

# SCULPT.



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## Scholarly & Creative Undergraduate Learning at UVU: A Vital Element of Engaged Learning

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# SCULPT

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### Executive Summary

Inquiry Based Learning (IBL), inside and outside the classroom, includes research, scholarship, and creative activity. IBL is imperative to efforts to retain and engage students in higher education (Kuh, 2008), particularly at teaching institutions, because they are robust and effective interventions. Students who receive the greatest benefit from IBL are those who are at-risk of dropout or failure, minority background, or first-generation status (Ishiyama, 2002). A key factor is development of faculty-student mentoring relationships that begin early in students' educational career. Utah Valley University has a solid foundation in IBL but there is a need to build on and institutionalize these practices on a larger scale.

This paper addresses the impact of undergraduate research and inquiry based learning on student engagement, learning, retention, and persistence to graduation with a focus on undergraduate research as an engaged pedagogy with application across all disciplines. Inquiry based learning is integral to the mission of Utah Valley University (UVU) and the institution's core themes. This report highlights the benefits of actively pursuing undergraduate research and creative inquiry to both students and faculty, evaluates UVU's current status, and proposes future directions that include sustaining and expanding the Scholarly and Creative Undergraduate Learning Partnership Team (SCULPT), a faculty organization whose mission is to expand inquiry-based learning at UVU. We conclude with a detailed proposal for a more intentional institutionalization of inquiry based learning on campus.

Inquiry based learning significantly contributes to the development of highly skilled professionals and productive adults. When combined with other traditional educational opportunities, these activities help prepare students for successful career paths after graduation.

- **IBL improves student learning outcomes.** Empirical studies of IBL yield robust effects that demonstrate long-term impacts on students' thinking, writing, problem solving, networking, and later employment opportunities. "The results also indicate that students involved in research projects demonstrate deeper learning through higher order thinking, integrative learning, and reflective learning" (Hoffman, 2009, p. 23).
- **IBL is a high-impact practice that increases retention and completion.** "Two significant outcomes of this program are the long-term retention and higher GPAs of students compared with those in the matched control group throughout the student's college experience."

(Schneider, Bickel, & Morrison-Shetlar, 2015, p. 42).

- **IBL prepares students for successful careers.** “Student’s research work has been helpful in improving skills related to networking, improving professional credentials, and contributing to a body of knowledge...skills that will help prepare undergraduates for their future careers” (Salsman, Dulaney, Chinta, Zascavage, & Joshi, 2013, p. 8).
- **IBL creates a positive experience for students in the present as well as in the future.** “A majority of respondents indicated that undergraduate research was a significant positive factor in their actual admission to graduate school, employment, or both” (Schmitz & Havholm, 2015, p. 1).

Nationally, institutions of higher education report improvements in retention and completion by emphasizing IBL; these efforts to retain students and remove obstacles to completion have generated successful models for the development and implementation of IBL at a variety of institutional types (Malachowski et al., 2015), models that could be applied to UVU. Most strategies emphasize the need to leverage student motivation via ownership of their own learning, engage the student as an active participant in the learning process, and the modeling of critical professional skills in the discipline.

Many UVU faculty currently include IBL activities in the course curriculum (e.g., Dr. Kopp in biology, Dr. Lieberwirth in psychology) or provide opportunities for students to engage in IBL outside of classes (e.g., Dr. Al-Ghaib in computer engineering, Dr. Hill in psychology, Dr. Hammond in sociology). Further, these professors and many others mentor and support students in the dissemination of their own research in public forums (e.g., professional disciplinary conferences, UCUR, NCUR) and often in professional publications despite some significant challenges (e.g., lack of space or scheduling issues). However, as UVU seeks to expand and increase student participation in IBL, it is increasingly important to support faculty efforts through institutionalized structures and ongoing support.

While UVU has a long history of involvement in faculty-mentored projects involving students, the traditional mentoring model is no longer sufficient if the goal is to involve increasing number of students in IBL. Due to the pressing need to address both UVU’s rates of retention/persistence and growing student body size and because of the strength of the data regarding IBL as a high impact practice that helps to increase student success and improve retention and graduation rates (Moran et al., 2015; O’Donnell, Botelho, Brown, Gonzalez, & Head, 2015), we make the following recommendations to enrich and extend IBL at UVU:

1. *INCENTIVIZE IBL CURRICULUM INTEGRATION VIA SCAFFOLDING OF BASIC SKILLS AND RESEARCH PRACTICES IN LOWER DIVISION COURSES (INCLUDING GE) THAT INCREASE IN COMPLEXITY THROUGH A STUDENT’S PROGRAM;*
2. *CHAMPION IBL AS AN ENGAGED PEDAGOGY IN HIGHER EDUCATION;*
3. *ENCOURAGE STUDENT PARTICIPATION IN IBL FROM ALL AREAS OF CAMPUS AND BUILD A CULTURE OF INQUIRY-BASED LEARNING INCLUDING POTENTIAL CREATION OF AN OFFICE OF UNDERGRADUATE RESEARCH;*

4. *INCREASE IBL RESOURCES INCLUDING: FUNDING FOR STUDENT INVOLVEMENT; DEDICATE SPACE AND MATERIALS FOR STUDENT PROJECTS; ADDRESS WORKLOAD CONCERNS REGARDING IBL;*
5. *FURTHER DEVELOP RECOGNITION FOR BOTH STUDENTS AND FACULTY INVOLVED IN IBL; OFFER STUDENT CERTIFICATES; AND ENCOURAGE EXPLICIT FACULTY RANK AND TENURE RECOGNITION FOR IBL EFFORTS;*
6. *ENCOURAGE INCREASED BIDIRECTIONAL COMMUNITY PARTICIPATION IN IBL ACTIVITIES;*
7. *PROMOTE INCREASED LIBRARY INVOLVEMENT IN IBL SUCH AS WITH REPOSITORIES OF STUDENT AND FACULTY RESEARCH AND CREATIVE WORK; AND*
8. *RECOGNIZE AND SUPPORT THE SCHOLARLY & CREATIVE UNDERGRADUATE LEARNING PARTNERSHIP TEAM (SCULPT) AS A PERMANENT FACULTY-LED ORGANIZATION.*

The university can better prepare students for success with undergraduate research available to all. Inquiry-based learning and undergraduate research are powerful forms of teaching with significant benefits to our students, especially those who are first-generation or are from underrepresented groups. By creating a culture and structures supportive of IBL and by expanding the reach of IBL to all students on campus, UVU's dedication to student engagement, inclusion, rigor, and student success will be enhanced. We hope to expand and strengthen UVU tradition of IBL by working together.



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# Scholarly & Creative Undergraduate Learning at UVU: A Vital Element of Engaged Learning

## I. INTRODUCTION

This paper addresses the impact of undergraduate research and creative activities for student engagement, learning, retention, and persistence to graduation with a focus on undergraduate research as pedagogy and describes how inquiry-based learning is integral to the mission of Utah Valley University (UVU). We will describe reasons for actively pursuing undergraduate research and inquiry on campus, UVU's current status and movement, and proposed future directions that include sustaining and expanding the Scholarly and Creative Undergraduate Learning Partnership Team (SCULPT) whose goal is to expand inquiry-based learning<sup>[1]</sup> at UVU. We conclude with a detailed proposal for a more deliberate institutionalization of inquiry-based learning on campus.

## II. RATIONALE AND SITUATIONAL OVERVIEW

Inquiry Based Learning<sup>[2]</sup> (IBL) is essential to the development of highly skilled professionals and productive adults. When combined with other traditional educational opportunities, undergraduate research helps in developing and preparing students for successful career paths after graduation. "Undergraduate research is like role-playing. I mean no disparagement of the research -- role-playing is a critical part of life. Children learn how to be adults in part by trying on grown-up clothes and imitating a parent who is, say, driving a car or vacuuming a rug. Similarly, undergraduates can learn the conventions of research through imitation and practice" (Chapman, 2003, para. 7). It is often said that 'practice makes perfect,' but it is probably better said that practice makes prepared. "Through guided participation and extensive collaboration, long-term observation and practice, the novice researcher gradually acquires the skills and expertise needed for effective performance in the profession" (Adedokun, Dyehouse, Bessenbacher, & Burgess, 2010, p. 3).

IBL is imperative for efforts to retain and engage students in higher education (Kuh, 2008), particularly at primarily teaching institutions, as it is a robustly effective intervention. Students who receive the greatest benefit from IBL are those who are at-risk of dropout or failure, minority background, or first-generation status (Ishiyama, 2002).

Encouragement and incorporation of IBL requires consistent and intentional effort, especially when campus resources and opportunities are strained. Many schools are looking outwards to their larger communities in order to support student development. “Unfortunately, underfinanced public and urban institutions are among the least able to offer undergraduate research. One solution has been to create networks of off-campus research internships, often at elite universities interested in enhancing their diversity” (Carpi & Lents, 2013, para. 15). These opportunities should not be wholly extracurricular but integrated into the standard curriculum because they prepare graduates to be successful. “For students entering the job market directly after graduation, a strong undergraduate research experience may substitute for ‘years of experience’” (Hoffman, 2009, p. 22).

In order to impact retention, students need to be involved in research early and often. “Students, who participate in research early, during the first year and second year, are more likely to succeed and graduate with college degrees in STEM disciplines. Such students are also likely to advance to graduate school in STEM areas or proceed to professional schools” (Fakayode, Yakubu, Adeyeye, Pollard, & Mohammed, 2014, p. 663). Much of the current research in the open literature has focused on increased retention rates as one of the main benefits of undergraduate research. “Despite the difficulty of isolating the main effects of research opportunities from other activities the student is exposed to on campus, the descriptive evidence indicates that undergraduate research programs are a vital component of an integrated retention strategy for STEM students” (Hoffman, 2009, p. 22).

Universities need to broaden access to undergraduate research opportunities. These opportunities are often reserved for the students who have proven to excel. Haave and Audet (2013) encourage institutions to not only focus on high achievers.

**Our data reveals that the majority of students with lower than average GPA earned relatively high grades in those research courses, hence receiving accrued benefits from the experience... Admission to [Undergraduate Research Experiences (UREs)] based only on prior GPA thus appears to be counter-productive by denying access to high impact educational experiences from students who would most benefit from it. (p. 4)**

Programs with varying time schedules also need to be created for students who work.

Unfortunately, students who have financial constraints and must work are frequently not able to put the time needed into the labs in order to be prepared to perform their own research or contribute in a meaningful way to existing research projects. Therefore only certain students, specifically those with alternative means of supporting themselves, are currently participating and will be able to participate in the future. (Davis & Jacobsen, 2014, p. 24)

Similar constraints and struggles with time may exist for students in the arts and in other academic disciplines.

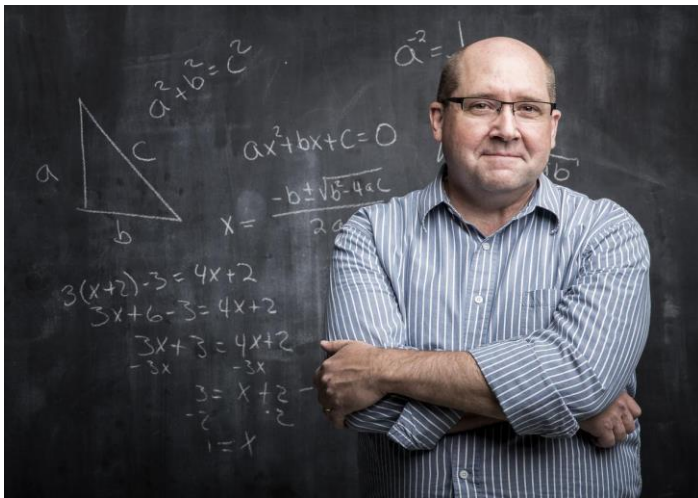
Undergraduate research is one of the best practices for helping minority and first-generation students succeed. “Since underrepresented minorities have higher rates of attrition and lower levels of academic performance to begin with, research participation may particularly help prepare underrepresented minorities for graduate education and careers in the sciences, while providing a form of institutional integration into a competitive major at a large university” (Jones, Barlow, & Villarejo, 2010, p. 106). Culp and Urtel (2013) found that undergraduate research interactions provided benefits for women, racial and ethnic minorities, and first generation students. These benefits included, but were not limited to, increases in retention and continuing education. IBL is also a means for these students to distinguish themselves academically and become sought-after candidates in a competitive environment and may help them make more informed career decisions (Shanahan, Xiangrong, Manak, Miller, Jing, & Chien Wen, 2015). As one study found, “Most of the [Undergraduate Biology Research Program] group felt their research experience had an effect on their choice of career and level of career satisfaction. Over 80% believed that their undergraduate research experience had a substantial effect, including 46% who felt that it was critical in their career choice” (Yaffe, Bender, & Sechrest, 2014, p. 5).



*“STUDENT’S RESEARCH WORK HAS BEEN HELPFUL IN IMPROVING SKILLS RELATED TO NETWORKING, IMPROVING PROFESSIONAL CREDENTIALS, AND CONTRIBUTING TO A BODY OF KNOWLEDGE. THE SKILLS FROM THIS SUBSCALE ARE SKILLS THAT WILL HELP PREPARE UNDERGRADUATES FOR THEIR FUTURE CAREERS” (SALSMAN, DULANEY, CHINTA, ZASCAVAGE, & JOSHI, 2013, p. 8)*

The long-term impacts of undergraduate research are undeniable. It boosts the learning process. “The results also indicate that students involved in research projects demonstrate deeper learning through higher order thinking, integrative learning, and reflective learning” (Hoffman, 2009, p. 23). It impacts retention. “Programs that support high-impact practices, such as undergraduate research, should be viewed as investments that provide a rate of return through the retention of students” (Moran, Wells, & Smith-Aumen, 2015, p. 63). It prepares students for the future. “Student’s research work has been helpful in improving skills related to networking, improving professional credentials, and contributing to a body of knowledge. The skills from this subscale are skills that will help prepare undergraduates for their future careers” (Salsman, Dulaney, Chinta, Zascavage, & Joshi, 2013, p. 8). It creates a positive experience in the present as well as in the future. “A majority of respondents indicated that undergraduate research was a significant positive factor in their actual admission to graduate school, employment, or both.” (Schmitz & Havholm, 2015, p. 1) Most importantly though, when contrasted, there is no question that undergraduate research opportunities are a high-impact practice. “Two significant outcomes of this program are the long-term retention and higher GPAs of students compared with those in

the matched control group throughout the students' college experience.” (Schneider, Bickel, & Morrison-Shetlar, 2015, p. 42)



Central to the concept of IBL as a form of engaged pedagogy is the role of the instructor in the design of students' scholarly and creative experiences, the integration and preparation of student skill development leading towards competence and autonomy in selecting their own questions or goals for their work, and the active use of best practices and student learning outcomes to shape the student experience. These pedagogical

elements need to be embedded in the context of supportive faculty-student mentoring relationships. Through these relationships, faculty are able to set professional expectations, assist students in applying the concepts they have been learning in their coursework, encourage problem-solving and autonomy, and more -- all things that are a core part of UVU's Essential Learning Outcomes and that support UVU's overall core themes.

The essential aspects of effective mentoring relationships have been emphasized throughout the literature. These relationships can be challenging to form, but individual contact and commitment can help to speed the process. "Research has shown that it takes one and a half to two years to establish a mentoring relationship in a university setting. In my experience, the liberal-arts setting, and especially a one-on-one research relationship, speeds up that process and is very effective at breaking down barriers between professors and students" (Zimmer, 2005, para. 16). Mentoring cannot be sporadic; it must be consistent to be impactful. "Even the best students need frequent contact with their advisor and constant mentoring to ensure that the project is making a genuine contribution" (Fenn, Johnson, Smith, & Stimpert, 2010, p. 13).

In order for faculty to have the time to dedicate to developing these nurturing and effective mentoring relationships with students, the infrastructure to support and encourage faculty to begin and sustain these practices needs to be in place. Consider the observations of Eigren and Hensel (2006):

*THE CURRICULUM IS THE PURVIEW OF THE FACULTY AND SHOULD BE A DIRECT EXPRESSION OF WHAT FACULTY VALUE MOST IN EDUCATION. IT IS ALSO ONE OF THE WAYS THAT ENABLE FACULTY TO GAIN SOME CONTROL OVER TIME, WHICH MANY REGULARLY CITE AS THEIR PRIMARY LIMITING RESOURCE. BALANCING A SCHOLARLY AGENDA WITH HEAVY TEACHING COMMITMENTS EASILY CONSUMES AVAILABLE TIME, BUT UTILIZING THE CURRICULUM TO BETTER PREPARE UNDERGRADUATES FOR INDEPENDENT RESEARCH SERVES THEM WELL...(P. 4)*

If IBL is to become institutionalized, more wide-spread across campus, and effective in reaching more students, particularly those who are first generation or under-represented, institutions need to create the structures to enable this to happen. Eigren and Hensel (2006) describe the efforts of some institutions towards these ends:

**Recognizing the impact of undergraduate research on student learning, student and faculty retention, and institutional reputation has led many institutions to respond with extraordinary support for undergraduate research. Some have allocated and sometimes raised funds for student (and faculty) stipends. Others have provided sabbatical leave programs to ensure continued scholarly development for faculty members. Still others have reduced teaching loads, rewarded research mentoring activities with teaching credit, provided generous start-up packages for new faculty members, matched funds from external grants, and increased technical support for routine departmental tasks (p. 5).**

Inquiry-based learning (IBL) efforts must be recognized for faculty in the official tenure and renewal process to be sustainable. “Unless there are formal procedures for rewarding IBL in promotion, tenure, and renewal or strong evidence that faculty benefit in the form of increased scholarly productivity from mentoring, some form of compensation will be necessary for continued faculty enthusiasm for this work” (Free, Griffiths, & Spellman, 2015, p. 5).

### III. HIGHER EDUCATION BACKGROUND

Participation in higher education across the United States is increasing. The National Center for Education Statistics (NCES) reports that for the time frame between 2002 and 2012, enrollment in degree-granting institutions has increased by 24 percent, i.e., from 16.6 million to 20.6 million (NCES, 2013). Student’s monetary investment in their education over the years has also increased.

*FOR THE 2012-13 ACADEMIC YEAR, ANNUAL CURRENT DOLLAR PRICES FOR UNDERGRADUATE TUITION, ROOM, AND BOARD WERE ESTIMATED TO BE \$15,022 AT PUBLIC INSTITUTIONS, \$39,173 AT PRIVATE NONPROFIT INSTITUTIONS, AND \$23,158 AT PRIVATE FOR-PROFIT INSTITUTIONS. BETWEEN 2002-03 AND 2012-13, PRICES FOR UNDERGRADUATE TUITION, ROOM, AND BOARD AT PUBLIC INSTITUTIONS ROSE 39 PERCENT, AND PRICES AT PRIVATE NONPROFIT INSTITUTIONS ROSE 27 PERCENT, AFTER ADJUSTMENT FOR INFLATION. (NCES, 2013B)*

Unfortunately, only about half of these students complete their education.

*THE 2013 6-YEAR GRADUATION RATE FOR FIRST-TIME, FULL-TIME UNDERGRADUATE STUDENTS, WHO BEGAN THEIR PURSUIT OF A BACHELOR’S DEGREE AT A 4-YEAR DEGREE-GRANTING INSTITUTION IN FALL 2007, WAS 59 PERCENT. THAT IS, 59 PERCENT OF FIRST-TIME, FULL-TIME STUDENTS, WHO BEGAN SEEKING A BACHELOR’S*



DEGREE AT A 4-YEAR INSTITUTION IN FALL 2007, COMPLETED THE DEGREE AT THAT INSTITUTION BY 2013. (NCES, 2013c)

### **A. Scholarly and Creative Learning in Higher Education**

Critical thinking and creativity are essential skills for success. Students can explore creativity by addressing problems and investigating appropriate solutions. Research, scholarly and creative activities are student-centered activities that enable them to use creativity and improve critical thinking skills. Through undergraduate research, students learn how knowledge is constructed, how to collect and analyze data, and how to solve problems. Students also learn to be independent learners and gain considerable self-confidence that prepares them for future careers in research and other disciplines (Lopatto, 2010). In addition, students learn how to deliver their findings to multispectral audience. These experiences should be available for students early in their careers to provide those students the opportunities to explore new career paths. As Adedokun and colleagues (2010) note, "Through guided participation and extensive collaboration, long-term observation and practice, the novice researcher gradually acquires the skills and expertise needed for effective performance in the profession" (p. 3).

Problem-based learning (PBL) and project-based learning promote metacognitive strategies, critical thinking, and problem solving capabilities. These activities promote student engagement and motivation for learning (Stolk & Harari, 2014). PBL allows instructors to use dialogic spaces differently creating spaces for reflection and shared vision with students (Colvin, 2005). These strategies can be applied at UVU at different levels to improve student learning and to create a culture that emphasizes the goals of creativity, critical thinking, and metacognition.

Martinez (2009), who presented a Ph.D. dissertation on the impact of summer undergraduate research experience on the college students' perspective of research and learning, found that "when students have more ownership over their research--such as data collection and analysis--they were more enthusiastic about the research, felt a greater association with the research field, and were more likely to pursue a STEM graduate education" (Malachowski, Osborn, Karukstis & Ambos, 2015). We believe this would be the case in a majority of disciplines at UVU, not limited to STEM alone. After all, as Shulman (2002) states, "Learning begins with student engagement, which in turn leads to knowledge and understanding. Once someone understands, he or she becomes capable of performance or action" (p. 38).

### **B. Active Learning in Higher Education**

When students experience the transition from simply enacting required tasks to analyzing consciously what constitutes and enhances learning, this transition



changes not only students' knowledge but also the students themselves (Bovill, Cook-Sather, & Felten, 2011). This is done through active learning component, which "implies not only a shift from passivity to agency but also from merely doing to developing a metacognitive awareness about what is being done" (Bovill et al., 2011, p. 2). In essence, active learning entails assessment and contemplation of the thoughts, perceptions, and emotions that come about during direct experiences (Cubukcu, 2012).

When students are actively engaged in the subject material through discussing it or applying it, they learn the material better (Wehlburg, 2006). This may involve doing hands on experiments, working with mentors or individual experience in the field, or other forms of student interaction or active learning. As Gordon and Crabtree (2006) noted,

*THOUGH ACTIVE LEARNING AND POSITIVE, APPROPRIATE FEEDBACK ARE ESSENTIAL COMPONENTS, THE MOST POWERFUL FACTOR IN BUILDING ENGAGEMENT IS IDENTIFYING AND FULLY DEPLOYING TALENTS IN THE CLASSROOM. AND NOT ONLY STUDENTS' TALENTS--THE TALENTS OF EVERYONE INVOLVED IN EDUCATION MUST BE LEVERAGED, FROM STUDENTS, TEACHERS, AND PRINCIPALS TO PARENTS AND COMMUNITY LEADERS. (P. 82)*

When innovative educators are able to embrace and enhance student's previously existing talents, much progress can be made toward successful active and applied learning process. For many students, the most important discoveries may be the realization of where their greatest talents lie and where the flow of experiences occur (Gordon & Crabtree, 2006).

Activities that promote intellectual engagement, and can be considered high-impact practices (HIPs), may include service-learning projects, undergraduate research, internships, student-centered learning, peer teaching, and a variety of other activities. These practices can have high impact on student learning and retention procedure. The National Survey of Student Engagement (NSSE) recommends all students to participate in at least two HIPs during their undergraduate years (NSSE, 2007). These learning activities should target different cognitive outcomes including critical thinking, synthesis and evaluation, and student motivation (Stolk & Harari, 2014).

### ***C. High Impact Learning in Higher Education***

Barkley (2010), who tackles the meaning of student engagement in the college classroom in her book *Student Engagement Techniques*, summarizes, "student engagement is a process and a product that is experienced on a continuum and results from the synergistic interaction between motivation and active learning" (p. 6). We strongly believe that research and inquiry based learning accomplishes this. It also can go beyond active learning into truly transformative experiences where the students redefine themselves or their thinking (Yaffe et al., 2014). As Barkley (2010) contends,

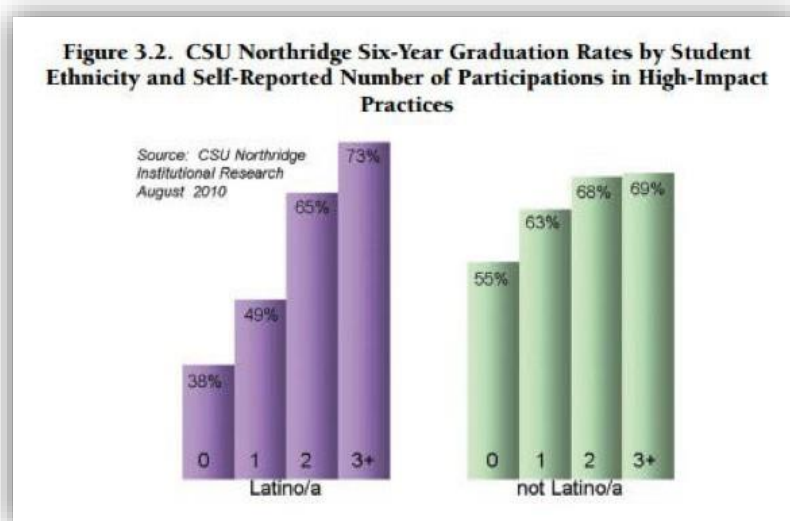




*WHILE COMBINED MOTIVATION AND ACTIVE LEARNING PROMOTE BASIC STUDENT ENGAGEMENT, SOME TEACHERS ARE PUSHING FOR MORE: THEY WANT STUDENTS TO BE TRULY TRANSFORMED BY THEIR EDUCATIONAL EXPERIENCES. ALTHOUGH ANY LEARNING, BY DEFINITION, RESULTS IN SOME LEVEL OF CHANGE, TRANSFORMATIVE LEARNING IS DEEP AND THOROUGH CHANGE. (P. 4)*

In some ways, transformative learning can occur when the right questions are asked which push or challenge a person's initial conceptions. For Morgan and Saxton (1994), engaging students in learning means, in part, effective questioning by not only instructors but by students. Undergraduate research experiences provide students with opportunities to engage in high-impact experiential learning. Although prevalent in the sciences, there are now extensive banks of case studies demonstrating the use of undergraduate research as an educationally enriching activity across many disciplines (Zimbardi & Myatt, 2014).

To this end, we recommend what are known as high-impact practices, which include service learning, peer mentoring, and undergraduate research (Malachowski et al., 2015). These activities are known to have a positive correlation with graduation rates (see Figure 3.2 [excerpt] below). For example, "at California State University Northridge (CSUN), there is a strong correlation between graduation rates and participation in multiple high-impact practices, particularly for Latino students" (Malachowski et al., 2015, p. 29).



#### IV. UTAH VALLEY UNIVERSITY CONTEXT

Utah Valley University (UVU) is the largest university in the State of Utah, a comprehensive public university of over 30,000 students and is a Carnegie-designated Community Engagement Institution. Because UVU is an open-access institution, retention and persistence of students to graduation is a priority. The university views high impact practices such as undergraduate research as significant approaches in helping improve student learning, retention, and persistence and seeks to increase student participation.

Utah Valley University has open enrollment, and hence, has students of vast and various educational and personal backgrounds. In the fall of 2015, the student's headcount is over 33,000 students. Currently, 30-40 % of all incoming UVU students need to take some type of remedial or developmental English courses and approximately 50-60 % of all incoming students need to take some type of developmental math course. That being said, as Malachowski and colleagues (2015) summarize, underrepresented minority students, students who enter college with less academic preparation, and first-generation students demonstrate the greatest benefits from undergraduate research. Additionally, introducing students to IBL in their early phase of education and over time generally increases the research's impact on student retention and academic performance (Davis & Jacobsen, 2014). As Ishiyama (2002) points out,

**students who participate in undergraduate research early on report significant gains in the ability to (1) think analytically and logically; (2) put ideas together, and note similarities and differences between ideas; (3) learn on their own and to find information they need to complete a task. Moreover, it was found that early participation in collaborative research was of particular benefit for first-generation college students. (para. 1)**

Based on these factors, it is obvious that undergraduate research produces positive outcome for undergraduate students, especially those UVU is seeking to serve most.

UVU has an active history of support for undergraduate participation in the Utah and National Conferences for Undergraduate Research (UCUR and NCUR, respectively), and offers competitive undergraduate research fellowships. In 2014, UVU has successfully launched the undergraduate research scholarly and creative activities (URSCA) program. During 2014, URSCA has allocated \$125,000 of support for upper division students and faculty mentors. These existing supports largely fit the primary faculty model of IBL consisting of a single professor working with a small group of advanced undergraduates. However, given the size of the institution and our goals of retention and persistence, especially for underrepresented students, this model cannot achieve the desired scope and impact.

Some UVU colleges and departments also offer additional support in the form of grants for students and faculty to address the needs that university-wide designated resources have not

been able to meet. The College of Science and Health, for example, offers College of Science & Health Scholarly Activities Committee (SAC) grants for faculty, the School of the Arts, College of Technology and Computing, the Woodbury School of Business offers summer research grants for faculty and University College also offer their own area-specific grants as well.

While the retention and graduation rates nationally hover around fifty percent, they are traditionally lower at Utah Valley University. For 2014, full time student retention was 59 % and part time retention was only 43 % for 2014. These percentages showed a little improvement when compared to data from 2008, which had 47 % retention rate for full time students (Utah Valley University Institutional Research, n.d.).

UVU is currently in the middle of 'major master planning' for the future of the institution, trying to envision the university 20 years from now, including a vision of itself as an institution serving a significantly larger population. Given the accelerating availability of information, it is important to recognize that the primary role of faculty in the classroom or online is no longer to provide content information; it is to engage students in skill development (e.g. critical thinking in our disciplines), undergraduate research, scholarship, and creative activities. Thus, consideration of promoting IBL as a central pedagogy for UVU's ongoing focus on achieving student success could not be more timely.

#### V. EXAMPLES: SCHOLARLY AND CREATIVE UNDERGRADUATE LEARNING AT UVU

While Utah Valley University is highly involved in engaged learning, the specifics of how that might include or incorporate scholarly and creative activities are somehow vague if defined at all. Some individual faculty members are quite involved in incorporation of research into their curriculum, but this is on a singular basis. One example of such a faculty is Dr. Olga Klopp, Associate Professor of Biology. As she states about her classroom,

*I STRONGLY BELIEVE IN PEER TEACHING AND COLLABORATION IN RESEARCH. IN MY LAB, ONE STUDENT BECOMES A LEADER OF THEIR GROUP AND THEY ORGANIZE THE EXPERIMENTS (ALONG WITH MY INPUT) AND COLLABORATE TO MAKE SURE THE PROJECT IS A SUCCESS. THERE IS POSITIVE PEER PRESSURE TO PERFORM WELL AND THEY FEEL VERY PROUD OF BEING THE LEADERS. THEY INCLUDE THAT IN THEIR RESUMES AND SOMETIMES THEY START A NEW PROJECT, BRANCHING OUT OF THE MAIN PROJECT THAT LEADS TO NEW QUESTIONS. I HAVE THREE LEADERS, THREE DIFFERENT GROUPS OF RESEARCH (PERSONAL COMMUNICATION, OCTOBER, 2015).*

A number of her students have presented at local, national and international conferences, including UCUR and NCUR, the Botanical Society of America, the American Association of Plant Biologists, and the International Journal of Arts and Sciences Conference in Europe. She has also worked to secure funding for these students via institutional research and engaged learning grants such as a \$4,000 Center for Engaged Learning grant for a natural history course or a School of Science and Health \$4,000 award for research with students. As a mentor to students, she not only guides them to have better understanding of research methodology but also inspires them to have their work published and/or presented. She has supervised publication of the work of approximately nine research assistants as well as supervising dozens of undergraduate research projects. To accomplish this, she customizes her mentoring for each student by understanding their

needs, supporting their ideas, and encouraging growth on a personal level. As student Samantha Beck notes, "I was awarded the URSCA grant last year and multiple SAC grants only because of Dr. Kopp's help. She individualized her mentoring with me by teaching me how to be autonomous in the lab and supporting my research ideas" (personal communication, October, 2015).

Students in the lab have published their research in national and international journals, 14 students being co-authors in the research papers. Students are active participants in the writing of the research and learn how to analyze the data and properly disseminate their findings. Each year students present the research in the form of posters at different conferences as indicated above. Thirty-three students have presented posters of their research at national and international conferences. Dr. Kopp believes that student involvement in research is pivotal for their success as future scientists. The experience acquired when doing research allows them to reach their goals in graduate school, improve their critical thinking and communicating abilities.

Dr. Kopp also uses research in the classroom where students in Plant Physiology, Plant Tissue culture and Ethnobotany develop their own research project, write a proposal, run the project, write the paper reporting their results using the format used in scientific papers, present a poster and a scientific presentation. The posters are presented to the UVU public. Students learn how to present their own research, to ask questions, to gather data, analyze it and present it.



Some of those projects have led to publications and some students are so excited about their project that they continue working on the research the following semesters. Students in the Ethnobotany course conduct research using human subjects. They create their own questionnaire to survey Utah residents about the use of plants for different diseases. They become certified to do research with human subjects through [www.citiprogram.org](http://www.citiprogram.org). They

write their IRB and learn the ethical procedures of how to conduct research with humans. After they collect data with the surveys, they analyze the data, write a scientific paper, and present the research with a poster in the style of a scientific meeting. Students learn that science is a wonderful venue to explore nature and to gain knowledge about it.

Another example is the NOVARAD research project being led by Huda Al-Ghaib, who is not only a highly innovative inquiry-based learning faculty but also one of our newest, having been here less than a few months. Al-Ghaib has been granted her Ph.D. degree on May 2015. Her work is in the area of digital image processing with applications in the medical field, specifically for improving the early detection of breast cancer. Screening mammography has been used for the detection and diagnosis of changes in the breast tissues. Asymptomatic women may be encouraged to undergo screening mammography on a regular basis after reaching a certain age. In most cases, mammograms, that are produced using X-ray imaging device, reveal information that could yield to the detection of suspicious lesions by a breast radiologist. Hopefully, the detection is achieved before the lesions are advanced to a late stage of cancer, which makes it difficult to cure. Lesions can be characterized as masses, calcifications, or

architectural distortions. Since mammogram is a 2-D projection of a complex 3-D object, this makes it challenging to identify all ill-defined lesions using mammography. Many factors such as: breast density, overlapping tissues, and the lesion's size affect the accuracy of the mammogram analysis. For every 1000 screening cases, 100 cases are called back for extra investigations and less than 10 cases are proven to be malignant. Routine examination of large numbers of mammograms by radiologists is a challenging task. The advancement in technology urged scientists and engineers to develop an automated system that could assist radiologists in interpreting the mammogram information. The automated system is recognized as computer-aided diagnosis (CAD) and uses digital image processing algorithms to interpret mammogram information. Many health facilities found CADs to be helpful in reading screening mammograms. However, CAD lacks consistency in interpreting the overlapped challenging patterns of the breast. Hence, many normal cases have been called back for extra unnecessary investigations. CADs are effective in identifying carcinomas associated with the presence of calcifications, masses of big sizes, and mixture of masses and calcifications. Nevertheless, many carcinomas are still missed by CADs.

To accomplish her research goals, Al-Ghaib, along with her graduate research team, reached out for radiologists to pinpoint areas that needed to be improved in the current CAD's software. The two radiologists, Dr. Melanie Scott and Dr. Heidi Umphrey, stated that CADs neither incorporate algorithms to register temporal mammograms nor include algorithms to detect



architectural distortions (Anderson-Maples, 2015). Hence, an automated mammogram registration algorithm is needed by the medical community to help radiologist in early detection of breast cancer. Al-Ghaib has developed an algorithm for mammogram registration that applies structural similarity (SSIM) index to compute the translation and rotation parameters of maximized similarity for an input temporal mammogram pair. Temporal mammogram pair is defined as two mammograms acquired for the same patient over time, maybe months or even years. Al-Ghaib has over ten journal and conference publications.

Currently, Al-Ghaib is working on securing funding to introduce undergraduate students at UVU to the digital image processing field and the research associated with that important field. Traditionally, the subject of digital image processing has been mainly taught at the graduate level. However, the fast growing technologies in different life aspects, screening mammography given earlier is one application that, have used digital images to convey different types of information for different purposes. Consequently, the digital imaging-processing field is an important active area of research. A challenging question is how to make use of the available



computational tools and advanced technology to teach the fundamentals of digital image processing and their applications in the medical imaging and diagnostic radiology at the undergraduate levels. Introducing the undergraduate students at UVU to this important field will enable them to perform research at their early stage of college education and, hence, open new applications for digital image processing. This will be done through a modular approach to teach digital image processing that is associated with hands-on computer aided diagnosis (CAD) projects, research internships, and interaction with a local radiology center, NOVARAD, under the support of Dr. Wendell Gibby, the cofounder and owner of NOVARAD.

A last example is Dr. Ron Hammond, Professor of Sociology. Dr. Hammond commonly publishes research with his undergraduate students in professional journals; to date, five students have collaborated on manuscript preparation with him. Moreover, Dr. Hammond mentored approximately 97 more students present at national, state, or professional conferences. He also implements student poster symposia at UVU where over 4,500 students have displayed their work. His paradigm for conducting undergraduate research includes two key components: first, discover the payoff to his undergraduate students that collaborative research will provide and make sure they recognize these benefits and that they can claim them after having completed the research project; and second, walk these students step-by-step through every part of the research project.

The main benefit of participating in undergraduate research that Dr. Hammond sees coincides with the motivations his students already have in earning a degree: to graduate, get a good job, and perhaps even to attend graduate school. Dr. Hammond teaches every student how to create a curriculum vitae and why they should keep it. Every single aspect of the research process is worthy of being documented in their curriculum vitae. Becoming Human Subjects research certified through [www.citiprogram.org](http://www.citiprogram.org); co-writing the IRB, co-developing the survey instruments; launching the paper or online survey; co-analyzing the data findings; and co-writing/co-presenting the findings in a scholarly event such as a campus, state, regional, national, and/or international conference.

The most common presentation is a poster. The most common type of conference is campus followed by national. Yet, in 2015 Dr. Hammond co-presented two posters with three students during the [www.ssea.org](http://www.ssea.org) international conference. Another faculty member attending the conference complimented the three undergraduate students by saying, "Your graduate students do good research." Dr. Hammond has learned to smile, thank them, and then for fun inform them that they are his undergraduate, not graduate research assistants. Many of his students intend to go to graduate school. Their undergraduate



research experience with Dr. Hammond enriches their curriculum vitae and provides Dr. Hammond with detailed and specific information to write in their graduate school letters of recommendation where he has referred to over 300 of his previous students as his “Research Assistants.” The interesting and useful aspect of curriculum vitae is that it can easily be converted into a resume. Dr. Hammond has written over 900 letters of recommendation and has provided many other recommendations via telephone in support of his students. Many employers are surprised that the applicant gained research experience as an undergraduate student.

The second and perhaps most utilitarian element of undergraduate research to Dr. Hammond and anyone else collaborating similarly with undergraduate students is to purposefully walk the student step-by-step through the entire research process. While in graduate school, the graduate student learns their value to professors as informed and prepared research assistants. Graduate faculty are often able to simply provide instruction on which types of analysis to conduct and how to prepare the results. The opposite tends to be true for undergraduate research assistants. They often come into the project with math anxiety, little experience, and quite often a reluctance to allow themselves to become motivated. It requires much patience to provide reassurances to these undergraduate students that if they will put their trust in Dr. Hammond he will help them learn what they need to do, how they should best do it and how to present their findings once they reach that point. How does he grade them? They must attend, they must document their participation, and they must carry their fair share of the research load. However, Dr. Hammond made the conscious choice grade neither their research nor statistical knowledge. Instead, he grades their participation, peer-reviewed literature supported final paper/report/poster, and their ability to work in small teams together. This essentially lowered both the stakes and the associated anxiety many students bring to the undergraduate experience.

Finally, Dr. Hammond and his students conduct pro bono research for on and off-campus non-profit organizations. This creates stronger buy-in from his students who realize that (1) they can now add the volunteering experience to their curriculum vitae and (2) their research experiences will help community agencies better serve their clients. In other words, students respond to situations that allow them to better position themselves for employment or further study while also doing something meaningful for those around them, which may, in a small way, ‘change the world.’ Foster care providers, kinship caregivers, government funded mental health providers, corrections, parole and probation, and other community agencies have benefited from the research evaluation conducted by Dr. Hammond and his students. That does not include the many UVU departments and divisions which have collaborated with Dr. Hammond and his students to assess how well they are doing what they do and often how they might better provide their service. Our desire is to have this type of curricular and faculty involvement across campus.

There are many reasons for pursuing undergraduate research and inquiry based learning on campus. The previous paragraphs illustrate only few examples of the benefits of the IBL. These high impact practices improve student retention and strongly support the UVU mission and goals of student success, inclusion, and engagement. As Hoskins (2012) points out, it is important for universities to develop models of engaged learning because they result in higher outcomes of student learning and increased retention. Added to that, these types of activities support stronger relationships for the student with the faculty, other students and the institution itself. Ahern-Rindell

and Quackenbush (2015) state, “Overall, UR leads to increased student engagement and closer connections to faculty, to other student researchers, and to the institution itself” (p. 2).

*VI.SCULPT: SCHOLARLY AND CREATIVE UNDERGRADUATE LEARNING  
PARTNERSHIP TEAM*

Based on funding supplied by Richard Tafalla of the Office of Engaged Learning via UVU’s Title III grant that incorporates undergraduate research as a method for enhancing student retention, the following individuals were able to attend training institutes offered by the Council on Undergraduate Research (CUR) during the 2014-2015 academic year:

Institutionalizing Undergraduate Research (April 10-12, 2015 -- San Diego, CA)

- Jon Anderson of Developmental Math
- Anne Arendt of Technology Management
- Olga Kopp of Biology
- Linda Shelton of English & Literature
- Maritza Sotomayor of Finance & Economics

Climbing the Ladder to Funding Success: Diverse Sources, Diverse Pathways (February 19-21, 2015, Arlington, VA)

- Daniel Horns of Earth Science
- Merrill Halling of Chemistry
- Andrew Creer of Exercise Science
- Kim Nielsen of Physics

Integrating Undergraduate Research in the curriculum 2015 (March 27-29, 2015 -- Trinity Washington University, Washington, DC)

- Kathie Debenham of Dance
- Jessica C. Hill of Behavioral Science
- Ryan Leick of Aviation
- Cyrill Slezak of Physics

Undergraduate Research in the Social Science Institute 2015 (March 13-15, 2015 – Stetson University Center, Celebration FL)



- Kris Doty of Behavioral Science
- Michael Goode of History
- David Morin of Communication
- Deb Thornton of English & Literature
- Stacy Waddoups of Student Leadership & Success Studies
- Jon Westover of Business Management

The goal of sending teams to these interactive institute trainings was to increase inter-departmental discussions regarding IBL and to promote enhanced understanding among participants of the value that increasing the scale and impact of IBL could have on student learning. Participation in the Institute provided the attendees with examples of successful models and feedback about educational approaches in use across the country. As part of the institute process, these faculty and department chairs were asked to develop specific plans customized to UVU's specific institutional context to increase the chances that their learning would be implemented on their return.

Based on ongoing discussions of how to incorporate the scholarly and creative results and learning from these institutes to UVU, the group of faculty members who attended the CUR conferences determined that a formal and ongoing affinity group needed to be created to promote and implement best practices. Thus, in the early summer of 2015 SCULPT was born. SCULPT stands for Scholarly & Creative Undergraduate Learning Partnership Team and its founding membership included approximately 30 faculty members from every college and school on campus. Since that time, membership has grown, now including 48 faculty members from across campus. It is currently led by three co-chairs: Olga Kopp from Biology, Anne Arendt from Technology Management, and Anton Tolman from Behavioral Science. In addition, there is an Advisory Group that provides input and feedback on strategic planning and that consists of: Jessica Hill (Behavioral Science), Ana Aguilera-Lopez (Languages), Linda Shelton and Rob Carney (English & Literature), Benjamin Johnson (Student Leadership and Success Studies), Jonathan Anderson (Developmental Math), Eric Domyan (Biology), Joe Jensen (Physics), Amir Kia (Economics), Paige Gardner (Marketing), and Sarah Donahue and Kathie Debenham (Dance).

This group has defined their role and mission as follows: SCULPT is a resource for teaching through inquiry-based learning. Inquiry-based learning, inside and outside the classroom, includes research, scholarship, and creative activity. SCULPT provides resources for: a) developing inquiry-based pedagogy, b) encouraging undergraduate research, c) developing programs, d) mentoring students, e) developing skills and traits in students, and f) helping identify and pursue funding.

#### ***A. Goals, Benefits, Drawbacks, and Challenges***

In order to successfully implement scholarly and creative learning processes at Utah Valley University there is both development and integration that needs to occur with curriculum and at an

institutional level. Below we address some obstacles as well as recommendations for development and integration at both levels.

## **Goals**

In considering our overall goals for inquiry-based learning, a good place to start is by reviewing the Council on Undergraduate Research Characteristics of Excellence in Undergraduate Research (COEUR). These include the following categories: a) campus mission and culture; b) administrative support, c) research infrastructure; d) professional development opportunities; e) recognition; f) external funding; g) dissemination, h) student-centered issues; i) curriculum; j) summer research program, k) assessment activities and l) strategic planning. A complete list can be found in Appendix A; a table for using these as measures at our own institution can be found at [http://www.cur.org/assets/1/7/CUR-COEUR-2014\\_Checklist.pdf](http://www.cur.org/assets/1/7/CUR-COEUR-2014_Checklist.pdf); and a fully detailed document which explains each category and subcategory can be found at [http://www.cur.org/assets/1/23/COEUR\\_final.pdf](http://www.cur.org/assets/1/23/COEUR_final.pdf)

Along with above, we also see the increased use of inquiry-based learning improving students' critical appraisal skills in thinking and problem solving, using data, teamwork and communication, and identification of similarities in people and projects. Added to that, it will demystify the path to research and publication. By incorporating it into the curriculum, we can help students view themselves in these roles and boost their self-confidence. As Malachowski and colleagues (2015) state, "the opportunity to deeply engage with role models--be the professors, graduate students, or more advanced peers--allows students to identify similarities in their backgrounds, demystify the path their mentors took to their positions, and, ultimately, view themselves in those roles" (p. 31).

## **Obstacles**

Perhaps the greatest initial obstacle is securing faculty involvement and commitment. Many faculty members are already performing undergraduate research and scholarly creative activities both in and outside of their classrooms in varying fashions. We are currently in the process of finding out the use of high impact practices in teaching by UVU faculty. Even so, we concur with the views of Davis and Jacobsen (2014) that there are "three main, yet intertwined, challenges to faculty participation: student preparation, time constraints, and demands related to the promotion and tenure process" (p. 20). We seek to encourage acknowledgement, collaboration, and interaction among these faculty as well as with faculty who are interested in incorporating research-based activities into their pedagogical practices (Schantz, 2008).

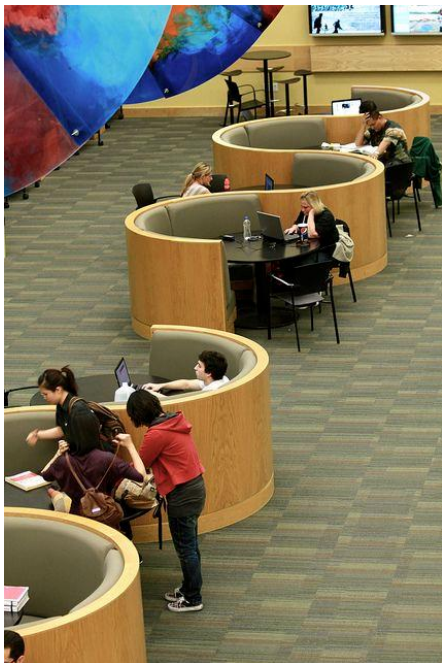
SCULPT has made significant progress in increasing its membership from the initial 30 faculty to 45 from across campus, but more work needs to be done, and there is faculty resistance to the idea of participating in another group. The next potential obstacles include institutionalizing and recognizing the value of IBL in faculty assessment, workload, and compensation. Further, opportunities to establish meaningful relationships with students in large classrooms make mentoring individual students more challenging, although curricular integration will assist in this area. While faculty may additionally face challenges regarding incoming student preparation as well as high student attrition rates, we feel our focus on inquiry-based learning will ultimately help

mitigate some of these issues. Hensley, Shreeves, and Davis-Khai (2014) point out, “There is a growing body of evidence indicating that scholarly disengagement can be reversed when students participate in high-quality, discipline-oriented undergraduate research programs” (p. 1).

An additional obstacle is a lack of an institutional inventory of courses that include inquiry-based learning as a significant component. We strongly support development of such an inventory. Each of these obstacles will be addressed in our recommendation section below.

### ***B. Development and Integration into Curriculum***

Across our institution, we are eager to facilitate inquiry-based learning and research as pedagogy (Schantz, 2008). It is a creative process that encourages early professional experience in student’s chosen careers. It encourages discovery-based learning in classroom curriculum and encourages the use of peers as models for doing research. We need to expand beyond a simple



mentoring approach to a limited number of students, but instead reach out to more students and explore the benefits of collaborative research.

Moreover, we need to help students understand that research and creative activities are not about succeeding or failing in accomplishing a task, they are about improving and learning. Overall, “Institutions must create incentives and rewards for both faculty members and students to participate in scholarly endeavors with one another. This can include institutional-level recognition of faculty members and students” (Davis & Jacobsen, 2014, p. 28). We also recognize there is no one-size-fits-all solutions to our concerns. Davis & Jacobsen (2014) note,

*A ONE-SIZE-FITS-ALL APPROACH TO INCREASING FACULTY PARTICIPATION IN MENTORING UNDERGRADUATES IS GOING TO FAIL. STUDENT SCHOLARSHIP IS BY ITS NATURE A DISCIPLINARY ENDEAVOR. THEREFORE, THERE WILL AND SHOULD BE DISCIPLINARY VARIATION IN THE MECHANISMS, METHODS, AND APPROACHES TO FACILITATING AND EVALUATING STUDENT SCHOLARSHIP. (P. 28)*

### ***C. Development and Integration into the Institution***

Early engagement in the career of choice is important in retention. As one example, the University of Michigan institutionalized research to improve retention. They found that the retention rates of African Americans increased from 65% to 81% with a degree of completion from 56.2% to 75.3%, they were more likely to go to graduate school--from 56% to 82%, and to pursue medical, law or Ph.D. degrees--from 56.6% to 78.5% (Gregerman, n.d.).

Concluding from the above, as well as on our own experiences, we desire to improve the acceptance of undergraduate research as a tenurable activity. We want to ensure that each school and college has representation on committees involved in IBL, and we desire to establish two research symposiums --one for fall term and another for spring term-- for all departments where all schools present their research.

## VII. RECOMMENDATIONS: STRATEGIES FOR INTEGRATION

In this section, we will discuss a variety of options and recommendations for integration of undergraduate research and scholarly creative activities at UVU. We believe these activities to be a worthy investment for students, faculty and the institution. "Programs that support high-impact practices, such as undergraduate research, should be viewed as investments that provide a rate of return through the retention of students" (Moran et al., 2015, p. 64). As has been noted previously, high impact practices such as undergraduate research experiences help to increase student success, improve retention rates, and improve graduation rates as well. (Moran et al., 2015; O'Donnell, Botelho, Brown, Gonzalez, & Head, 2015)

### A. Scaffolding in the Curriculum

We realize that not every student or every faculty member has the tools available for high integration of advanced inquiry-based learning in their classrooms. This may have to do with student preparation, complexity of course content, level of course, familiarity of faculty with inquiry-based learning within their fields, etc. Therefore, we recommend that UVU adopt a 'scaffolding' approach to IBL -- starting with basic skills and research practices in lower division courses and moving in complexity as students progress to upper division courses. At each step along the way, students can be learning skills that help them be stronger researchers and scholars.

This should occur at every level of their educational experience. We believe, as Fakayode and colleagues (2014) have found when researching a program known as "Raising Achievement in Mathematics and Science" (RAMS) project at Winston-Salem State University (WSSU), that early and continued exposure to undergraduate research and related activities will benefit the students throughout their academic careers and beyond.

**Students who participate in research early, during the first year and second year, are more likely to succeed and graduate with college degrees in STEM disciplines. Such students are also likely to advance to graduate school in STEM areas or proceed to professional schools. (Fakayode et al., 2014, p. 663)**

The RAMS project, as well, focused specifically on underrepresented minority students (URM) with great success. The following outlines how RAMS works at WSSU,

*PARTICIPANTS WERE ASSIGNED TO WORK FOR 8–10 H/WEEK WITH A FACULTY MENTOR TO CONDUCT RESEARCH OF MUTUAL INTEREST FOR THE ACADEMIC YEAR. EACH SCHOLAR RECEIVED A \$2,400 STIPEND FOR ONE ACADEMIC YEAR BUT MAY BE RENEWED FOR ANOTHER YEAR. TO QUALIFY AS A RAMS SCHOLAR, THE STUDENT MUST BE A FIRST YEAR OR SECOND-YEAR STEM MAJOR AND HAVE A GPA OF 3.0 OR HIGHER. HOWEVER, FIRST-YEAR STUDENTS AND STUDENTS WITH GPA OF LESS THAN 3.0 WHO EXPRESSED STRONG INTEREST IN RESEARCH AND GRADUATE STUDIES IN STEM HAVE ALSO BEEN ADMITTED INTO THE RAMS PROGRAM. (FAKAYODE ET AL., 2014, P. 663)*

Establishing a similar type of scholarships for students at UVU could improve the student's participation in undergraduate research. As mentioned by Davis and Jacobsen (2014, p. 24), students with financial constraints have difficulty to participate on research projects. Creating scholarships will allow those students to participate.

Students were also given limited research supplies and support to attend conferences. Added to that, speakers from graduate and professional schools were invited to give seminar presentations. This project, along with a Summer Undergraduate Research Experience (SURE), proved monumentally successful.

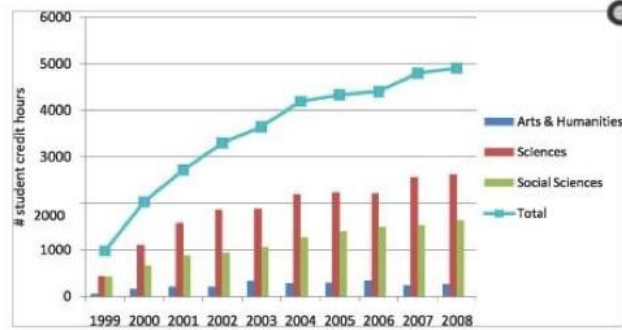
**Retention rates for first-year (77.8%), second year (61.9 %), third-year (56.8%), and fourth-year (35.4%) students were observed at WSSU in 2008. The first year (47.5%) and second-year (34.4%) retention rates were recorded for STEM majors at WSSU in 2007. Similar first year (48.5%) and second-year (29.6%) retention rates were obtained for STEM majors in 2008. In contrast, a high retention rate for RAMS scholars after year 1 of 98.8% was observed. The retention rate of RAMS scholars of 98.8% was maintained after year 2, year 3, and year 4. In fact, less than 1% of the 88 RAMS Scholar program participants dropped out of the program due to GPA, research schedule problems, or change in full-time status. (Fakayode et al., 2014, p. 663-664)**

They continue, "It is of considerable interest to note that the entire 2009 RAMS scholar cohort has graduated in STEM disciplines (with graduation rate of 100%) and are currently enrolled in either M.S./Ph.D. graduate programs or professional schools" (Fakayode, et al., 2014, p. 664). While the RAMS project may not be fully representative of the success we could have at UVU, it certainly demonstrates the fact that student participation in research types of projects can prove very beneficial, particularly if embedded throughout the educational experience.

As Fechheimer, Webber, and Kleiber (2011) describe, at the Center for Undergraduate Research Opportunity (CURO) at the University of Georgia, the investigation of the impact of CURO at the University of Georgia documents clearly that this university-wide center has promoted student engagement and dramatically increased the amount of IBL activity as measured by student credit hours, presentations at IBL symposia, and theses (see Figure below).



Figure 1.



Student credit hours in directed-research courses at University of Georgia from 1999–2008. Student credit hours in UR courses across all disciplines and honors shown as a total sum, or sorted by discipline. “Sciences” includes the biological and physical sciences. “Social sciences” includes the conventional social sciences as well as business, law, and journalism. Arts and humanities were combined into a single category since they were about equal and together comprise ~5% of all of the UR hours.

For the above case, as Malachowski and colleagues (2015) point out, “even when controlling for academic preparation (SAT score), taking courses with an authentic research component was positively correlated with academic performance across classes (cumulative GPA)” (p. 33). We feel this type of ‘scaffolding’ of research throughout our curriculum will have similar positive effects at UVU.

### ***B. Encouraging a Culture for Inquiry-Based Learning***

In order to encourage a culture of inquiry-based learning, we enthusiastically envision increased hiring of faculty who have personal experiences and/or beliefs in undergraduate research. We also recommend both departmental and university-wide recognition of those who are currently, and potentially more in the near future, involved in undergraduate research whether via compensation, awards, or acknowledgements.

Faculty in SCULPT, who have discussed establishing this culture, identify our obstacles to undergraduate research at UVU as time, money, and space. Each department can find creative methods to remove these obstacles if we are serious and willing in developing this culture. Even with the identified and previously explained obstacles, we have the urge to identify the significant gains from overcoming them since our unique student body fits the demographic of benefiting the most from inquiry based learning. As reported in Malachowski and colleagues (2015), multiple studies confirm, “Under-represented minority students, students who enter college with less academic preparation, and first-generation students demonstrate the greatest benefits from undergraduate research” (p. 29).

### **C. Encouraging participation.**

One strategy for integration is to encourage faculty participation in SCULPT from all areas of campus. We realize this will require educating faculty and others about both the resources and pedagogical relevance. To this end, we plan to have SCULPT socials that encourage faculty interaction and idea sharing with one another at least twice during the academic year: one time for each fall and spring terms. A second strategy for integration is to support the campus-wide student Research group and promote student involvement in SCULPT-sponsored research collaboratives.

We also recommend that inquiry-based scholarly and creative activities be further incorporated into UVU's current Engagement Week celebration, held every spring term. We would like to see more poster presentations from students from a variety of departments and areas of campus. This would necessitate, however, that the period for engagement week be consistent year to year and occur near the end of the term so students and faculty have ample time to develop their posters or other presentation materials. An attempt was made this year to expand Engaged Learning Week by linking it to the 75th anniversary celebration. While partly successful, ongoing effort is needed to expand the number of students participating and grow the number of faculty and departments involved. This type of growth and gradual improvements can be made when Engaged Learning Week and similar events are seen as major campus celebrations of student work rather than as "boutique" events. UVU Administration, especially the President's Office but also including department chairs, can provide significant support and highlighting of these events as core examples of UVU's focus on student success and engagement. These events offer students opportunities to highlight their original and creative undergraduate work and will give them practical experience in working on oral, written, and professional communication.

We recognize that there are a variety of methods in which academic research and creative activities could be incorporated into a student's educational experience. We believe Zimbardi and Myatt (2014) summarize well when they identified four broad models, plus a mixed model category, that reflected the major differences in the characteristics of the undergraduate research activities within our broad database of case studies:

*A) APPRENTICESHIP - STUDENTS WORK UNDER THE DIRECT SUPERVISION OF AN ACADEMIC STAFF MEMBER, IN AN AREA RELATED TO THE ACADEMIC'S CURRENT RESEARCH OR EXPERTISE; B) INDUSTRY PROJECT - STUDENTS FOCUS ON A COMPLEX PROBLEM THEY ARE LIKELY TO ENCOUNTER IN THEIR PROFESSION; C) INQUIRY PROJECT - STUDENTS UNDERTAKE THE ENTIRE RESEARCH PROCESS WITH A FOCUS ON LEARNING DISCIPLINARY CONTENT AND PROCESSES OF KNOWLEDGE PRODUCTION; D) METHODS COURSE - STUDENTS ENGAGE IN TRUNCATED VERSIONS OF THE RESEARCH PROCESS, WITH A FOCUS ON A BROAD RANGE OF METHODOLOGICAL PROCESSES COMMONLY USED IN THE DISCIPLINE; AND E) MIXED MODEL - COMBINES FEATURES OF TWO OF THE ABOVE MODELS. (P. 7)*

We also agree with the statements of Zimbardi and Myatt (2014) when he notes:

WE HAVE SHOWN THAT THERE ARE ALSO BROAD DIFFERENCES IN THE WAYS IN WHICH ACADEMICS DESIGN AND IMPLEMENT RESEARCH EXPERIENCES IN THE UNDERGRADUATE CURRICULUM, WITH APPLIED DISCIPLINES FOCUSING ON STUDENTS USING RESEARCH SKILLS TO INVESTIGATE INDUSTRY PROBLEMS, AND HARD DISCIPLINES PRIMARILY USING MODELS WHICH HELP STUDENTS TO UNDERSTAND THE COMPLEX AND STRINGENT PARADIGMS THAT ARE THE HALLMARK OF THEIR DISCIPLINES. HOWEVER, WE HAVE ALSO SHOWN THAT ACADEMICS OFTEN COMBINE ELEMENTS OF THESE DIFFERENT MODELS OF UNDERGRADUATE RESEARCH, AND THAT EACH TYPE OF UNDERGRADUATE RESEARCH ACTIVITY CAN BE EMBEDDED INTO THE CURRICULUM OF A RANGE OF DIFFERENT DISCIPLINES. BY CHARACTERIZING THE MODELS USED TO EMBED RESEARCH EXPERIENCES INTO THE UNDERGRADUATE CURRICULA ACROSS A BROAD RANGE OF DISCIPLINARY CONTEXTS, THIS WORK HAS PROVIDED A STRATEGIC GUIDE FOR ENHANCING THE DIVERSITY OF WAYS UNDERGRADUATE STUDENTS CAN BE ACTIVELY ENGAGED WITH THE RESEARCH CONTENT AND PROCESSES OF THEIR DISCIPLINES. (P. 16)

#### **D. Dedicated Space and Resources for Students**

**1. DEDICATED RESEARCH SPACE.** UVU needs to develop engaged-learning spaces for student study, research and discussion as well as establish dedicated lab space that can be reserved by faculty when their standard classroom is not in a lab setting. As it stands, only the College of Science and Health has such dedicated space and even this took several years to accomplish. For other areas of campus it simply does not exist. For example, this semester Drs. Hill and Lieberwirth are trying to work with their students using an eye tracking system but have no location where they can set up and perform this work. In more detail, part of engaged learning in psychology, a STEM field (Bray et al., 2010), involves having access to appropriate technology. Drs. Hill and Lieberwirth have received grant funding to purchase and incorporate equipment and technology into current and future laboratory-based psychology courses (e.g., Psychological Psychology, Cognitive Psychology, Sensation and Perception). The aforementioned courses are the core of psychology programs nationwide (Stoloff et al., 2010). Further, such courses “focus on undergraduate students, engage more students in experiential learning, and have more frequent student–faculty interaction outside of the classroom” (Stoloff, Curtis, Rodgers, Brewster, & McCarthy, 2012).

**2. LABORATORY-BASED COURSES.** The number of students attending UVU continues to increase ultimately leading to a larger number of students in various majors across the university. It should be noted that the number of students pursuing a Behavioral Science degree with an emphasis in psychology increased from 1,729 to 1,963 from 2013-2014 to 2014-2015. To meet the demands of the continuously increasing student body interested in psychology, two new full-time psychology faculty have been hired in the beginning of the current academic year. Furthermore, over the past three years, the newly hired psychology faculty have increased the areas of expertise of the psychology faculty by adding cognitive psychology, developmental psychology, and neuroscience. These faculty have subsequently proposed and created various laboratory-based courses (such as Principles of Learning, Sensation & Perception, and Physiological Psychology) to meet one of the goals of the American Psychological Association of increasing the recognition of psychology as a science. To this end, the laboratory-based courses serve to engage students in hands-on demonstrations and experiments. Through various grants, the faculty have acquired the necessary resources to be able to attract students and to utilize these resources for hands-on demonstrations and experiments with the students. Resources include E-prime software (to allow computerized experimental design and data collection), Sniffy The



Virtual Rat software (to allow computerized experiments on classical and operant conditioning), BioPac (to record various physiological measures on human participants), various brain models including a plastinated human brain (to learn hands-on about brain structure and function), etc. Unfortunately, classroom scheduling for these courses has been challenging since there is no designated classroom to be utilized for the laboratory component of these courses. The laboratory portion depends on sensitive equipment that cannot easily be transported across campus or set-up within 10 minutes, which is the time between classes. It is a realistic concern that these scheduling difficulties will reduce these classes' scheduling frequency each semester. Therefore, it would be highly beneficial to have a designated classroom for these types of classes.

**3. STEM OUTREACH.** There is a tremendous need to foster STEM education by increasing science awareness and exciting students about science. To this end, UVU has participated in countless number of activities promoting STEM awareness including the Expanding Your Horizons conference, SheTECH conference, UVU PREP, just to name a few. Having obtained the resources mentioned above (e.g., E-prime, BioPac, and various brain models), we have resources available to expend the STEM outreach even further—within the assumption of having access to a designated classroom space. Previous participation in the Expanding Your Horizons and SheTECH conferences (through workshops created by Dr. Lieberwirth) has provided evidence that high school students can greatly benefit from using BioPac and brain models. In addition, UVU undergraduate student co-presenters also benefitted from these workshops. Unfortunately, the transportation and set-up of the equipment significantly limits the type of activities the high school students are able to conduct—a designated classroom space would eliminate the set-up time allowing for much more in-depth hands-on and engaging activities. Furthermore, Dr. Lieberwirth has established a Brain Awareness Outreach program partnering with various local high schools. So far, the outreach has been limited to classroom demonstrations that rely on equipment that can easily be brought into the classroom. However, it would be very beneficial if high school students could be involved in hands-on science activities during a field-trip type activity to visit UVU. Furthermore, the designated classroom would allow Dr. Lieberwirth to establish a Brain Bee more easily at UVU—a STEM event she has been instrumental in coordinating at Florida State University (for more detail about the Brain Bee see <http://www.ibb2015.org/>).

**4. INQUIRY-BASED AND ENGAGED LEARNING USING CLASSROOM SPACES.** Designated classroom space could be utilized, when not used for laboratory-based courses, for various student activities that are under the guidance of faculty members in the College of Humanities and Social Sciences. In the attached Excel sheet, it is shown that many faculty members in the College of Humanities and Social Sciences are in need of space for activities that allow engaged and applied learning outside of class. Such activities are beneficial to meet various Essential Learning Outcomes. In particular, such activities will foster teamwork and collaboration skills (ELO 1 & 4); promote communication skills (through scientific writing and presentations at conferences, ELO 2); deepen quantitative and qualitative reasoning (through analyzing data, ELO 2); cultivate information and technical literacy (ELO 2); and encourage our students to become People of Integrity (by gaining better ethical reasoning, ELO 3) and Stewards of Place (by becoming more aware of local, national, and global issues, ELO 5). Faculty occasionally participate in collaborative work, one recent example is the creation of SCULPT (Scholarly Creative Undergraduate Learning Partnerships Team)—a faculty organization

that provides resources and support for researching through inquiry-based learning. It should be noted that such and other collaborations could greatly take advantage of a shared and designated space.

It should be noted that a designated and permanent laboratory-based classroom spaces for the College of Humanities & Social Sciences will provide many benefits to the students and faculty in the College of Humanities & Social Sciences, in particular psychology, the university, as well as the local community. Specifically, laboratory-based psychology courses will provide an engaging and interactive learning environment—essential components to facilitate student retention (Jansen et al., 2015). Furthermore, extracurricular learning opportunities via inquiry-based and engaged learning activities guided by faculty will promote the acquisition of skills and experience that will make our students competitive applicants for professional careers and graduate school. Such increased level of competitiveness will reflect positively on the status of UVU. Finally, expanding STEM outreach efforts will offer valuable contacts with the local community. Such contacts may influence the decisions of high school students to attend UVU rather than a different college or university. Therefore, a designated multi-purpose laboratory-based classroom space is in line with the mission statement as well as the administrative imperatives of UVU. Specifically, the mission statement asserts that “UVU builds on a foundation of substantive scholarly and creative work to foster engaged learning” (Utah Valley University Office of the President, n.d.), while also mentioning that it is the university’s duty to operate effectively, manage growth, and secure resources in order to fulfill UVU’s mission.

In sum, a designated classroom would allow engaging learning opportunities inside and outside the classroom by providing students with a space to conduct laboratory-based activities as well as participate in inquiry-based and engaged learning for students in the College of Humanities & Social Sciences. Such space is necessary for our students to be successful and reach their educational, professional, and personal goals.

**5. ADDITIONAL RESOURCES AND OPTIONS FOR STUDENTS.** For students who are completing work that is not credit bearing, it would be helpful if the institution could find a means to recognize and compensate the student’s efforts. At the Indiana University Purdue, for example, faculty members take advantage of the resources and support available on campus to recruit and compensate undergraduate students to assist them with the research projects they are conducting for their own line of inquiry. In this situation, “research provides an opportunity for students to challenge themselves, build relationships with faculty, and add depth to their university experience” (Culp & Urtel, 2013, p. 3). As they see it,

*ONCE A STUDENT HAS COMPLETED THE NECESSARY IRB TRAINING, FACULTY START THE PROCESS OF FORMAL MENTORING BY ‘HIRING’ THE STUDENT. THIS, ALONG WITH MUTUALLY AGREED-UPON EXPECTATIONS AT THE OUTSET OF THE PROJECT AND A STIPEND EARNED BY THE STUDENT FROM INTERNAL AND EXTERNAL GRANT FUNDS, HELPS TO MOTIVATE STUDENTS THROUGH COMPLETION OF THE EXPERIENCE. (CULP & URTEL, 2013, P. 4)*

After this point, expectations are identified and the process of developing an outcome begins. This method is not without risk as well as benefit though. As Culp and Urtel (2013) continue,

*THIS PROGRESSION IS WHERE THE BENEFIT OF THE FACULTY-SPONSORED FORMAT REVEALS ITSELF, AS THERE IS NO IMPENDING 'END' TO THE SEMESTER AS IN THE CASE OF COURSE-BASED FORMATS. HOWEVER, THIS ALSO MEANS THE PROJECT HAS THE POTENTIAL FOR IMPEDIMENT IF THERE IS NOT AN IMPENDING TIMELINE FOR A GRADE TO BE OFFERED. (P. 4)*

They also note,

**The reality is that when students self-select an undergraduate research (UGR) opportunity, it usually means they have an interest in the project (or at least the process) and are willing to do what it takes to get the most benefit out of the project. This fosters a mutually motivating experience that the student and faculty both benefit from. (p. 5)**

Monetary resources for students will facilitate the involvement of minorities and students that need to work and attend school. Davis and Jacobsen (2014) clearly describe how students with financial constraints must work and are not able to participate on research projects. "Therefore only certain students, specifically those with alternative means of supporting themselves, are currently participating and will be able to participate in the future" (Davis & Jacobson, 2014, p. 24). UVU as an inclusive university could provide an opportunity for those students by providing financial compensation or scholarships for the participation of students in research.

#### ***E. Establish an Office of Undergraduate Research***

UVU needs to establish and support an Office of Undergraduate Research. Currently, Undergraduate Research consists of a program run through the Office of Engaged Learning. This approach has been helpful in providing a set of grants for student research projects, recently expanding that support through the URSCA grants made possible by Title III and additional PBA funding. It is important to note that students who have received prior NCUR or SURF support and now URSCA grants represent a minority of students who are engaged in IBL across campus. However, as things stand, faculty, and staff are not clear as to the roles and responsibilities of related departments or service areas. It seems there are related programs across campus, but faculty express confusion and frustration as to how they interrelate, why different programs exist, where and how these programs can be accessed, and timelines. For example, the Office of Academic Research Support (OARS), led by Mohammed El-Saidi, is often associated by faculty with the Assistant Vice President of Teaching and Learning Bethany Alden while he actually reports to Assistant Vice President Richard Tafalla in the Office of Engaged Learning. Added to that, there is no directorship of undergraduate research nor a specified hard budget for that area, which only serves to further confuse faculty on how to access resources. We are also unclear

on the specific roles of the Office of Engaged Learning, versus the Office of Teaching and Learning (OTL) with regard to undergraduate research. Neither the UVU website nor organization charts found therein seem to clarify. While we don't doubt there is structure, roles, and intention at the institution in the areas of undergraduate research and scholarly creative activities, communication and clarity has been to this end, in our perception, lacking.

#### ***F. Awards and Recognition Specific to IBL***

We recommend two types of awards or recognitions relating to inquiry based learning. In both cases, individuals are nominated by others and are not required to submit their own self-promotion information, as is currently the practice in all awards for faculty. Our rationale is that self-promotion is not a cultural norm nor even culturally acceptable for some of our faculty and students.

First, is the distinguished employee award, similar to that of the Professional Association of College Employees (PACE) as can be found at [http://www.uvu.edu/pace/in\\_action/past\\_awards.html](http://www.uvu.edu/pace/in_action/past_awards.html), With this award, peers complete the nomination form and submit to the Chair of the SCULPT Recognition Committee. The Committee evaluates candidates through nomination statements and conversations with associates of the candidates. Each year, up to four full-time faculty members are selected as Distinguished Inquiry Based Educator of the Year and are awarded \$500 each. Additionally, up to four part-time faculty are selected and awarded \$250 each. Also, up to eight students are selected and awarded up to \$500 each.

The second is also similar to another PACE award known as the Wolverine Sighting Award as described at [http://www.uvu.edu/pace/in\\_action/sighting\\_form.php](http://www.uvu.edu/pace/in_action/sighting_form.php). This would be the "Inquiry-Based Learning Sighting Award" which would be a recognition award sponsored by SCULPT. The award would seek to recognize faculty or students who are active in inquiry-based learning, foster a culture of professionalism and excellence, benefit the UVU community, and promote opportunities for growth and development in scholarly or academic creative work.

Similar to what PACE does for their Wolverine Sighting award, we would draw winners quarterly from those recognized to receive one of the following: a recognition postcard, a \$25 UVU gift card, or a voucher for dinner at Restaurant Forte located on the 1st level of the UCCU Center. Nominations could be submitted on an ongoing basis by community members, students, faculty, administration, or other staff members.

#### ***G. Faculty Rank and Tenure Recognition***

We support both release time and monetary incentives for incorporating IBL activities either in the classroom, small groups, or one-on-one. We highly recommend that UVU determines means for recognition of these activities formally in faculty rank and tenure recognition. Overall, universities such as ours need to provide incentives to faculty that devote time to mentoring undergraduate research if we intend it continue (Adedokun et al., 2010).

## H. Faculty Workload

In order to succeed in bringing IBL activities to scale, there is need to have a reasonable amount of reallocated teaching time; it is very difficult for faculty teaching four courses plus engaging in service activities and their own work to carve out additional time for intensive mentoring of undergraduate research, even if they are highly motivated to do so. Indeed, in attempts to recruit faculty to SCULPT, the single largest concern that is expressed as an obstacle is lack of time.

To that end, what follows are recommendations for IBL related activities in the curriculum as well as independent research projects. While there may be many indirect benefits for faculty for mentoring, supervising, and advising on student research projects, providing direct benefits in the form of either pay or load recognition is likely essential for continued, wide-ranging success.

Furthermore, administration, faculty, and students need to work together to define what can be accomplished in the timeframe of a class and what alternatives exist if the project continues beyond a single term. As Adedokun and colleagues (2010) noted during the annual meeting of the American Educational Research Association, “Challenges for us--Better definition and understanding of what can be accomplished in a semester” (p. 8). In some cases, a project could continue for more than one semester or more. Otherwise, another key challenge is developing projects that are straightforward enough to fit within the limited hours of a course held in one semester (Adedokun et al., 2010). Presently, we have no method to address this.

**1. INQUIRY BASED LEARNING RELATED ACTIVITIES IN THE CURRICULUM.** A large amount of IBL related activities occur within regularly scheduled classrooms. This follows national trends, in a study done of sixteen (fourteen responses were complete) Council of Public Liberal Arts Colleges (COPLAC) locations, where “less than 50% of faculty mentor UR on a regular basis in a one-on-one or small group environment, and 25% or less of the students participate in UR in these forms” (Malachowski et al., 2015, p. 54):

**Table 5.1. Faculty and Student Participation in Undergraduate Research at COPLAC Institutions**

Percentage of Faculty Mentoring UR on a Regular Basis in a One-on-One or Small Group Environment		Percentage of Students Participating in UR on a Regular Basis in a One-on-One or Small Group Environment	
	Number of Campuses		Number of Campuses
> 80	2		
61-79	0	51-60	2
51-60	3	25-50	2
26-50	5	10-25	8
<25	6	<10	4

At most COPLAC schools, IBL can be offered through independent studies, summer research projects, small research seminars, or embedded within a course:

**Table 5.2. Method of Incorporating Undergraduate Research in the Curriculum at COPLAC Institutions**

<i>Method of Conducting UR</i>	<i>Number of Campuses</i>
Independent studies	16
Summer research projects	16
Small research seminars	15
Embedded within a course	14
Other models	5

(Malachowski et al., 2015, p. 54).

**2. INDEPENDENT RESEARCH.** Currently UVU faculty might or might not receive 0.1 credit hours for every student with whom they are working on the students' independent research. Often, faculty members do not get load credit for supervising independent study during the academic year, and they are not compensated in another way. Thus, our first recommendation is to change this to 0.2 credit hours per student. Our next recommendation is institutional incorporation of credit banking for faculty. Considering that some teaching activities contribute to faculty workload, faculty may bank CHEs for subsequent course load reductions. Essentially, faculty members can “bank” credits accrued for teaching independent studies or 489R (or 495R) research courses. These credits are accumulated, or “banked” until they amount to at least 3 CHEs, which can result in a one-course reassignment, depending on curriculum needs and subject to the approval of the department chair and dean. One example of such a practice can be found at the University of North Carolina at Wilmington Department of Physics as can be found at <http://uncw.edu/phy/documents/BankingForm.pdf> and <http://uncw.edu/phy/documents/WorkloadBankingPolicy.doc>

We want students to be able to see the process of scholarship unfold over time and be able to be involved in research that is ongoing over the course of several semesters. We agree with Jansen and colleagues (2015) who note, “student-faculty scholarship is particularly exciting and productive when it is designed to extend beyond using students to simply help collect data” (p. 1354). This might range from research question generation, literature reviews, methods development, and data collection and analysis, to presentations and manuscript publication.

### ***1. Communication and Networking***

Of course, all of these efforts will be for not if they are not communicated adequately and to the right channels. Effective communication and networking is critical to the success of not only SCULPT but for the whole of inquiry-based learning as a pedagogical priority at UVU. We need means for communication about training, funding opportunities and similar resources for



faculty and students alike. These needed to be structured based on student and faculty needs rather than the organizational structure and terminology.

We recommend the development of a school-wide system of information about funding; for example, a table, which lists sources of funding that, is not restricted to merely local avenues. We hope to: a) raise awareness of research-related programs, research groups, and local and national labs among majors; b) raise awareness of the practices of undergraduate research and creative work, and c) raise awareness and promote positive student perceptions about undergraduate research and creative activities as early in their undergraduate career as possible (Hanshaw, Dounas-Frazer, & Lewandowski, 2015).

Student support should be improved with continued research, dissemination of finances which touch the students directly, and resources targeted specifically at students. We not only need to improve student opportunities for award, celebration and recognition, we also need to work to improve the impact of inquiry based learning and undergraduate research for both students and the community at large. One method for accomplishing this to to increase student publication efforts and opportunities, potentially offering a centralized publication process on campus. We also have needs for cataloging and archiving student research.

#### *J. Interaction with Community*

UVU already has a number of relationships with community members (see: <http://www.uvu.edu/oel/communitypartnerships.html>), although these relationships are individualized and department-specific. For example, the College of Science and Health has a number of government-related projects and areas of Woodbury School of Business perform work for local organizations on a service basis.

Among other benefits of expanding IBL activities is the positive impact on local and regional economic development. Even though the empirical evidence of a positive correlation between IBL and economic development is relatively recent (Shaffer & Wright, 2010), the Woodbury School of Business (WSB) recognizes the significance of close collaboration with Utah Valley firms, in particular with small and medium businesses. Interaction with the business community takes several forms, from consulting services to internships where faculty and students are active participants. Examples include the Business Resource Center run by the Entrepreneur Institute where start-up companies receive mentorship and consulting support. Companies such as Vivint facilitated the creation of the Sales Marketing and Research Test (SMART) Lab which applies visual technology tools to forecast consumer preferences. This partnership represented a \$2 million dollar gift to the WSB. This lab has been an opportunity for UVU MBA students to be involved as graduate assistants.

Business Management students participate in consulting projects as an integral part of their learning. Students are presented with live cases where they have to answer real business problems. James Mortensen is a Professional in Residence who identifies firms in Utah County facing business challenges. At the beginning of a semester, a senior class of 20-24 students is

grouped in teams of five or six members and each group is assigned to a project. Throughout the semester students receive the mentorship of other faculty, besides Jim Mortensen, working more closely with students as they propose different solutions. At the end of the semester, students should be ready to present their cases before the firms' executives. Similar live case projects where UVU students are involved in research and learning by doing are taught in Letty Workman, Paige Gardiner and Steven Huffs' Marketing classes. Besides consulting, the WSB provides training to Utah firms. For example, students in Bern Kupka's class learn worker-training skills which prepares them to train employees for a firm. Again, this service to our business community represents a well-strengthened connection between what is being taught at our school and professional practice.

Internships are part of the graduation requirements for several WSB majors (Personal Finance Planning, Finance, Hospital Management and Marketing). Some WSB students are full time or part-time employees; therefore, internships for these students need to be done in a different company. In fact, one of the requirements of an internship is that it needs to match the student's major. In this respect, the WSB has a number of Professionals in Residence who are instructors with previous professional experience who have excelled in their firms and developed an interest in teaching. This group of professionals is the link between UVU and Utah industry, which serves to confirm if what we are teaching is relevant to them under the current economic conditions.

Partnerships between the WSB and Utah companies provide an opportunity for students to learn research tools to be applied in live cases and at the same time offer solutions to small or medium companies that otherwise can't afford it. Furthermore, UVU is not only providing skilled workers to the job market, but also enhancing the connection between higher education and local economic growth.

The InnovaBio® program from the Department of Biology (Biotechnology) and Salt Lake Community College (SLCC) is a Contract Research Organization that partners with corporations to support Utah's biotechnology industry. InnovaBio provides consulting and industry-based research to Utah biotechnology companies that sponsor students and create opportunities for UVU, SLCC and high-school students. Biotechnology students are required to do an internship as part of their graduation. Students are trained and supervised by faculty from SLCC and UVU. The students are solving real-life problems presented by the biotechnology industry in the area. The biotechnology program partnership with SLCC has faculty that teach at both campuses and students take classes at any of the campuses. Students present their research in the form of posters and learn how a scientist works in the lab and reporting the data.

In Earth Science, there are a number of projects in place. There are four faculty members in Earth Science, who are working on various aspects of the environmental quality of Utah Lake: Dr. Steve Emerman (water quality), Dr. Weihong Wang (chemistry of water and sediment as indicators of human impacts), Dr. Joel Bradford (PCB-contamination of fish in the lake), and Dr. Eddy Cadet (PCB-contamination of fish in the lake, plus role of shoreline vegetation in removing contaminants from the lake). Communities involved in this work, or directly impacted by it, include



the Utah Department of Natural Resources and the U.S. Fish and Wildlife Service, the iUTAH project (<http://iutahepscor.org/>), and the BYU Department of Geological Sciences.

Consider Dr. Cadet's trace metal and PCB-contamination of fish in Utah Lake as another case example. For this project Dr. Cadet, along with his group student researchers registered in 495R, perform research on the safety of Utah Lake water and its fish. Utah Lake is one of the largest natural freshwater bodies in the western United States and is a popular local recreational area. Unfortunately, industrial releases and domestic sewage, as well as discharges from municipal wastewater treatment plants and mine tailings, over the past few decades have increased the heavy metal concentrations in the lake. There is a concern those heavy metals (Arsenic, Cadmium, Lead, Mercury, and Zinc) and poly chlorinated biphenyls (PCBs) may accumulate in fish tissues which are consumed by citizens. Long-term exposure may result in slowly progressing physical, muscular, and neurological degenerative processes that mimic Alzheimer's disease, Parkinson's disease, muscular dystrophy, and multiple sclerosis. Allergies are common, and repeated long-term contact with some metals may cause cancer. This issue is of great concern to Utahns, particularly those residents living in the immediate vicinity of the lake in Utah County.

Because this environmental and public health concern has not been addressed, there is a scarcity of in-depth studies regarding the bioaccumulation of metals by fish in Utah Lake. Dr. Cadet and his students were determined to seek answers. In this investigation, he and seven students in the Environmental Science and Management program at UVU worked in collaboration with the Department of Wildlife Resources (DWR). They collected 225 samples of fish from the lake including five commonly consumed fish species (walleye, largemouth bass, white bass, channel catfish and the common carp), transported them to Dr. Cadet's Environmental laboratory according to research protocol at UVU, processed the fish, digested them in the Microwave Accelerated Reaction System and finally analyzed them for heavy metal content using an Inductively Coupled Plasma Optical Emission Spectrometer. Analysis of PCB samples have been submitted to a local EPA certified laboratory for analysis. This work is ongoing. The results will be compared to existing established FDA limits to determine whether Utahans are at risk. Once data is generated, students will be involved in the statistical analysis of the results and the preparation of a manuscript. Several abstracts are anticipated and will be submitted for presentations at local and national conferences. Engaging students in environmental research in their academic emphasis gives students the excitement that will help motivate them to complete their academic objectives in a reasonable time and pursue an environmental career. This type of hands-on science will prepare them for the workforce in industry or regulatory compliance.

Dr. Tim Doyle's cancer research engages students in projects focusing on the use of high-frequency ultrasound to detect cancer margins during breast cancer surgery. This research includes a partnership between the Physics and Biology department, Intermountain Health Care, the Huntsman Cancer Institute and the Ludwig Botzman Institute. The Botany program has a partnership with the Bureau of Land Management that involves students in the creating of an up-to date website and checklist of the most common and well-documented native plants in the Mojave Desert ecoregion. Students are actively involved during the process, learning from experience how to identify the plants and how to report the findings. The chemistry and Mathematics department have a partnership with U.S. synthetic, Dixie State University, Snow College and Utah College of

Applied technology that involves 10-15 students per year, providing educational opportunities and practical skills in emerging chemistry research and development at U.S. Synthetic.

Each of these faculty members and many more, such as Dr. Kim Nielsen's research on breathing and children, not only do their own research but have students significantly involved in all the steps of the process. There are a number of opportunities for community based research (CBR) which UVU is not currently taking advantage of fully if at all. We recommend that external relationships relating to academics for the university are both expanded and clarified.

### ***K. Library Involvement***

We encourage SCULPT to be a platform for developing faculty relationships and work teams. An additional recommendation is for UVU to utilize the George Sutherland Archives' institutional repository found at <https://www.uvu.edu/library/archives/> for storing and accessing student papers, posters, etc. Information for each project can include the project name, the mentor, the courses involved, and collaboration information. A submission permission form can be found at <http://www.uvu.edu/library/archives/drpermissionform.php> and a sample collection, actually from UVU Engagement week, can be found at <http://161.28.20.133/cdm/landingpage/collection/engaged>. By using the established institutional repository, SCULPT could assist in population, distribution, and awareness. Passehl-Stoddart and Monge (2014), although referring to an undergraduate peer-reviewed research journal, make a statement we feel directly relates to the idea of having a public repository for student work,

**These student collections have the ability to increase student academic confidence, provide access to student research and scholarship, introduce scholarly communication concepts and practice, offer internal and external promotion of programs, provide inclusive opportunities and documentation of student scholarship, and contribute to student retention. (p. 2)**

Institutional repositories provide an opportunity to enhance the undergraduate education experience by developing student-centric collections. There are limited options for undergraduate students to publish and share their work; academic librarians are well-positioned to develop a student-centric institutional repository supporting undergraduate student research while working at instilling better information literacy standards and practices (Passehl-Stoddart & Monge, 2014). Pashel-Stoddart and Monge (2014) describe a similar scenario at Western Oregon University's Hamersly Library where they developed an institutional repository with an initial collection development strategy around undergraduate student collections based on the university's strong identity and emphasis on undergraduate education. While traditional academic publishing opportunities are represented, there is also space and encouragement for publication of other types of student created material including presentations and creative works. There is an emphasis on representing student work from all grade levels. By connecting the student scholarship collections to high-impact educational practices, the library can advocate and demonstrate

additional types of value that resonate with faculty and university administrators (Passhel-Stoddart & Monge, 2014).

Additionally, librarians and library staff could play additional roles as well. As Stamatoplos (2009) points out,

*UNDERGRADUATE RESEARCH PRESENTS OPPORTUNITIES FOR LIBRARIANS TO EXTEND THEIR REACH ON CAMPUS AND ENGAGE A LARGER NUMBER AND BROADER RANGE OF STUDENTS, FACULTY, AND DISCIPLINES. THIS REQUIRES COLLABORATIVE RELATIONSHIPS IN WHICH LIBRARIANS ARE PARTNERS WITH FACULTY AND STUDENTS. IN SUCH COLLABORATION, LIBRARIANS MUST BE OPEN TO NEW AND CREATIVE STRATEGIES FOR CONTRIBUTING TO EDUCATION AND SCHOLARSHIP. THE RESULT SHOULD BE NOT ONLY GREATER INVOLVEMENT BUT ALSO GREATER IMPACT IN THE ACADEMIC COMMUNITY. (p. 246)*

#### **L. Continuation and Formalization of SCULPT**

Based on our success to date, we strongly recommend the continuation of SCULPT as a faculty-led group. Currently, this group is led by co-chairs who are all faculty. Participation in this group is optional and can be fluid based on faculty workload and needs. The SCULPT group would meet once a month in a round-table format to discuss projects, ideas, and collaborations. In addition, SCULPT would have a distinct mentoring group to help newer faculty and could potentially also offer a learning circle to discuss current topics or research in the area of inquiry-based learning. The SCULPT group would also offer training and information sessions relating to inquiry-based learning in both the spring and fall terms; this process has already begun, but needs support to continue into the future.

One option is that SCULPT could be housed under Faculty Senate due to its role as being primarily faculty led with involvement as well from library staff but not with administrative staff caretakers. One possibility would be to have champions who work with the Office of Engaged Learning, the Office of Teaching and Learning, and Academic Affairs. We are open to consideration of other ideas and possible connections to ensure ongoing financial, administrative, and structural support for this vibrant and growing organization.

#### **M. Mentoring**

Mentored undergraduate research is an emergent pedagogy in higher education which we wish to encourage at UVU. It differs fundamentally from course-related student research and is largely independent of the curriculum (Stamatoplos, 2009). In order to facilitate strong mentoring and mentoring skills, we recommend a mentoring academy be sponsored via SCULPT. Actually, a small version of such a group has gone into place informally via Dr. Anton Tolman and Dr. Olga Kopp with support from both OTL and OEL. One issue that has to be addressed, however, is how to obtain mentors for students who are interested but do not currently have one available to them. As Stamatoplos (2009) notes, "Faculty mentors guide and provide structure to students' research experiences. Student researchers are treated as members of the scholarly community, even if they are still novice members" (p. 237). Currently, the SCULPT Task Force for a

“One-Stop Website” is working to develop a pathway for students in this situation to guide and assist them in finding a mentor.

## VIII. CONCLUSION

Inquiry based learning is a natural fit with UVU’s overall goals and mission. A key goal of SCULPT is to increase student and faculty involvement in IBL activities that engage students throughout their career. We believe that by implementing some or all of the aforementioned recommendations, we can enhance students’ ability to think critically and draw connections; engage in research as a process; pursue authentic investigation of real-world problems; develop interdisciplinary and collaborative skills; reify a deeper understanding and passion for their field; and present ideas creatively (Kaiser, Mishler, Peoples, & Wells, 2014; Manak & Gregory, 2014; Stamatoplos, 2009; Hoffman, 2009; Ishiyama, 2002; Schmitz & Havholm, 2015).

The authors of this white paper agree with Morgan and Saxton (1994) who assert that engaging students means that students are active: not only taking in, absorbing and being acted upon but working energetically, acting upon their initiatives, acting upon others, asking questions and understanding they have the right to contribute their ideas, experiences and feelings about the content and procedures of the lesson (p. 17). We also agree with Ahern-Rindell and Quackenbush (2015) who state, “UR...experiences provide academic challenge, an enriching educational experience, active and collaborative learning, and close student-faculty interactions” (p. 1). By creating a culture and structures supportive of IBL and by expanding the reach of IBL to all students on campus, UVU’s dedication to student engagement, inclusion, rigor, and student success will be enhanced. We hope to expand and strengthen UVU tradition of IBL by working together.

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[1] Inquiry-based learning consists of open-ended situations best addressed by question-driven processes (Edelson, Gordin, & Pea, 1999, p. 392)

[2] Note: Throughout this paper, the term “Inquiry Based Learning” (IBL) is used as a shorthand for a wide variety of learning opportunities for students including undergraduate research, other scholarly work, and creative activities generated by students under the guidance of a faculty mentor.

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**APPENDIX A:** Council on Undergraduate Research Characteristics of Excellence in Undergraduate Research (COEUR)

- Campus mission and culture
  - Institutional commitment
  - Scholarly faculty
  - Faculty commitment
  - Broad disciplinary participation
  - Accessible opportunities for undergraduates
  - Integration with other engaging and high-impact opportunities
- Administrative support
  - Internal budgetary support
  - Startup funding
  - Faculty load credit for supervising undergraduate research
  - Reassigned time for research-related tasks
  - IBL administrative support including IBL program office, space, support
  - Travel and other student funding
  - Research grants office
- Research infrastructure
  - Space
  - Instrumentation and equipment



- Library resources
- Computational resources
- Other research resources
- Research oversight structures
- Support, administrative, and technical staff
- Professional development opportunities
  - Research leaves
  - Research training opportunities
  - Non-research-related professional development
  - Mentorship training for faculty, grad students, and post docs
- Recognition
  - Promotion and tenure guidelines
  - Salary review
  - Campus awards
  - Prominent publicity for research accomplishments
- External funding
  - Faculty research funding
  - Institutional funding for research
- Dissemination

- Peer-reviewed publication, exhibition, or performance
- Presentation at professional meetings
- Student research conferences
- On-campus symposia
- Student-centered issues
- Opportunities for early, sustained involvement
- Establishing and communicating expectations
- Developmentally appropriate expectations and intellectual ownership
- Community of scholars
- Peer mentoring, teamwork opportunities
- Expanding and integrating student research opportunities with other engaging experiences
- Mentor availability
- Curriculum
  - Research-supportive curricula: content, scheduling, integrating teaching and research
  - Additional training opportunities and workshops, e.g., RCR, professional skills workshops
  - Student course credit for research
  - Requiring undergraduate research
- Summer research program
  - Research-supportive teaching calendar

- Faculty compensation
- Student compensation
- Student housing and access to facilities and student services
- Student programming
- Summer research symposia
- Coordination among multiple programs
- Hosting visiting students
- Assessment activities
  - Assessment of student learning
  - Program assessment and evaluation
- Strategic Planning

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**APPENDIX B:** Evidence for Space Needs

**Table B1: Hypothetical Fall Semester**

Time	M	T	W	R	F
<b>8-9</b>	Perspectival Lines Project	Perspectival Lines Project	Hybrid Scheduling Project	Aesthetics Project	Love and Lust is in the Gaze
<b>9-10</b>					
<b>10-11</b>			S&P Lab		
<b>11-12</b>			S&P Lab	S&P Lab	BioPac
<b>12-1</b>	BioPac	BioPac	S&P Lab	S&P Lab	BioPac
<b>1-2</b>	BioPac	BioPac	S&P Lab	S&P Lab	BioPac
<b>2-3</b>	BioPac	BioPac	BioPac	S&P Lab	Phenom Project
<b>3-4</b>	Phenom Project	Hybrid Scheduling Project	BioPac	Love and Lust is in the Gaze Project	Phenom Project
<b>4-5</b>	Phenom Project		BioPac		Phenom Project

**Table B2: Hypothetical Spring Semester**

Time	M	T	W	R	F
<b>8-9</b>	Perspectival Lines Project	Perspectival Lines Project	EM & IQ Project	EM & IQ Project	Love and Lust is in the Gaze
<b>9-10</b>					
<b>10-11</b>			Physio Lab		
<b>11-12</b>			Physio Lab	Physio Lab	BioPac
<b>12-1</b>	BioPac	BioPac	Physio Lab	Physio Lab	BioPac
<b>1-2</b>	BioPac	BioPac	Physio Lab	Physio Lab	BioPac
<b>2-3</b>	BioPac	BioPac	BioPac	Physio Lab	Phenom Project
<b>3-4</b>	Phenom Project	Aesthetics Project	BioPac	Love and Lust is in the Gaze Project	Phenom Project
<b>4-5</b>	Phenom Project		BioPac		Phenom Project