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INNOVATIVE SEMINAR COURSE MODEL
FOR UNDERREPRESENTED
FRESHMAN/NEW TRANSFER
UNDERGRADUATES IN MATH AND
SCIENCE

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**Innovative Seminar Course Model for Underrepresented
Freshman/New Transfer Undergraduates in Math and Science**

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Abstract:

UHD is a minority-serving and Hispanic-serving institution integrating teaching, service and scholarly research to develop students' talents and preparing them for a global outcome. This urban University is engaged with the community to address the needs and advance the development of the Greater Houston region and of Texas. The UHD Scholars Academy is an academically competitive scholarship and mentoring program which supports gifted minority and female students, first-time-in-college (FTIC) students, first generation students and transfer students pursuing bachelor's degrees in science, engineering, technology, mathematics, and computer science (STEM) fields. The Scholars Academy is focused on the retention and graduation of students in high-demand STEM fields, in order to prepare them for productive STEM careers and/or entrance into STEM graduate school programs. The program accepts up to 60 new FTIC/Transfer students annually and its total enrollment is approximately 180 students, each of whom receives the intense and targeted support needed to insure success. Since its founding in 1999, the Scholars Academy has graduated over 500 students, 91 percent of who have gone on to medical/professional/PhD graduate programs or entered STEM-related workforce careers. The Scholars Academy College Success Program Seminar Course offered for freshmen (CSP FTIC) and new transfers (CSP Transfers) is in its fourth year of working toward several goals which include: 1) building a cohort community of learners, thereby increasing retention; 2) providing first generation STEM students foundational reading, writing, presentation skills, and knowledge/skill of applied research, thereby enabling a visioning process of advanced graduate work for minority students; and 3) building leadership skill sets through teamwork and service learning, thus building self-sufficiency, confidence, capacity for the rigors of university academics and STEM careers.

Background Information:

The Scholars Academy (SA) is an academically competitive scholarship and mentoring program housed in the University of Houston-Downtown College of Sciences & Technology supporting exceptional minority and female, first time in college (FTIC), first generation, and transfer students pursuing baccalaureate degrees in science, technology, engineering, and mathematics (STEM). By providing tuition support scholarships and year-round mentoring with both peer mentors and STEM PhD faculty mentors, a scholars' community forms the foundation for success in this program. This successful community of learners becomes further enriched through high impact activities promoting both scholarly research and career investigation in first hand ways. Seminars, colloquia, and on-sight field trips with peer and faculty mentors afford these undergraduates the mechanisms to experience many of the careers they envision for themselves. Support of student research presentations locally and at regional, national, and international conferences provides the high impact experiences which acclimate, motivate, and dedicate these students. Finally, the addition of service learning components to the peer mentor group experiences truly establishes a science leadership experience within the community/industry setting. Our SA stem graduates experience course content, laboratory skills, as well as the ethical and leadership components that transfer learning into actions. The Scholars Academy mission ten years focused primarily upon increasing underrepresented in the undergraduate STEM university experience. Ten years later, the SA's mission, while in part the same, now evolves to include focusing upon increasing on-time graduation rates, greater retention rates, and increasing the number of candidate acceptances into graduate/professional programs and ultimately keeping STEM graduates within the STEM workforce.

Program/Department Staff and Estimated Budget:

Program staff is comprised of one program director, a program manager, one administrative assistant, and three student support staff. Essential staff includes: Dr. Mary Jo D. de Garcia Parker, Director and faculty member in the Natural Sciences department; Mr. Rene Garcia, Program Manager; Ms. Melissa Elias, Administrative Assistant; Student workers: Ms. Alyssa Smith, computer science major; Mr. Jonathon Lacayo, computer science major; and Ms. Ana Argueta, history major. Programmatic yearly estimated budget is \$1.5 million dollars with an operating budget of just under \$250,000. Three years ago the administrative staff became the single institutionalized component of the SA program, thus providing a much needed element of stability and UHD administrative benchmark of the importance attached to the academic unit's mission and end-products.

A Brief Program History:

The SA's inception was the result of an initial Army Research Office grant in 1999 authored by two UHD STEM professors, one in the Natural Sciences and one in Computer Sciences. Over the time period from 1999 to 2004 the SA grew in an ebb and flow manner with a changing student population from 80 to 180. During this same time period a full-time Director position and full-time program manager position was established and funded solely through soft money. By 2008, UHD elected to institutionalize the administrative arm of the SA bringing about a long-warranted level of stability and a note of institutional confidence in the program and its mission toward STEM students. Current funding levels, soft and institutional matching support, maintain a stable membership of 150 students per semester. In 2009 the SA membership was comprised of 79% minority and 55% female. Examination of the first six years of SA undergraduate retention (69%), graduation (44%), and entrance into graduate/professional programs (39%) exhibits rates which still have room to inch upward, but exhibit definite progress in improvement. Over 86% continue in STEM through continued graduate studies or the workforce following graduation from SA/UHD. Scholars Academy in 2004 was awarded the Texas Higher Education Coordinating Board's STAR Award for "Closing the Gap" among Texas undergraduates. In the same year SA was honored by a congressional record item from the National Science Foundation for stewardship of NSF-awarded grant funding in support of undergraduate success.

More recently an Advisory Council of Education/Industry/Business has been formed to support feedback in the future vision of the Scholars Academy program. Currently, over 76% of Scholars Academy students are first generation entrants. Likewise, SA Alumni have formalized an every two-year reunion in an effort to "Pay It Forward". All SA members enter with a minimal 3.0 grade point average, however current data indicates that over 57% maintain a grade point average between 3.5-4.0, while over 29% maintain grade point averages between 3.81-4.0 supporting the premise that while in the SA, members improve study skills and intellectual capacity as associated with rising grade point averages.

Five Point Model

SA has established a five-point STEM model yielding not only student success, but also a template for replication. The five-point model includes: Point 1: Scholarship Support - Barriers to underrepresented project participants are eliminated through academic scholarships. Academic scholarship support ranges from \$3000 to \$5000 per year with stipulations and academic

requirements; **Point 2: Mentoring** - Assignment of SA students to faculty mentor and peer mentor groups. Through these groups STEM students will receive advisement for course selection and major declaration (occurs within the first semester), mandatory networking sessions, feedback on curriculum vitae (CV) development, and sponsored field trips arranged by the faculty mentor to broaden the landscape of STEM career/research possibilities. Mentoring support encourages and supports SA members' maintenance of those academic standards associated with the SA and associated with increased persistence/retention and graduation rates. The mentoring and peer mentoring activities will last the whole 2-year SA program; Pre-Start week-long orientation session for entering SA students and parents (early August), a core College Success Program (CSP) course for freshmen and transfer students, and tuition scholarship support; **Point 3: Seminar/Field trips** - STEM seminars/field trips by faculty mentors or guest faculty (provided as a mechanism to further broaden and/or provide detailed understanding of STEM career/research possibilities; intervention series per semester presented by faculty mentors; **Point 4: Graduate School Preparation** - Exposure and preparation for graduate school entrance following baccalaureate graduation through 1) Graduate School and Internship Fair, 2) GRE Prep course as elective credit, and 3) free practice test arranged through Kaplan (GRE, MCAT, DAT, all other graduate entrance exams) each semester, and has been giving these workshops for over 15 years to undergraduates and other interested parties. Topics including: the admissions process, advice on choosing the right graduate school for you, what to include in your personal statement, tips on increasing your interview skills will be included. Students that participate fully in these workshops on average increase their combined Verbal and Quantitative GRE scores by 200 points; and **Point 5: Scholarly research/internship** opportunities by PhD faculty-mentored research occurs on-site and off-site in NSF-funded labs, followed by sponsored research in competitive, state and national research programs across the U.S., and support for professional conference dissemination of research findings, and possibly co-authorships of published research. Within the UHD College of Sciences and Technology (CST), SA begins its thirteenth year with 450 alumni members. With an SA retention and graduation rate of first-time-in-college (FTIC) students of 69% and 49%, respectively.

Evidence of SA Effectiveness:

Over 500+ members have graduated in the first seven years of the 14-year SA program. Membership ranges include: 40% Hispanic, 18% Caucasian, 15% African American, 1-2% Asian American, 1% American Indian, and 3% Other. SA/UHD has a 51% acceptance rate into medical school as noted from the Health Professions Advisory Committee. Currently, SA evidences a 39% acceptance rate to graduate-level programs up 2% per year since 2009 (See Figure 1). Likewise, with a rate of more than 91% remaining in STEM following baccalaureate degrees, SA continues to demonstrate that this model can increase the number of underrepresented completing at the baccalaureate level (See Figure 2). SA continues to attract slightly more females than males with 55%/45% gender breakdown.

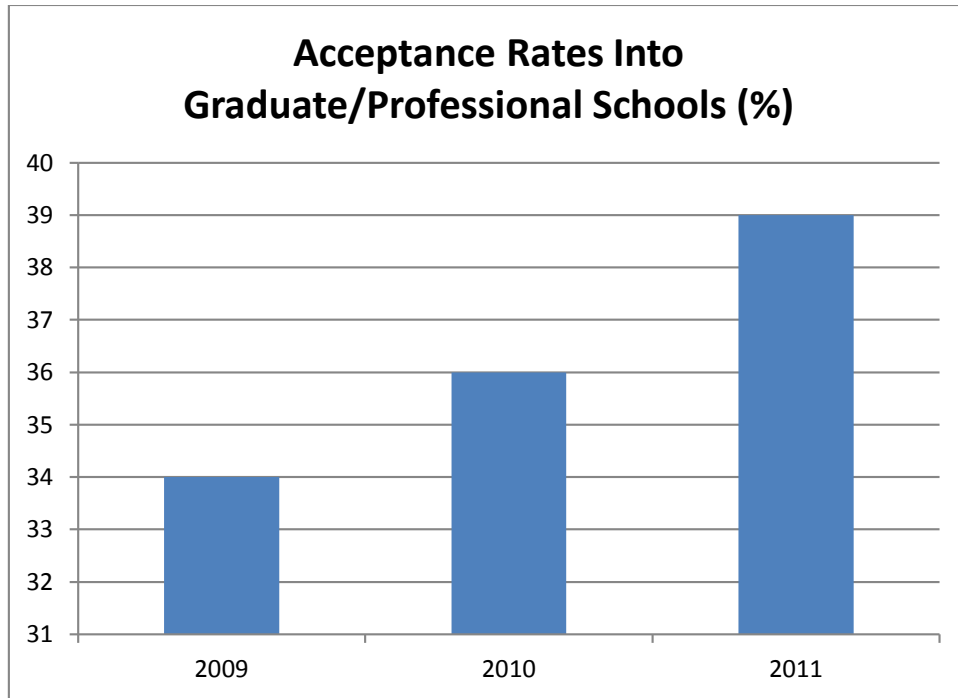


Figure 1. Three year review of increases in acceptance rates into graduate and professional schools by UHD/SA STEM undergraduates.

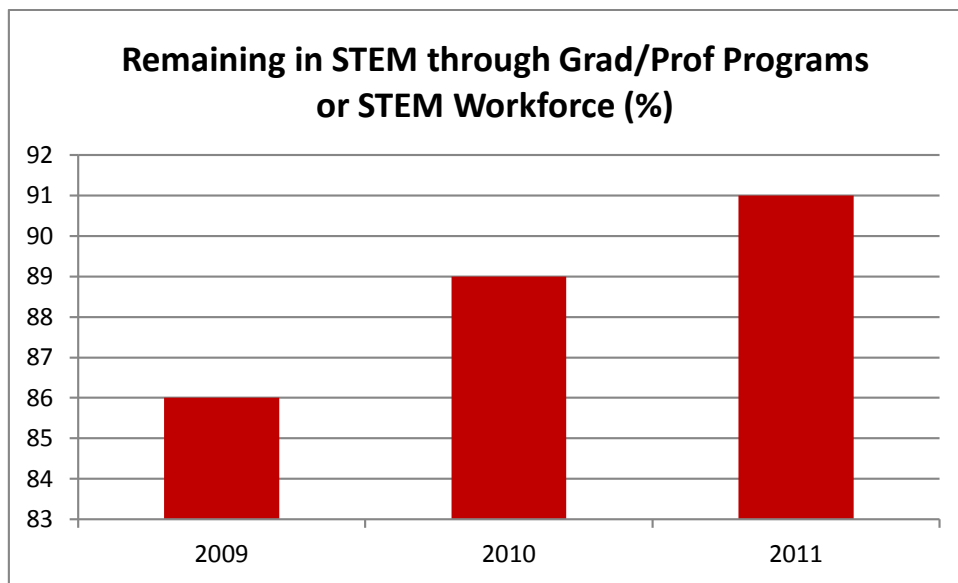


Figure 2. Three year review of increases in continuity into graduate and professional schools by UHD/SA STEM undergraduates following graduation.

Breaking down the monetary barrier associated with many Hispanics entrance into higher education has always been part of the formulaic success of the SA. Over 20% receive scholarships providing over 100% full-load tuition support. Likewise, 60% received scholarships providing at least 86% support, while 77% receive over 70% support. SA

longitudinal data indicates that 100% of SA scholars receive well over 61% financial support towards tuition support.

Of course SA historically has provided more than fiscal support to its scholars, and has found this additional support makes up critical components to the success of its scholars. 100% of SA scholars are mentored by an upper level peer mentor as well as a PhD faculty mentor. All SA scholars actively participate in networking meetings, semester orientations, and two service learning projects per year within a peer group setting. SA peer groups produce over 450 hours of service each semester. Over 60% of SA scholars have participated in summer or academic year stipend-supported, on-site or off-site, PhD-mentored research programs.

In terms of retention and graduation rates SA currently has a FTIC retention rate of 69% and an FTIC six-year graduation rate of 50% (based on Texas Higher Education Coordinating Board formulas and disaggregated data). To better understand the impact the SA has on UHD's overall retention and graduation rates, examination of SA's value-added nature is needed. Examination of UHD's 2004 6-year graduation rate indicates SA's 46% disaggregated rate adds 45.45% value to UHD's 12.5% graduation rate. The Scholars Academy, beyond supporting a vital model for improved success among the underrepresented STEM population, also plays a key role in its contributions to the larger university's metrics of success.

Scholars Academy Innovative Freshman Seminar Course Success:

In 2007 the Scholars Academy made the decision to bring a University College optional freshmen course, College Success Program, under its guidance for all SA freshmen members. This task was accomplished through the Natural Sciences (NS) department listing of the SA section of a College Success Program course. All first-time-in-college freshmen entering SA would mandatorily be signed up for this one-hour section. This "adoption" by SA and NS allowed the course curriculum and learning outcomes to become more aligned with the SA outcomes for all incoming freshmen. The goals and learning outcomes focused upon

- 1) building a cohort community of learners, thereby increasing retention;
- 2) providing first generation STEM students foundational reading, writing, presentation skills, and knowledge/skill of applied research, thereby enabling a visioning process of advanced graduate work for minority students; and
- 3) building leadership skill sets through teamwork and service learning, thus building self-sufficiency, confidence, capacity for the rigors of university academics and STEM careers.

By bringing innovative practices into the SA Freshman Seminar CSP course, SA began to evidence impact on freshmen year one to year two retention rates (See Table 1). Likewise, an out-budding of bringing this seminar course into SA was seen in the formation of deep cohort-relationship building practices among the SA freshmen. SA freshmen knew classmates' names, kept contact information from class activities, began to form study groups as a result of course experiences which grouped the students according to majors.

Table 1. Four Semester review of SA FTIC Retention

	2009	2010	2011	2012
FTIC Entered	12	20	28	32
FTIC Retained	9	15	26	27
%	75%	75%	93%	84%

The SA Freshmen Seminar CSP course syllabus speaks to the increased relevancy brought to the course through innovative teaching practices. The course syllabus initially focused upon traditional and non-traditional freshmen seminar topics such as: 1) time management, test-taking skills and plagiarism, and 2) use of mathematics software as a tool supporting math and science (TI calculators, Microsoft Excel, Maple software). Additionally, incorporation of Graduate Record Exam vocabulary was instituted to increase the vocabulary skillsets of SA freshmen. This was essential as so many are first-generation students from multi-lingual families and critically needed expansion of vocabulary.

The FTIC CSP mathematics focus is integral to adding supportive instruction in the area of mathematics for all STEM majors. Mathematics presents a barrier to most freshmen, average and high-achieving. Incorporating instructional strategies targeting the use of mathematical tools from calculators to common higher education software packages prepares FTIC students through confidence, familiarity, and proficiency for their current math challenges, but more importantly, for the next four years' math needs. Because SA members must take at least one math and science course as part of their 12-hour full load requirement, the CSP mathematics strategy offers an important retention strategy.

Beyond the focal topics presented in the course, the method of instruction establishes the truly innovative piece to this course. Using upper classman (jr/sr) SA members trained in *peer-led team learning* (PLTL), allowed the class to become more academic while still building a cohort mentality and experience. PLTL SA upperclassmen were selected through an application process whereby each group would be assigned a peer leader. The number of peer leaders was determined by the class size with groups averaging 5-6 freshmen each. PLTL leaders met regularly with the instructor (Mitsue Nakamura) to best understand the goals of the weekly class. The use of PLTL student group facilitators continues as a primary instructional modality. Having upper classmen (male and female leaders) modeling academic excellence through Socratic questioning and group facilitation practices, promotes serious focus and raises the standard of expectation for all FTIC SA freshmen. These leaders also engaged STEM FTIC in the simulated practice of developing a research project based on an observed problem/issue from a “scifi” movie. The exercise entitled “movie project” took place over the entire semester, involved group dynamics, scientific literature searches, scientific analysis of the possible solutions available in society mimicking the “scifi” research question. Above all student ownership of the research was a focal point executed through oral presentation. For SA FTIC each was exposed to extensive oral, public demonstration related to the movie project.

Over the last semester more innovation, taking the form of an introductory research project and service learning components to the course, have be added, thus giving the SA FTIC students a clear jump-start into on-campus research in the STEM arena and into the development of leadership and community through service learning. The same can be stated of the service learning project, a relatively newly integrated instructional methodology. Once again in groups, SA FTIC undergraduates were asked to arrive at a consensus of 1) the type of service project, 2) service connected to STEM major, 3) service that would be extended, and 4) wholly organized

by the group from start to finish as part of their CSP course. The focus of the service learning project is to developing leadership skills, developing group dynamic skills, and connecting STEM to the community it serves.

All of these innovations serve to prepare STEM undergraduates for the rigors associated in a research community and importance of connecting to the geographical community in acts of service which lend themselves to building individual and group character as well as a sense of purpose to one's education (See Table 2 and 3 as examples of the innovated FTIC CSP syllabi).

Table 2. 2007 Example of Early FTIC Freshmen Seminar CSP Course Syllabus.

Week	Topic	Due Dates
8/22	Introductions; College Life; Chapter. 1-3	
8/29	Peer-Led Team Learning	Vocabulary quiz 1
9/5	Time management and Stress – Chapter 7 & 9	Vocabulary quiz 2;
9/12	No - Class (Fieldtrip Friday Sept 14)	
9/19	Note taking – Chapter 15	Vocabulary quiz 3;
9/26	Plagiarism – Test Taking Skills – Chapter 20/21	Vocabulary quiz 4;
10/3	Special Talk	Vocabulary quiz 5;
10/10	Technology in Math: TI Calculators	Vocabulary quiz 6; Midterm Grade Report
10/17	Technology in Math: TI Excel	Vocabulary quiz 7
10/24	Technology in Math: Stella Software	Vocabulary quiz 8;
10/31	Technology in Math: Maple Software	Vocabulary quiz 9;
11/7	Technology in Math: Maple Software	Vocabulary quiz 10;
11/14	Personal Statement / CV	Essay
11/21	No class	Holiday
11/28	Projects Due	Reading Day
12/5	There will not be a Final in CSP 110N	

Table 3. 2012 Example of Current FTIC Freshmen Seminar CSP Course Syllabus.

Week	Topic	Projects
08/27	Introductions to Course	
09/04	Time management and Stress – Chapter 7, 9	Common Book Project
09/11	Introduction to Movie Project – View a movie	Movie Project
09/18	Note taking – Chapter 15 Plagiarism – Test Taking Skills – Chapter 20,21	Movie Project
09/25	Personal Statement / CV Midterm Grade Report	Movie Project
10/02	Service Learning – Dr. Parker	Movie Project
10/09	Service Learning – Dr. Parker	Movie Project
10/16	Service Learning – Dr. Parker	Movie Project
10/23	Technology in Math: Worksheet 1	Movie Project
10/30	Technology in Math: Worksheet 2	Movie Project
11/06	Technology in Math: Worksheet 3	Movie Project
11/13	Technology in Math: What happened to Brian???	Math Project

11/20	Field Trip	
11/27	Special Talk	
12/04	Presentation of Scavenger Hunt Project	
12/06 or 07	Presentation of Movie Project	

Scholars Academy Innovative New Transfer Seminar Course for College Success:

In 2009 Dr. Parker, new Director of the Scholars Academy made the decision that a college success course strictly for new transfer students would increase two key factors for SA transfer members. Factor one, quick integration into the four-year university, its distinctive level of rigor, and complex system would be key to retaining and graduating on-time these incoming undergraduates. Factor two, for SA STEM students getting a jump-start into knowing the research faculty and into becoming involved with on-campus research (or off-campus research) would be key to increasing the quality, experiential base of transfer candidates into graduate programs with only a single summer in which to accomplish this factor. This task was accomplished through innovatively modifying and adjusting the FTIC CSP course for the needs reflected by a transfer STEM population. All new transfers entering SA would mandatorily be signed up for this one-hour section. This re-alignment and innovative modification allowed the course curriculum and learning outcomes to become more aligned with the SA outcomes for all incoming new transfers. The goals and learning outcomes focused upon

- 1) building a cohort community of learners, thereby increasing graduation rates;
- 2) providing transfer STEM students foundational scientific reading, writing, presentation skills, and knowledge/skill of applied research proposal composition, thereby building skills needed in the short-term process of entering graduate/professional school, especially for minority students; and
- 3) building leadership and group dynamic skill sets through service learning, thus targeting skills any STEM career would warrant.

Key modifications of the SA Transfers CSP course center on the development of written and experiential components known to immediately impact any graduate/professional school application process, interview and selection. Development of the curriculum vitae (CV) and the personal statement (PS) as documents transmitting credentials became central to the first module. Even though these students were to be transfers, a time-management component was also included since moving from community college to the four-year institution often poses a major shift in work-study priorities. Next activities to create discourse and dialogue among many of the STEM faculty, still new to the transfer students was critical to learning of the STEM research on campus and to becoming better acquainted with these key faculty members. In like manner assistance in developing summer research program applications was much needed for these newcomers to the four-year university. This module (3) focuses upon putting together a group scientist interview, its write-up, and developing two summer research program applications for submission. A module entitled “Scientists as Leaders” (Module 2) utilized service learning as a methodology to exploring and managing group dynamics within a group process, interfacing with general non-profits in an effort to become partner in a solution to a community-based problem, and finally to gain experiences in written and oral communication of a product. Finally, the better half of this course focused upon the processes needed for developing a testable

research proposal in a field of serious interest to the STEM transfer student. Through Module 4 objectives, a brief, but serious review of literature over an instructor-approved research question would initiate this aspect of the module. Simultaneously, brief overviews of research design and methodologies would provide fundamentals in preparation of writing the proposal, a culminating project of this module. References and proposal writing techniques will prepare the student for an oral presentation of the individual proposal as well as provide a visual guide (PowerPoint) to the audience. The SA CSP for New Transfers serves to prepare the new students not only for rapid assimilation into UHD from their community colleges or other four-year universities, but also prepares them for immediate entrance into the research community, both at UHD and outside of UHD within research. Developing writing, group/individual communication capacity, and leadership through service to others ensures skills needed for both graduate/professional school entrance as well as rapid workforce acculturation (See Table 4).

Table 4. 2012 Example of New Transfer SA Seminar CSP Course Syllabus.

Module	Module Description	Activities (All Required Readings precede Activities)
Module 1: College Success and Credentials of the STEM Scientist in the University Setting Aug. 30-Sept. 13	Module 1 focuses on the importance of building and documenting experiences, activities, and accolades of a professional nature through the development of a curriculum vitae and personal statement. Understand the protocols associated with the professorship in spoken and written interactions. Practice valuable time-management skills supporting success.	Readings CV/Personal Statement Project Module 1 Discussion Topics
Module 2: Scientists as Leaders Sept. 13-Nov. 1	Module 2 focuses on the the importance of scientific leaders to involve themselves in the community as leaders. Service learning, as a component of leadership, will be explored, discussed, organized, and executed using a group process.	Readings Service Learning Group Project Service Learning Field Activity Service Learning Slideshow Project Service Learning Presentation Module 2 Discussion Topics
Module 3: Preparation for Research Experiences Sept. 13-Sept. 27	Module 3 focuses on the preparations necessary and practical execution of those materials necessary for garnering a successful summer or academic year research experience now or in the future.	Contact List Scientist Interview Project Internship Application Project Module 3 Discussion Topics
Module 4: Preparation to Learn & Apply Research Principles	Module 4 focuses on learning the components comprising a research proposal, developing proficiency in the use of targeted research databases and	Readings APA Citation of References Quiz Research Proposal Question

Sept. 27-Nov. 29	concurrently production of a written literature review; development of a written research proposal, developing a Powerpoint poster of the proposal, and executing a presentation of the completed research proposal.	Research Proposal Outline & References Written Research Proposal Project Research Proposal Powerpoint Project Research Proposal Presentation Module 4 Discussion Topics
Final Exam	Final Exam will be the Research Proposal Presentation accompanied by the Proposal Powerpoint as a visual guide	December 13 th 1:00-3:30 pm A423

One assessment measure of the impact the Transfer CSP course has had in rapidly engagement of new transfers in research can be evidenced by analyzing the extent to which new transfer students move into mentored research activities either on- or off-campus during the summer following the CSP course (See Figure 2). Review of those SA members withdrawing from the SA organization and thusly impacting the retention rate of the SA indicates 13% (n=7) over the course of six semesters (Spring 2010 through Spring 2012).

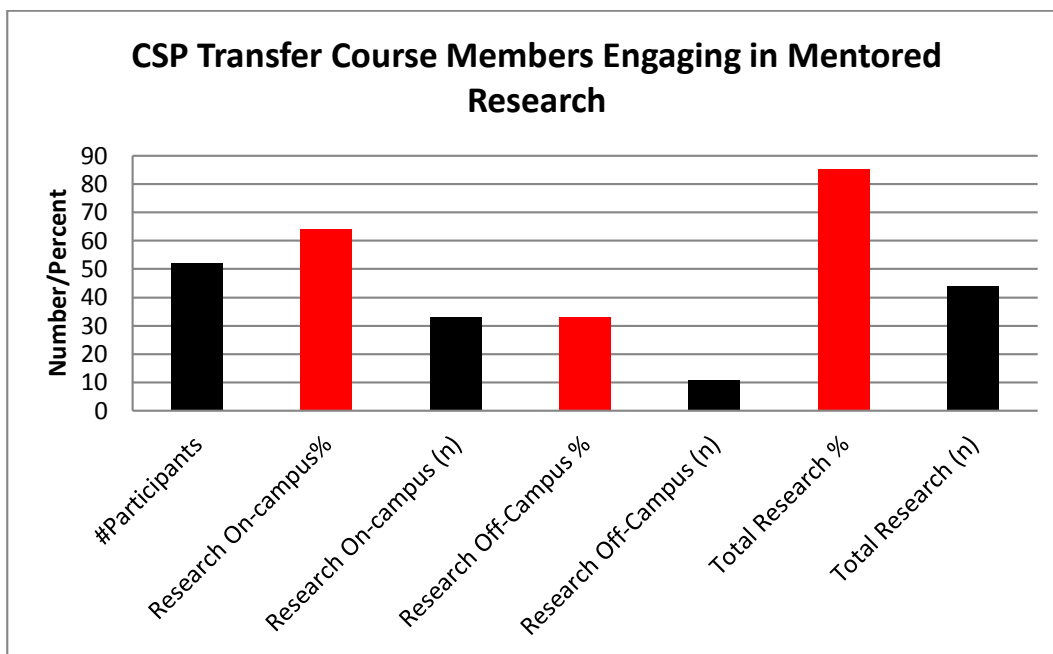


Figure 2. CSP transfer course members engagement in on- and off-campus mentored Research (a major focus of the course for entering transfers (jrs/srs).

The CSP Transfer course has an intensive, proposal writing component supporting learning objectives associated with research proposal preparation (Module 4 in the sample syllabus). As incoming juniors and seniors, new SA transfer students come to UHD with only four short semesters remaining in their undergraduate career. The proposal writing strategy of this course supports the writing needs sure to accompany their upper level major courses. More

importantly, intensive research-focused writing further prepares these students with many of the skills needed upon entry into graduate school/professional school or the STEM workforce.

Similarly, the SA CSP Transfer course recognizes the need for continued individual development of oral, visual, and public presentation skills. To this end the service learning project demands a learning outcome where a visual and an oral presentation recap of the project along with an analysis of the project's effectiveness is presented publically. Finally, each course member presents the research proposal, along with a visual accompanying presentation, as a seminar to fellow SA members and others wishing to attend.

Model for FTIC and Transfer Underrepresented STEM Undergraduates:

The Scholars Academy offers two realistic, effective courses focusing on first year and transfer years that can benefit any STEM major. Perhaps the critical points the CSP course models offer deal with student preparation geared to the present and the future. Preparing the most highly capable and high quality successful STEM student is not solely the mission of the SA. Instead, producing high capacity STEM graduates is vital to the U.S. and its leadership role in the world.