group of Gemstone students has been from the A. James Clark School of Engineering or close to 23% of the total which is followed closely by the College of Chemistry and Life Sciences at nearly 22%. But over one-third of these bright and industrious students have double or even triple majors. Figure 2 provides a breakdown by College for the classes of 2006-2009, totaling 590 Gemstone students.

<b><u>College</u></b>	<b><u>Avg GPA</u></b>	<b><u>**Total</u></b>
Agriculture	3.48	15
Architecture	3.64	6
Arts/Humanities	3.67	47
Business	3.68	70
Chemistry/Life Sciences	3.66	119
Computer Science/Math	3.62	67
Education	4	4
Engineering	3.53	135

Health	3.71	2
Journalism	3.74	12
Social Sciences	3.77	81
Undeclared	3.5	30
**freshmen included in Total but not Avg GPA (UMD GPA)		
Double Majors	3.65	184
Triple Majors	3.57	26

**Figure 2. Distribution of Gemstone Students by College, Classes 2006-2009**

*(Data provided by Angela Dawson, Gemstone Academic Advisor, October 31, 2005)*

A \$400,000 grant from the National Science Foundation was used to support the Gemstone program in the early years along with grants of \$220,000 from the GE Foundation and \$150,000 from the AT&T Foundation.[Rahmoeller, 1996, p. 13] Other support came from educational and financial participation by corporate or government organizations through the Partnership Program. This includes the three facets related to the Partnership Program of 1) Gemstone Partners 2) Team Partners, and 3) Friends of Gemstone that provide varying measures of financial support and research ideas, as well as scientific advisors. [G. Rahmoeller, personal communication, January 13, 2003] The program is no longer dependent on soft funding, but Gemstone teams will seek grants on their own.

#### **Main features of the Gemstone Program**

Gemstone students come from many disciplines, but the program was started and is still managed by the A. James Clark School of Engineering. It is a living-learning community and the vast majority of the first-year students live in one large dormitory, Ellicott Hall, on the main campus. In this dormitory the students hold many of their activities and the Gemstone director and support staff have offices there as well. The program focuses on the whole student, not just the student in the classroom. Usually, mentors are faculty members with expertise in the topical area in which the Gemstone team members are working. However, they can be members of the University of Maryland staff as well, with experience/expertise in the desired area. Mentors meet with their Gemstone teams regularly, setting up a schedule conducive to all. They offer “advice and expertise about the substance of their topic.” [University of Maryland Gemstone Program, 2008b] Faculty mentors guide rather than direct. They receive a modest stipend and work with the team for three years.

During this time lasting relations develop between all parties. In most cases the teams meet weekly with the mentors present at those meetings. The students learn how to function as productive team members over the life of their projects. As indicated above, Gemstone students have already excelled academically in high school. Many are also leaders or will learn to become leaders. During their research projects, they learn to share leadership roles as well as to be productive followers. Gemstone also includes the heavy commitment of eighteen additional credit hours. [University of Maryland Gemstone Program, 2008c]

Students and new mentors receive training in the art and science of working in teams. Expectations are made very clear but students are given “significant latitude in making their own decisions.” [G. Rahmoeller, personal communication, January 13, 2003] The multi-disciplinary teamwork interaction provides real depth for their research projects. Some of the teams, such as *Smart Roads*, had mostly engineering undergraduates; but others, such as *Education Reform*, had a diverse mix of majors participating. One of the key outcomes is that graduates of the program learn to communicate effectively with technical and non-technical team members. This valuable experience may transfer to working relations the students will have in their careers. This type of training and experience is clearly valued by all professions and industries, and is a major goal sought by those who started Gemstone.[G. Rahmoeller, personal communication, January 13, 2003]

The librarians’ involvement with the Gemstone students requires working closely with a group of undergraduates on a team research effort for three years on the same project. Their contribution to the

Gemstone program over the four years is seen in each of the Gemstone classes. Librarians are part of a team research project from the formulation of ideas to the final formal presentation four years later.

### **Collaborative Programs at Other Universities**

Though much of the literature was reviewed in order to find programs somewhat comparable to the Gemstone Program, surprisingly little was found that closely matches it. While the programs described were similar to the Gemstone Program in that they provided opportunities for students to work collaboratively on science or technology related projects, they did not share other components of the Gemstone Program. Either the programs were not very long (one-two semesters), not diverse enough in including social sciences or arts and humanities students, or they were more like apprenticeships.

Research engineers and physicists are often known to conduct projects together as a team, as opposed to solo research popular in other disciplines. It has been noted that these project teams would often consist of only engineers. But Mansilla [2005] states that "... a deep understanding of contemporary life requires knowledge and skills that transcend the traditional disciplines. Such understanding demands that we draw on multiple sources of expertise to capture multi-dimensional phenomena to produce complex explanations or to solve intricate problems". [p.14]

Mansilla defines "interdisciplinary understanding" as the capacity to integrate knowledge from two or more disciplines in order to produce a cognitive advancement. [2005, p.16] She concludes then that "quality work integrates these perspectives to generate a new understanding --- one that would not have been possible using a single discipline." [Mansilla, 2005, p.19] This is the same precept used in the Gemstone Program to explain why the interdisciplinary element is one of its four key elements.

The original request made to the NSF for assistance on behalf of the A. James Clark School of Engineering noted that in 1996 at least twenty-three schools had programs related to what is referred to as Science, Technology, and Society (STS) --- an emerging field at that time. These schools include Cornell, MIT, Princeton, Georgia Tech, Vassar, and UC-Berkeley. [Rahmoeller, 1996, p.10] At that time, the STS Programs at the University of Pennsylvania's Science and Technology Wing appeared to most nearly resemble Gemstone's "residential, living, and learning program focusing on the effects and implications of science and technology". However, that program was limited to students with majors in technical fields doing technical projects only, and it lacked Gemstone's long-range research component. [Rahmoeller, 1996, p.11]

Some other programs have had common tangents to the Gemstone Program. For instance, the "Self as a Citizen" experiment at the New Century College at George Mason University (GMU) involved an integrated studies learning community. As with Gemstone, it was an interdisciplinary program but only included first year students whereas Gemstone is a full four-year program.[Eby, 2001] Another program with some similar features is the University of Delaware's Undergraduate Research Program. It involves all majors across campus but is more of an apprenticeship program that links students with faculty members who want to involve them in their research. [Gempesaw, Bennett, Zydne, & Bauer, 2003] Other programs worth noting include Ohio University, which developed a course for students in a variety of disciplines to participate in a project to design, construct, and control a team of robots for a competition [Elder, 2001] and Tennessee Tech University, which developed a course for students at all levels of study to work together by learning and at the same time teaching each other. [Birnacki & Ayers, 2000] The programs had more limited members than Gemstone (only seniors, only engineering students).

Other articles discuss issues that relate to Gemstone librarians' activities, such as interdisciplinary information consulting and work with honors students in general. Frank, Raschke, & Wood describe information consulting as an important expansion of the academic librarian's role, and discuss how interdisciplinary research is breaking down the traditional model of librarian liaisons to narrow subject departments. [2001] Penn State University librarians have worked with honors students on their theses, and covered many aspects of information such as intellectual property and other social issues. Although Penn State's honors program, like Maryland's Gemstone, has encouraged students to explore interdisciplinary topics outside of their majors and to present their findings at conferences, their projects generally are limited to several semesters. [Snavey & Wright, 2003] Oakland University Library emphasizes consulting in its information literacy program for Honors students and faculty. [Kraemer, 2007] However, Gemstone is still unique in the duration of librarians' involvement with a group of students.

## Gemstone Four Year Curriculum

In keeping with the trend at academic institutions to have librarians provide information literacy integrated within the curriculum, Gemstone has made a concerted effort to include librarians as an integral part of the team and its work. It has allowed librarians to provide more focused, quality service as they are involved with the students through the life of their projects. Dr. Neal Kaske, former Manager of the Engineering & Physical Sciences Library, lead the librarians' early involvement. He was a member of the Gemstone Advisory Committee, and was awarded a Libraries' Leadership Initiative Award in May 2001 for organizing library participation. [Engineering & Physical Sciences Library, 2001] By 2001, science and technology librarians were serving on 20 Gemstone teams, and 3 of them were discussants for senior team presentations. [Science & Technology Services Team, 2001] A brief overview of the four years of classes is outlined in Figure 3, including a birds-eye-view of the librarian's role for each year.

Academic Year	Courses	Librarian's Role
<b>Freshman</b>		
<b>Fall Semester</b>	GEMS 100 (1 credit) - <i>Freshman Honors Colloquium: Introduction to Gemstone</i>	Small team of librarians provide library session and students complete project worksheet
<b>Spring Semester</b>	GEMS 102 (1 credit) – <i>Research Topic Exploration</i>	Librarians provide information on how to complete project sheet
	GEMS 104 (3 credits) – <i>Topics in Science and Technology and Society I</i>	Librarian and archivist give in-class demo; Web page (tutorial); additional session at University Archives
<b>Sophomore</b>		
<b>Fall Semester</b>	GEMS 202 (2 credits) – <i>Team Dynamics and Research Methodology</i>	Librarian in-class demo; introduction to working with team librarian
	GEMS 296 (1 credit) – <i>Team Project Seminar</i>	Teams begin to work with designated team librarian(s)
<b>Spring Semester</b>	GEMS 297 (2 credits) – <i>Team Project Seminar II</i>	Librarian provides reference support on as-needed basis
<b>Junior</b>		
<b>Fall Semester</b>	GEMS 396 (2 credits) – <i>Team Project Seminar III</i>	Librarian provides reference support on as-needed basis; review draft thesis; attend and/or serve as moderator at Junior Colloquia
<b>Spring Semester</b>	GEMS 397 (2 credits) – <i>Team Project Seminar IV</i>	
<b>Senior</b>		
<b>Fall Semester</b>	GEMS 496 (2 credits) – <i>Project Writing Seminar</i>	Librarian provides reference support; review drafts of thesis; attend Presentation Rehearsal and provide feedback to team; attend Team Thesis Conference; attend Gemstone Citation Ceremony
<b>Spring Semester</b>	GEMS 497 (2 credits) – <i>Team Thesis Defense Seminar</i>	

Figure 3. Gemstone Curriculum 2006-2010 with Librarian's Role

Following is a description of the Gemstone curriculum detailing the significant role of librarians throughout the four year cycle that shows the quality and range of services able to be provided in a long-term program.

### **Freshman Year**

During their freshman year, the students take two one-credit courses, GEMS 100: Freshman Honors Colloquium: Introduction to Gemstone, taught by upperclass student section leaders, and GEMS 102: Research Topic Exploration. GEMS 100 provides the students with an orientation to both the Gemstone Program and the University of Maryland. In small groups, the students are taught about responsibilities of Gemstone students, discuss the social value of a liberal education, become aware of current events and how that feeds into a topic, become involved in a cultural activity to learn more about diversity, learn the importance of the arts in society and society's relation to technology, participate in five hours of a community service project, discuss academic integrity, prepare for teambuilding, and read an assigned class book for discussion about its relation to Gemstone. During this time, they also engage in a mock topic selection process to prepare them for GEMS 102 in the spring. In GEMS 102, students propose research topics to work on for the next three years and then vote on their top choices. They are assigned to teams based on their top three choices. At the end of the semester, they meet in their new teams and begin the team development process with a section leader.

*Librarians' role:* In this year, librarians provide an overview of library resources, instruction in basic search strategies, and guidance as teams practice selecting a topic and developing a research question. A small team of librarians teach approximately sixteen sections of a library session for GEMS 100. Each team comes to the session with an initial topic for a Gemstone project. The librarian teaches them to brainstorm keywords, looking at the topic from multiple perspectives. Following an overview of the libraries resources and services, including appropriate databases for searching on their topic and constructing search strategies, the students work in groups to refine their research question, find four to six authoritative references, and complete a project worksheet with the librarians providing advice. Librarians use student evaluations, in the form of a journal entry, to assess the success of the class. For GEMS 102, a librarian presents to the entire class of approximately 150 students on research strategies. Librarians encourage students to contact them for help as needed throughout the year.

### **Sophomore Year**

In their second year, students take a two-credit course, GEMS 202: Team Dynamics and Research Methodology, a one-credit course, GEMS 296: Team Project Seminar I, and GEMS 297: Team Project Seminar II, a two-credit course during which the team thesis proposal is written and presented to a committee. GEMS 202 is taught by Gemstone staff and involves upperclassmen as mentors to the new teams. The course focuses on understanding group dynamics and learning basic research methodology and culminates in an initial draft of a research proposal written collaboratively as a group. In GEMS 296 and 297, the teams meet weekly with their mentors to focus the research topic, formulate the research question, review the literature, and discuss the research process as they synthesize the elements into a final draft. The focus is on identifying and describing the instrument(s) to be used for data collection, submitting an Institutional Review Board (IRB) application if involving human subjects, and continuing with the literature review. They present their research proposal to a committee of Gemstone staff and experts in the spring.

*Librarian's role:* In this year, librarians begin work with a specific team, offering in-depth research strategies and tips, helping students hone their topic and research question, and providing feedback on the project proposal draft. Prior to the sophomore year, Gemstone staff work with the Coordinator of Gemstone Librarians to recruit librarians to work with a Gemstone team based on preliminary topics, research questions, and descriptions provided by the teams. Each team typically has one librarian, but at times two librarians will work together to combine expertise or to mentor a new Gemstone librarian. A few librarians volunteer for more than one team in a given year and have worked with as many as 4-5 teams simultaneously across graduating years. Due to the interdisciplinary nature of the topics, there is participation by a wide range of librarian subject specialists with expertise in areas such as government documents, education, politics, economics, adaptive technology, biology, agriculture, and engineering.

In the fall, the librarian conducts a brief library instruction session to meet the team in person, to allow the students to describe their progress to date, and to demonstrate research techniques and resources, based on the interests of the students. This meeting sets the stage for the relationship that

will continue between the librarian and the team for the next three years. Frequently, the focus is on sharing the librarians' expertise in selecting appropriate sources, avoiding plagiarism, scanning articles for important points, critiquing an article, building knowledge about the research problem, and exploring the literature. Librarians also provide advice as the students work on refining their topics throughout the literature review process.

### **Junior Year**

In the fall semester of the junior year, the students take GEMS 396: Team Project Seminar III. This two-credit course directs the students in implementing their research, outlining the thesis, identifying experts to guide the project, and presenting their progress at the Junior Colloquia. In the spring, the two-credit GEMS 397: Team Project Seminar IV engages the students in completing their original research by the end of the semester, writing a draft of their thesis, sending the draft thesis to experts for comments and recommendations, and presenting their progress at a poster session on Undergraduate Research Day at the University.

*Librarian's role:* In this year, librarians support the team by offering research guidance, reviewing the draft thesis, and attending presentations. Librarians serve a continuing role of reference and support. They are often asked to review the draft thesis for the team, focusing on the quality of the bibliography, and are encouraged to attend the Junior Colloquia and Undergraduate Research Day to provide support and ask questions. Some Gemstone librarians serve as moderators for the sessions in which students present their research.

### **Senior Year**

In the fall semester of the senior year, GEMS 496: Project Writing Seminar is a two-credit course in which students attend a senior orientation in September, complete the analysis of their research data, and redraft the thesis based on their analysis and the comments received from experts or future discussants. In the spring, the program closes with GEMS 497: Team Thesis Defense Seminar, a two-credit course in which the team thesis is completed. There is a Presentation Rehearsal and the final work is presented and defended at the Team Thesis Conference. At the Conference, which is open to the public, professional experts in the field are invited to be discussants in a panel format and offer suggestions for improvements to the thesis. The final thesis is submitted after having incorporated suggestions made by discussants.

During Commencement week, recognition for the graduating teams' work is made at a formal Gemstone Citation Ceremony with parents, friends, mentors, and team librarians in attendance. Each student receives a certificate and a Gemstone medal. Awards are given for specific categories of achievement for individuals and teams. The best Gemstone thesis of the year is determined by three judges who typically consist of a professor, an instructor in the Gemstone program, and the Coordinator of Gemstone Librarians, all of whom have strong research backgrounds.

*Librarian's role:* In this year, librarians continue supporting the team with research needs and advise on their presentations. Librarians often review drafts of the thesis and are encouraged to attend the Presentation Rehearsal and the Team Thesis Conference as well. Some librarians have been asked to serve as part of the discussant panel at the final presentation. Librarians are also encouraged to participate in the Gemstone Citation Ceremony during which they are formally acknowledged, receive a certificate of appreciation, and are part of the team pictures.

### *Gemstone Librarian Experiences*

***As noted, the Gemstone program provides a unique and valuable opportunity for librarians to follow students as they progress through their research project. This setting allows for establishing relationships with the students; providing hands-on service and instruction with many opportunities for follow-up, feedback, and reinforcement; tracking new developments alongside the students; and seeing the outcomes of the students' growth as researchers. In the experience of one librarian, she has been able to follow the students from their first weeks in the program where many don't know what a database is, through their sophomore year where they have requested sessions beyond what is required in the program to learn more sophisticated research tips, to their junior and senior years where they value feedback on their papers and presentations, grateful for another set of trusted eyes and ears.***

In addition to their primary role in helping the students to be successful in conducting their research, at times Gemstone librarians are invited to be involved in an experiential part of the project along with the

team of students and mentor by stepping out of the library and joining the team "in the field". Following are a couple of examples of these memorable adventures.

The agriculture subject librarian on the Sustaining Wetlands and Marsh Protection Team (S.W.A.M.P.) was invited to accompany the students and mentor to a National Agriculture Library wetlands site in Maryland. It was anticipated that this would be a good activity for team bonding. Not only was the experience a good one for bonding among teammates, but there was a lot of bonding between the heavy knee-high boots that were worn to wade through the incessant mud in this swamp-like site. In fact, many of the participants had to be pulled out of the miry mess and even out of their boots where necessary!

In another team, some of the students developed an idea called "Doc in the Box" in order to improve communication between paramedics in the field and the emergency room of a hospital in life-or-death situations. The team librarian persuaded officials responsible for emergency situations on the University of Maryland campus to allow some of the Gemstone students to accompany the ambulance personnel in real life trips in order to test out their ideas and prototypes related to their quest.

### **The Future of Gemstone**

The Gemstone Program at the University of Maryland in College Park has matured into a prestigious honors program with almost 600 students currently enrolled and over 30 Gemstone teams. Of the nearly 150 incoming freshmen students that entered the program for fall semester 2007, the average SAT score was 1467 and the median GPA was 4.49. This is up from the first Gemstone year 1996/97 when the average SAT was 1417 and the GPA 3.96. Many Gemstone students use this particular undergraduate research experience as a steppingstone to graduate or medical school.

Younger siblings and friends are now joining this unique experience through the referrals of current Gemstone students and alumni. In 2003 Gemstone was mentioned on "It's Academic", one of the Washington DC area's longest running television shows where three top students of local high schools compete to answer questions presented to them. A senior, when asked about his plans for the following year, proudly stated that he was going to the University of Maryland --- and would be part of the Gemstone program. Gemstone continues to be an invaluable undergraduate interdisciplinary team-based research program at the University of Maryland with many opportunities for students, faculty, and librarians to work together to create an enriched learning experience.

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