

**Camp Badger – Exploring Engineering™
Challenges and Best Practices Learned in Twelve Years of Leading a University
Based Engineering Summer Camp for Middle School Students - 11382**

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ABSTRACT

Camp Badger – Exploring Engineering™ is a weeklong, in-residence, summer camp for middle school children offered by the Department of Engineering Professional Development (EPD) at the University of Wisconsin – Madison (UW). The mission of the camp is to introduce Wisconsin youth, particularly those from underserved populations, to engineering through a strong UW and an engaging camping experience. In the 12-year history of the camp, Camp Badger – Exploring Engineering™ has been successful in exposing underserved populations to science, technology, engineering, and mathematics. When compared to University of Wisconsin – Madison, College of Engineering undergraduate enrollments statistics, Camp Badger – Exploring Engineering™ exceeds in female and underrepresented minority participation. Similarly, economically disadvantaged campers are served through an aggressive scholarship program that provides assistance to more than two-thirds of Camp Badger – Exploring Engineering™ participants.

INTRODUCTION

Camp Badger – Exploring Engineering™ is a weeklong, in-residence, summer camp for middle school children offered by the Department of Engineering Professional Development (EPD) at the University of Wisconsin – Madison (UW). The camp employs concepts from adventure and experiential learning to provide campers with a rich exposure to science, technology, engineering and mathematics. The camp strives to serve its mission and core values by actively recruiting girls, children representing racial and ethnic minorities, and children from economically disadvantaged backgrounds. This paper reports on Camp Badger – Exploring Engineering™ program performance statistics and demographics of camp participants.

EXPERIENTIAL AND ADVENTURE LEARNING LITERATURE REVIEW

Elements of experiential and adventure learning guide the design and spirit of Camp Badger – Exploring Engineering™. Experiential education has its foundation in Constructivist learning theory, which postulates that learning is the outcome of interactions between concepts and ideas held by the learner and the application and recognition of them through the learners’ experiences. Educational pioneer John Dewey created an educational movement in the early 1900’s that employed complex and challenging projects that reinforced learning through the integration and application of

factual information and social concepts. Adventure learning ventures are designed to provide learners with novel, and challenging experiences that promote personal development through personal and group achievement. A key element of adventure learning is placing learners in unfamiliar situations that provide them the opportunity break through perceived obstacles in their routine environment, and recognize their ability to succeed in ways that were heretofore unimaginable.

Camp Badger – Exploring Engineering™ was created to provide campers with an understanding of how science, mathematics, technology, and other factors combine to influence the practice of engineering. Science, Technology, Engineering, and Mathematics (STEM) curricula and programs have been an area of focus for political and educational leaders in America. In *Rising Above the Gathering Storm* [1] the National Academies warned, “the dominant position of the United States depended substantially on our own strong commitment to science and technology and on the comparative weakness of much of the rest of the world. But the age of relatively unchallenged U.S. leadership is ending.”¹

Frequent comparisons of US performance on standardized science and mathematics scores reveal that the US performance on standardized science and math in the 8th grade falls in the middle of subset of nations that either have advanced economies that compete globally in fields related to science, technology, engineering, and mathematics (STEM) or have developing economies with rapidly growing capabilities in these areas.² In this analysis, the Trends in International Mathematics and Science Study (TIMSS) [2] assessment found that the U.S. eighth grade average mathematics score of 508 was also below the combined average (514) for 16 selected nations and below 5 nations' individual averages, and that the United States scored higher than 7 nations, putting it just above the middle among these 16 nations.³

To address the challenge of lagging STEM performance, a number of organizations have developed experiential learning programs. Project Lead The Way (PLTW) has developed a rigorous STEM curriculum and teacher development program for middle and high schools. At present, PLTW claims to have established programs in all 50 states, which has led to the engagement of more than 350,000 students.⁴ Two other experiential learning programs, FIRST Robotics⁵ and the Science Olympiad⁶, employ a technical

¹ *Rising above the Gathering Storm*. Washington, D.C.: National Academies, 2005. p. 9.2.

² Science and Engineering Indicators, Student Learning in Mathematics and Science, National Science Foundation, *Science and Engineering Indicators 2010* Arlington, VA (NSB 10-01) | January 2010

³ Ibid.

⁴ Homepage, Project Lead The Way, <http://www.pltw.org/>

⁵ First Robotics Homepage: <http://www.usfirst.org>

competitive challenge model, where student teams vie to develop technical solutions to practical problems. A key element in these competitive programs is the engagement of the engineering professional community in roles as coaches, mentors, and judges. Experiential and adventure learning is the cornerstone for a number of summer camps, including the University of Wisconsin – Madison Camp Badger – Exploring Engineering™. Camps similar to Camp Badger – Exploring Engineering™ provide either day camp or in-residence camping experiences to middle school students. Camp themes range topically as well as in the range and depth of topical engagement. Similarly, STEM camp mission statements reflect a wide range of program objectives. The research on the impact of STEM camps is quite limited, and generally reports measures of participation and customer satisfaction.

In one study of urban campers, participation in a science camp found it reasonable to predict that participants were more likely to pursue further education, and possibly even a career, in the field of science [3]. In a different study of a science camp for high school students, researchers demonstrated that the camp is meeting its primary objective of moving more students towards studying the physical sciences in college [4].

In addition to developing STEM knowledge and skills, summer camp experiences have demonstrated effectiveness in developing moral decision-making, social skills, and positive personality characteristics. In a study of an outdoor adventure education program, the evaluation results suggest that using a strengths-based approach in outdoor and adventure education has merit in supporting developmental outcomes in three key ways: (a) by focusing their attention on opportunities for personal development, (b) by enhancing their personal relationships, and (c) by helping them respond effectively to physical challenge [5]. Findings of a study of girls in Passages Northwest, an adventure-learning program, indicate that these programs create an environment where girls develop physical, expressive, and moral courage [6].

From this discussion, one can conclude that experiential and adventure learning activities in a summer camp milieu can have an impact on a camper's intellectual, social, psychological and physical development. Additionally, the camp experience may be transformative in opening camper's appreciation of, and career opportunities in, science, technology, engineering, and mathematics.

CAMP BADGER – EXPLORING ENGINEERING™ PROGRAM OVERVIEW

Camp Badger – Exploring Engineering™ is a weeklong, in-residence, summer camp for middle school children offered by the Department of Engineering Professional Development (EPD) at the University of Wisconsin – Madison (UW). The mission of the camp is to introduce Wisconsin youth, particularly those from underserved populations, to engineering through a strong UW and an engaging camping experience.⁷ In support of

⁶ Science Olympiad Homepage: <http://soinc.org/>

⁷ Camp Badger Presentation, UW-EPD, 2009

the mission, the camp adheres and operates around a stated set of core values. These include:

- Our commitment to creating an environment that can awaken a child's senses, curiosity, and desire to learn.
- Our commitment to provide safe, fun and nurturing learning environment.
- Our commitment to inclusiveness; welcoming all regardless of race, religion, socioeconomic status, disability, or other aspect of diversity.
- Our commitment to serve the future of the University, our community and our profession.
- Our commitment to support parents and teachers in their work in developing the next generation

Camp Badger – Exploring Engineering™ is structured as service provided through EPD. The camp is funded through participant fees, corporate and foundation philanthropy, and through support from the UW. The Chairman of the Department of Engineering Professional Development provides executive oversight. Facilitators, who include UW faculty, K-12 teachers, and similarly prepared professionals, staff the camp. Undergraduate students comprise the majority of camp counselors. And a student coordinator manages the camp schedule, housing, and logistics; EPD staff provides administrative and marketing support.

The target audience is Wisconsin students who will be entering 8th grade. Students must complete a camp application and essay to be considered for enrollment. In addition a teacher in their home school must write a letter in support of the camper's application. This requirement is intended to strengthen the relationship between the camp experience and on-going K-12 schooling. Campers are selected on the basis of need, first time opportunity, strength of application and teacher nomination. The camp provides participants with an adventure / experiential learning experience. The primary objective is to provide campers with positive experience and exposure to engineering, and to help campers envision a college career, in addition to having a positive camp experience.

Camp Badger – Exploring Engineering™ is an in-residence camp, with campers housed in college dormitories on the UW campus. A typical camp has 32 campers. Each year five weeklong sessions are offered, with a sixth added this past summer to accommodate more participants. Sessions are a mix of technical explorations, discussions, research, field trips and recreational activities that transform an 8th grader into a college student. The sessions are designed so campers can explore the possibilities of engineering, and gain exposure to a wide range of engineering activities and disciplines. In a typical week, campers are exposed to a wide range of engineering activities, ranging from nuclear power plant design and operations to field environmental systems engineering. In addition, campers grow through group recreational activities.



Illustration One – Camp learning activities – Nuclear Energy



Illustration Two – Camp learning activities – Nuclear Energy

Sessions are generally led by practicing professionals who volunteer their time and organizations to provide a rich, real world, learning experience. In this model, campers meet and interact with practicing professionals, and through their questions, each gain an understanding of the people and the profession. Similarly, campers gain direct exposure to people and places they would normally be excluded from. Finally, having UW students as camp counselors has been reported to be very effective in creating relationships with campers, through which they can envision themselves as college students. Interspersed throughout the week are learning laboratories, where campers apply mathematics and science through engineering problem-solving challenges. These activities range from the construction of “marshmallow bridges”, to performing materials

testing and analysis, to learning how to use lasers to analyze lunar soil. Camp experiences include opportunities for group and individual reflection and an assessment of what was learned. On the last morning, the campers make short presentations to their families; all in an effort to have the parents better understand the university experience in which their children participated.

A number of factors have been identified as critical to the program's success. First are the commitment of the UW College of Engineering and the dedication of the camp leadership. This commitment and dedication have sustained the program through times of financial and organizational challenge. Second is the strong support of a dedicated corps of volunteers, businesses, and governmental agencies that form the core of the camp curriculum. Engaging K-12 teachers in the nomination and application process has been a critical factor in developing highly beneficial long-term relationships with parents and the community. The final key success factor is the financial support from corporate, foundation and individual sponsors. This money provides scholarships that enable the participation of campers from economically disadvantaged situations. No limit is set on the number of scholarships provided.

CAMP BADGER – EXPLORING ENGINEERING™ PERFORMANCE METRICS

Camp Badger – Exploring Engineering™ is entering its 13th consecutive year of operations. Throughout its existence the camp has measured performance against mission imperatives. Program metrics include application and enrollment activity, and measures of diversity inclusion for gender, race and economic diversity. This section reports Camp Badger – Exploring Engineering™ performance over the history of the program, and provides comparisons to similar measures for the UW College of Engineering.

The number of enrollments in Camp Badger – Exploring Engineering™ is constrained by the number of available slots in a given year. During the first two years of operation, Camp Badger – Exploring Engineering™ offered only two sessions, and annual enrollment ranged from 60 to 69 campers. From 2001 through 2009, Camp Badger – Exploring Engineering™ offered five sessions each year, during that period average enrollment was 165 campers. In 2010 a sixth session was added to accommodate ever-increasing applications. In that year, 201 campers participated.

Though capacity improvements have increased the number of campers enrolling, many applicants are turned away for lack of space. Over the past seven years, enrollment numbers in Camp Badger – Exploring Engineering™ have been in a range from 54% to 76% of all applicants, with an average of 60% over the past three years. Table 1 shows total enrollment and total applications by year.

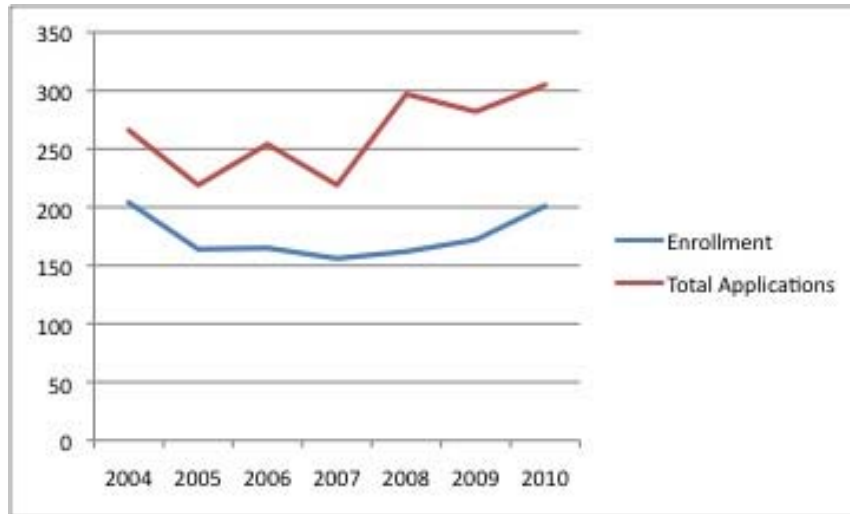


Table 1 - Total enrollment and total applications by year

In addition to maximizing enrollment, Camp Badger – Exploring Engineering™ strives to improve access to female, racial and ethnic minorities, and economically disadvantaged persons. Over the camp’s history, girls have represented from 25% to 43% of enrollments each year. Over the past 5 years, girls represent an average of 36% of program participants. This compares favorably to women as a percent of UW College of Engineering undergraduate enrollments, where women represent 19% of students.⁸

For racial and ethnic minority campers, Camp Badger – Exploring Engineering™ has actively recruited participants from this community. Over the camp’s history, racial and ethnic minorities represent from 12% to 30% of annual enrollments. Over the past 5 years, racial and ethnic minority participation has averaged 22%. This compares to 6.9% underrepresented minority students in the UW College of Engineering undergraduate population (URM students as designated by the State of Wisconsin: African American, American Indian/Pacific Islander, Hispanic/Latino, Southeast Asian).⁹ Table 2 shows gender and minority enrollments as a function to total enrollment/year.

⁸ Source – UW College of Engineering Diversity Affairs Office – 11-11-2010

⁹ Ibid.

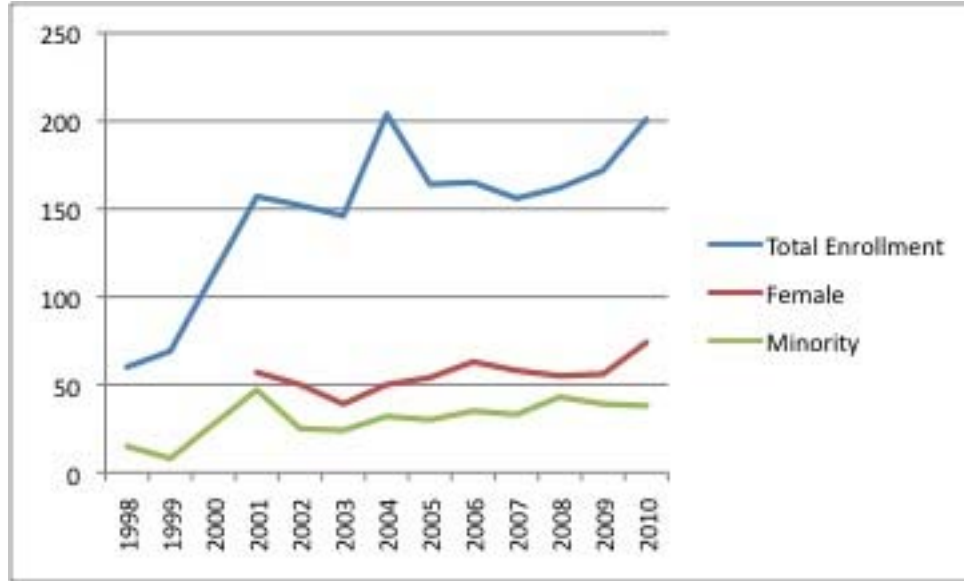


Table 2 – Camp enrollment by gender and minority status

The final performance measure is inclusion of economically disadvantaged persons. As part of the application / nomination process, full and partial scholarships are provided to defray costs to attend camp. Over the camp’s history, participants receiving full or partial scholarship represent from 33% to 85% of annual enrollments. Over the past 5 years, full or partial scholarships have been provided to 57% of campers. Table 3 shows scholarship awards, both full and partial, as a function to total enrollment/year.

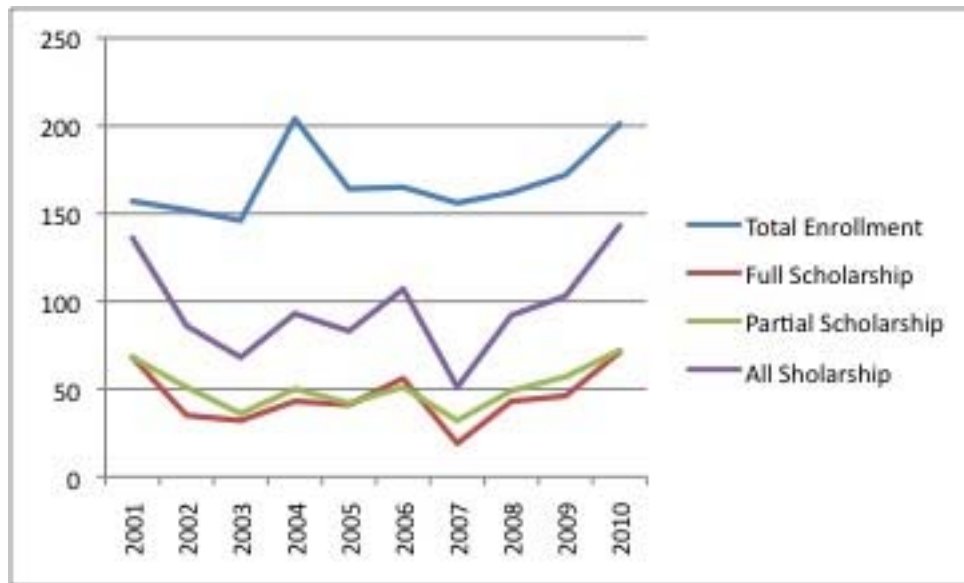


Table 3 - Scholarship awards: full, partial, and all and total enrollment/year.

KEY SUCCESS FACTORS

From our experience we have found a number of key programmatic characteristics that are critical to a successful and sustainable program. Foremost on the list is maintenance of focus on the needs and learning goals for the participant. In our experience, we have found experiential learning activities that predominantly focus on sponsor imperatives fail to optimize the learning experience.

Other key success factors are related to characteristics of the sponsor organization. First among them is a dedication to the program's mission. Organizational commitment to the project is found at every level, and permeates the organization's culture. Personal engagement of the executive leadership differentiates programs that are successful over the long term from those that fail to sustain themselves over time. In addition to the culture, the organization must be structured in such a way as to consistently deliver in a timely and predictable manner. This means that the sponsor has dedicated resources to plan, organize, and execute logistical aspects of the program. Attention to detail is crucial.

The active and ongoing engagement of a corps of volunteers from the professional community is a key characteristic of successful and sustainable programs. The identification, recruitment and engagement of volunteers are managed in such a way as to provide a diversity of experiences as well as create acquaintances between participants and professionals. In this give and take relationship, all parties learn about interests, passions, and the motivations of others through shared experiences. For participants, they learn not only what engineers do, but what they are like as well.

The final critical-to-success factor is the engagement of teachers and parents. An important design feature of Camp Badger – Exploring Engineering™ is that campers must be nominated by one of their teachers. This requirement compels a discussion between teacher, camper and parent. Furthermore, the requirement provides an opportunity for the teacher to integrate the camp experience with the individual's learning plan.

OPPORTUNITIES FOR IMPROVEMENT

Though Camp Badger – Exploring Engineering™ has been successful in achieving its mission, there are opportunities for improvement. As we look at Camp Badger – Exploring Engineering™ programs, we continually strive to identify ways to better engage participants' schools and teachers. To this end, a number of programmatic strategies have been proposed. At present, they represent design concepts for further consideration.

The first is the development of a camp for teachers. In this design concept, Camp Badger – Exploring Engineering™, working with the University of Wisconsin School of Education, would create continuing education programs for teachers. These programs would identify curricula and instructional strategies that teachers would use to reinforce

and enhance the camp experience throughout the local school's STEM curriculum. In addition to teacher training, we have begun to explore how to develop and use strategic partnerships with schools and community organizations to identify and recruit campers from our target population. We believe that establishing these relationships with institutions in the local communities will strengthen and reinforce the camp experience. Finally, we have begun to explore ways to replicate the Camp Badger – Exploring Engineering™ success in other organizations. This will require collaboration in development of organizational structures and capabilities in such a way as to replicate the ongoing success of Camp Badger – Exploring Engineering™.

SUMMARY

Camp Badger – Exploring Engineering™ employs and adventure / experiential learning modes to provide middle-school children with an engaging exposure to engineering and related STEM disciplines. The camp has a demonstrated history of serving traditionally underrepresented populations, including girls, racial and ethnic minorities, and the economically disadvantaged. This is accomplished through a targeted recruiting effort and through philanthropic support from the UW, corporate donors, foundations, and individuals.

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