Individual Advanced Development Academic and Undergraduate Education

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Two strategic documents direct the United States Military Academy leader development model: Building the Capacity to Lead, which describes the six domains of the Cadet Leader Development System (CLDS) and Educating Future Army Officers for a Changing World (EFAOCW), which explains the intellectual domain of CLDS. Both documents briefly mention Individual Advanced Development (Academic) or IAD(A)s as opportunities for cadet development. Building the Capacity to Lead lists it under the Social Domain, and EFAOCW includes it within cultural perspectives under the Intellectual Domain. Based upon that limited framework, it is critical to evaluate the purpose of IAD(A)s within the Department of Chemistry and Life Science mission of “Leadership in Science for Soldiers and Citizens”. In addition to the academy’s emphasis on IAD(A)s as a social and cultural opportunity, the Department of Chemistry and Life Science IAD(A) program’s purpose and intent is three-fold: 1) to inspire interested cadets to choose a major in Chemistry, Chemical Engineering, or Life Science 2) to provide introductory research experience to departmental majors in order to provide them the skills necessary to continue research while at the academy and 3) to confirm or deny long-term career goals for departmental cadets.

Research conducted over the past 15 years is the basis for these goals, which are highly influenced by the Boyer Commission, which suggests improvements to undergraduate education at research universities (Boyer Commission, 1998). The Howard Hughes Medical Institute (HHMI) and National Science Foundation funded much of the research in order to examine the benefits and goals of an undergraduate research experience (URE). The primary objectives of the HHMI in particular were “1) Is the educational experience of undergraduates being enhanced? 2) Are undergraduate research programs attracting and supporting talented students interested in a career involving scientific research? 3) Are undergraduate research programs retaining minority students in the ‘pathway’ to a scientific career?” (Lopatto, 2004). The following summary will describe the finding of several studies examining those or similar questions.

First, the University of Delaware has an extensive undergraduate research program involving a large percentage of undergraduate students. Two separate studies utilized thorough and well-conceived alumni surveys to evaluate perceived benefits of their undergraduate education. In the respective studies, alumni who completed undergraduate research reported higher self-evaluation of speaking effectively, self-directed information gathering, leadership, researching, and analyzing literature critically (Bauer et al., 2003); or speaking effectively, scientific literacy, and possessing clear career goals (Zydney et al., 2002). Likewise, a similar study of alumni perspectives of non-science undergraduates who completed a business internship compared to those who did not found increased job satisfaction in the group that completed an internship (Gault et al., 2000). Undergraduates and faculty in several studies also corroborate these findings.
For example, small liberal arts colleges support summer undergraduate research programs often being eight to twelve weeks at either the college or other participating college. The shorter duration of these summer programs are the most similar to the IAD(A) model offered at USMA. Four researchers evaluated these summer programs in two separate studies by conducting interviews with critical analysis of the interview text. The main conclusion from both the student and faculty perspectives was that an undergraduate research experience was important in “thinking and acting like a scientist” and “becoming a scientist” as well as improvement in personal and professional skills (Seymour et al., 2004; Hunter et al., 2006). Additionally, Lopatto (2004, 2007) conducted a survey and follow-up survey nine months later of a large undergraduate population, 1,135 students from 41 institutions. He concluded that an URE is very effective (91% or respondents) in solidifying undergraduate aspirations to pursue graduate science education. Additionally, the students who had the least favorable impression of undergraduate research also were the most likely to change their career goals. With reference to particular skills gained, Kardash (2000) provided critical evaluation of the most likely skills enhanced by an URE as reported by students and faculty mentors. The skills primarily dealt along the continuum of data from collection to independent thought and analysis.

Finally, with respect to faculty perspectives, several papers describe common themes for the expectations and motivations of faculty mentors. Faculty mentors primary motivation in supporting undergraduate research is to attract promising undergraduate students into their respective disciplines with the secondary purpose of supporting their research efforts (Zydney et al., 2002). Lopatto (2003) described faculty goals related to both elements of structure, the research program, and consideration, the interpersonal relationships. Like Seymour’s research, faculty desire through the program and interpersonal relationships to influence students to begin to think and act like a scientist with the ultimate goal of becoming a scientist. Lastly, with respect to the interpersonal relationship between the mentor and student, a separate study of veterinary interns in the Netherlands determined that the student-mentor relationship was the critical factor for students reporting an overall positive experience for the internship (Jaarsma et al., 2009).

As described above, the published research supports the three purposes and intent of the Department of Chemistry and Life Science IAD(A) program. First, the initial purpose of an IAD(A) for rising yearling cadets is to inspire the cadet to a departmental major. The department must carefully select mentors to ensure IAD(A) cadets have a rewarding experience. Jaarsma et al. (2009) and Lopatto (2003, 2004, 2007) as well as the other papers confirm the importance of that relationship in attracting the cadets to studying the sciences. Secondly, for rising cow and firstie cadets, the IAD(A) is important for introducing cadets to research or industry in order to direct cadets towards how scientists critically think about data and models (Kardash, 2000; Zydney et al., 2002; Bauer et al., 2003; Seymour et al., 2004; Hunter et al., 2006). Additionally, the IAD(A) is a much shorter period of time than the URE models evaluated in the papers. A goal of IAD(A)s for departmental majors is for the cadet to build upon the skills learned during the IAD(A) by conducting research during the academic year. There is a clear benefit to the development of research related skills based upon the time involved (Zydney et al., 2002). Finally, IAD(A)s provide an important experience, particularly for physician shadowing, of
providing important observations of professionals in the cadet’s desired career path in order to confirm or deny the cadet’s intended post-graduation plans.

Consequently, clear steps must be taken within the department in support of this purpose. A short survey will be given to all cadets who completed a department supported IAD(A) and a similar survey will be emailed to all IAD(A) mentors. The purpose of the survey is to provide critical feedback to the effectiveness of individual IAD(A)s with respect to the overall purpose of the department’s IAD(A)s. Secondly, a conscious effort to increase opportunities for cadet research during the academic year must be undertaken and as much as possible cadet research projects should build upon research skills cadets gained during their IAD(A). Finally, long-term, the department’s strategic vision must include clear, measureable purposes and objectives for IAD(A)s.

Reference


Annotated readings

-This article compares the differences between three populations of alumni from the University of Delaware who either participated in the Undergraduate Research Program (URP), reported conducting undergraduate research, or did not participate in the undergraduate research. The survey sent to the alumni did not reveal its intent and asked a broad range of questions about the subject’s undergraduate experience. The survey was highly successful in elucidating differences between the samples with respect to skills and abilities self-reported to have been enhanced by undergraduate research to include speaking effectively, self-directed information gathering, leadership, researching, and analyzing literature critically.

-This study is cited in almost every article related to this topic. The authors target research universities, which are composed mainly of large state universities, in describing the integration of undergraduates into research being conducted at those institutions. The commission asserts that research universities focus their efforts to research and graduate students and do a tremendous disservice to the paying undergraduates. Additionally, including undergraduates in research will encourage more of them to pursue degrees and advanced degrees in the sciences. This article relates to our department as the department attempts to utilize the tremendous capabilities for research afforded by the new science center.
-This article does not deal with research but it does pertain to academic experience versus real-world experience. The study compared alumni responses contrasting those who completed internships as undergraduates versus those who did not. The overall conclusion of the study was that the undergraduates who completed an internship had greater job satisfaction than those who did not; however, the increased job satisfaction was exclusively correlated with the increased salary of those who had completed an internship. Money cannot buy happiness, but it can make you like your job more.

-This article examined summer research (10 weeks) at four undergraduate liberal arts colleges. Though the IAD(A), is much shorter, the summer undergraduate research in this paper is the most similar to the experience of USMA cadets. This study compared faculty versus student perspectives of the gains that occurred during summer research. The data was collected through interviews and analysis of text from the interview. Both students and faculty reported gains in thinking and acting like a scientist and becoming a scientist. Students also reported a sense of personal improvement as they became more technically competent in research and working in a laboratory.

-This paper was written about the experience of veterinary students in the Netherlands in the fifth year of a six-year program. The students conduct a three-month research internship. The study was a survey of the students compared to the quality of their research project. The more positive the perceptions of the intellectual and social climate resulted in better reports. Likewise, if the students liked their faculty supervision, this also resulted in better reports and overall favorable experience. I find these results critical to the IAD experience. If cadets like their supervisor at the IAD, they will most likely have a favorable impression of their IAD experience. Conversely, if multiple cadets do not have a favorable opinion of an IAD supervisor, the IAD should be discontinued.

-This paper is heavily cited by subsequent papers. Within it, Kardashian examined student and mentor self-evaluation of improvement in 14 research skills possibly improved within an undergraduate research experience. I will adapt these 14 items in order to develop the questionnaire for the chemistry department IAD(A) cadets and supporting mentors. Of note within this paper, students and mentors gave the highest ratings to the same five skills and also to the same skills not improved. The improved skills dealt primarily with data with regards to collection, observation, analysis and independent thought. The students within this study also
more closely resemble USMA IAD(A) cadets as the duration of the research was over either a summer or one academic year.


-This paper is a follow-up to the Lopatto, 2004, paper listed below. In this paper, Lopatto re-surveyed the same cohort nine months after the post-research survey in 2004. The results of this survey one academic year later confirmed the results of the 2004 study. The key results are that the students who had the most favorable experience in their URE were most likely to continue to pursue graduate education. Those students who rated their URE the lowest were also the least likely to plan on pursuing graduate education in the sciences. I discussed this concept with my sister who completed two summers like this while she was an undergraduate. She stated that her URE at Davidson College and Eli Lilly both confirmed for her that she enjoyed conducting research and should pursue a PhD, which she obtained from UC-Berkeley in Chemistry.


-This paper compares survey results for faculty mentors and students with respect to the benefits that should be obtained from URE. Students selected benefits from 45 possible choices. Faculty, on the other hand, responded with free text to two survey questions: the essential features of URE and the benefits of URE. Lopatto separated responses into two categories, either structure or consideration. Structure relates to the facilities available and design of the URE, while consideration dealt with the interpersonal interactions that occur during the URE. Students gave higher ratings to benefits associated with consideration, while mentors give equally high marks to both items of structure and consideration.


-This paper is Lopatto’s original survey of 1,135 undergraduates from 41 universities/colleges after completing a summer undergraduate research project. The survey consisted of 44 items including demographic information, learning gains and the respective programs. One goal of this research was to determine how to improve retention of minorities in science. The results of the study strongly supported that an URE confirms aspirations of graduate education in most cases as confirmed by 91% of respondents. Additionally, it provides a determining experience for those who reported low gains as well as by redirecting their career path away from research.


-This paper is very long and difficult to read, but other papers heavily cite it. The researchers interviewed 76 students following a summer research internship and then analyzed the transcripts of the interview for common language. Interestingly, the researchers identified five common benefits described by the students. The greatest benefits were personal/professional gains and thinking/working like a scientists. The Hunter, 2006, paper was a follow-up to this paper where they added a new category of becoming a scientist. The paper was hard to read as the authors
gave numerous examples of interview responses to support each of their claims. The interview segments made the paper longer and did not necessarily add any benefit to the reader.

-This paper was very interesting and painstaking in its approach. The researchers compared alumni of the University of Delaware who participated in undergraduate research (engineering) with those who did not. The survey asked a wide range of questions, so that the respondent did not know the objective of the survey was to determine the benefits of research. The results clearly identified differences in self-assessment between populations of those respondents who conducted research versus those who did not in the areas of public speaking, scientific literacy and clear career direction. There were not differences in skills between samples except for those items, which research enhances. There are so many variables that go into human decision making and self-assessment; however, the authors in survey design and group selection were very thorough in their attempts to negate those differences.

-This second paper by the group from the University of Delaware examined faculty evaluation of undergraduate research. The survey results revealed the highest motivation in faculty support of an URE was to recruit and retain undergraduate students into the faculty member’s discipline. The second highest motive was contribution to the faculty member’s research. The study also reported the significant benefits of longer periods of research with perceived gains in research related skills in undergraduates. The more time students are able to spend with a faculty mentor, the greater gain that will occur. Conversely, the three-week IAD model will accomplish little in terms of improvement in student research skills unless it is followed by subsequent research with a USMA mentor.