

A White Paper on DISCOVERY as an Undergraduate Experience

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Summary

In March 2019, the Undergraduate Experience Executive Steering Committee (UEESC), led by VCUE Catherine Koshland and VCSA Stephen Sutton, constituted an Undergraduate Experience Curriculum Work Group to enhance Discovery and Discovery Experiences as part of the larger Strategic Planning for undergraduates. After review of many initiatives and papers, this white paper defines the characteristics of Discovery, incentives for supporting Discovery experiences, and next steps.

A History describes a much abbreviated history of some of the Discovery activities undertaken on campus. This is followed by the **Charge to the Working Group** and description of the **Working Process**. The cyclical topic and primary theme of the group was to answer “What is Discovery?” In this paper, we propose that Discovery is the *pursuit* of new knowledge- a contribution that provides social benefit, new information to a research domain, or fulfills an unmet need- in which students are no longer passive recipients of others' knowledge, but rather become active practitioners and producers of knowledge themselves. A Discovery Experience is an immersive learning experience that begins with an originating intention and culminates in reflection. In other words, intention launches the student into a Discovery experience, immersion enables learning in deep and consequential ways, and reflection allows the integration of those lessons and fosters an ongoing process of translating what has been learned and experienced into practice.

While part of the charge was to define the characteristics of the **Arc of Discovery**, our group soon came to agree that a sequence that ends in mastery is both limiting and unrepresentative of Discovery Experiences. In no way diminishing the sound benefits of a four-year trajectory, we believe that the Discovery initiative involves a broader field of possibility.

There has been a great deal of research on the means and locations of **Discovery in the Curriculum**. Encouragingly, our departments provide nearly three-quarters of our undergraduates with a Discovery opportunity, within the previous requirement of Mastery. We see these current Mastery offerings as opportunities because, while they offer advanced study, they await a shared understanding of and commitment to the goals of Discovery. With a revised definition that includes intention, immersion and reflection, that percentage may change, but an important question remains: which students are not engaging in Discovery, and why?

With a broader definition, the potential for Discovery moves **Beyond the Classroom**. The opportunities include research, internships, engaged scholarship, and so on. We note that not all of these opportunities are necessarily Discovery Experiences since by our definition, a student needs to be able to reflect and identify the experience. Already there are a multitude of initiatives throughout campus, and a central center to better direct efforts and to share opportunities with students is key.

Returning to the question of access to Discovery, **Expanding Access** builds the case for Discovery as a right and not a privilege and **Building Incentives** suggests some ways that campus can change our culture to one in which the narrative about what is discovered begins to abound.

The Discovery Experience, with components either defined as “Connect, Engage, Discover and Reflect” or defined as “Intention, Immersion, and Reflection” both share Reflection as a key component of **Assessing Discovery**. This section describes how Reflection might be shaped on campus, much supported by **Student Interviews**.

This report ends with some **Future Directions** that include: further engagement with students - both undergraduates and graduates within this new Discovery framework; a review of UCUES questions in light of the many activities and new discussions surround the Discovery initiative; ways to promote a culture of Discovery with the Faculty and Departments; and increasing accessibility, coordination, and incentives for Discovery Experiences.

The report also contains an **Epilogue** from the authors that does not necessarily reflect the thoughts of the working group. Since the authors attended other meetings that could not be shared with the entire group, we felt it best to separate these conclusions. And, in the time since the group started meeting, much has already changed on campus and we wanted to update the report to reflect this.

In summary, in a Discovery Experience, you move from being a student to being a practitioner. Beyond acquiring knowledge, it is practicing to be a producer of knowledge, or art, or social change that dramatically changes a student’s role as a learner. Discovery centers on that turning point between learning and practicing. This transition allows for Discovery to be pursued and acknowledged in a wide range of immersive learning experiences, while maintaining the levels of initiative, engagement, and self-awareness that bring about change.

A History

In Spring 2017 EVCP Paul Alivisatos, then Vice Chancellor of Research, and VCUE Catherine Koshland hosted four open forums for faculty, staff, undergraduates, as well as graduate students and postdocs to engage the broader campus community in imagining how a focus on discovery experiences could become a signature element of the Berkeley undergraduate experience. Members of the Berkeley Collegium, a group of faculty who hold endowed chairs related to teaching, were also present to facilitate the forum discussions in light of Discovery efforts this group had launched in 2014. During the summer of 2017, working groups were convened to develop a vision for a campus effort to expand opportunities for Discovery experiences. With a sense that there were many forms for this kind of learning, in January of 2018, a survey was launched to capture how each academic unit defines Discovery learning for its undergraduates, to learn how the unit’s curriculum supports such experiences, and to identify gaps. A summary of the survey was published in August 2018 as “The Arc of Discovery in the Undergraduate Curriculum”.

In December 2018, the UC Berkeley Strategic Plan launched with the *Student Experience Working Group Final Report* stating that “‘Discovery’ should be the theme of our undergraduate experience and every Berkeley student (including graduate students) should have the opportunity to take full advantage of the unique resources and opportunities of studying at a world-class research university... a ‘Discovery Experience’ should be developed as the common denominator of the Berkeley experience, whatever the student’s course of study or professional ambition.” In the body of the report is a description of Discovery as the “Heart of the Berkeley Study Experience”.

As a result, numerous Discovery initiatives have been launched throughout campus, through the Office of Undergraduate Research & Scholarships (OURS), Golden Bear Orientation (GBO), Arts + Design, Data Science, The American Cultures Center, the Berkeley Collegium, and the Center for Teaching and Learning, to list just a few units reviewed by the working group. In short, Discovery is being embraced, and a strategic framework is the next step in the evolution of this initiative.

Charge to the Working Group

In March 2019, the Undergraduate Experience Executive Steering Committee (UEESC), led by VCUE Catherine Koshland and VCSA Stephen Sutton, constituted an Undergraduate Experience Curriculum Work Group to enhance Discovery and Discovery Experiences as part of the larger Strategic Planning for undergraduates. In particular, the following questions were asked:

- How do we deepen and more specifically define the characteristics of the “Arc of Discovery” in an undergraduate student experience?
- What framework would best support incorporating Discovery Experiences into the curriculum? Should Discovery Experiences be the culminating (“capstone”) for each major?
- How do we provide space within the majors for alternatives - either for alternate forms of experiences or for students to define their own Discovery Experience?
- How can departments incorporate co-curricular and extra-curricular Discovery Experiences into that framework?
- What resources will departments need to offer the opportunities of a Discovery Experience to all undergraduates in the department’s major(s)?
- What next steps should the campus take to implement these recommendations?

It is within this context, that this working group was charged to write a white paper to address these questions and to frame questions and steps going forward.

The Working Process

The working group consisted of faculty, staff and one doctoral student from a variety of disciplines around campus who also brought their expertise in undergraduate teaching, research, and co-curricular activities. (A list of all the members can be found in the appendix.) The working group met four times. As a large body, not everyone could attend all meetings with a typical meeting having about eight to twelve discussants.

In April 2019, the group first met to discuss the definitions of Discovery based on review of the Strategic Plan, “The Arc of Discovery in the Undergraduate Curriculum Report” and a brief titled “Discovery and the Undergraduate Student Experience.” We discussed the breadth and depth of Discovery, and described some of its key components as *cognition*, or awareness of the Discovery experience, *intentionality* of question and pursuit, and *reflection* on both the process and product of the learning. In assessing the various descriptions of Discovery, we came to a workable definition that a Discovery experience is the point at which the student becomes a practitioner.

In a second meeting, held in May, we discussed the place of Discovery in the curriculum based on a review of the Discovery Data Portal “The Arc of Discovery in the Undergraduate Curriculum Report” as well as a review of “Benchmarking Report: Discovery Programs.” We explored best practices, especially noting those units with deliberately scaffolded curricula that progressively lead students through the discipline to an intensive, sustained, and mentored project. We also noted the many challenges units faced in providing these capstone experiences. Although we admired those curricula that developed an “Arc of Discovery,” our conversation interrogated this model as a template for Discovery on campus, and moved to decouple “mastery” from Discovery learning.

In August, the group met for a third time to discuss the non-curricular locations of Discovery learning, non-departmental processes for tracking Discovery experiences, the metrics for evaluating reflection reporting, and ways to make a Discovery experience universally accessible. We returned to the need for reflection in Discovery, and discussed whether this could be a common activity for all undergraduates. Last, the group discussed incentivizing Discovery, and considered ways to recognize, broadcast and reward Discovery experiences in order to provide models and inspiration for the campus.

At our final meeting in October, we reviewed a draft of the white paper, recommendations and next steps to make to the Undergraduate Experience Executive Steering Committee.

Throughout the process, the co-chairs met with leaders of Discovery initiatives that are taking place throughout campus. Our thanks to Yukiko Watanabe who introduced us to the work of the Center for Teaching and Learning, supported by a Presidential Chair Fellows Curriculum Enrichment Grant. Four projects in five units are conceptualizing Discovery in the curriculum, articulating Discovery learning and advancing Discovery learning in courses. The work at the point that we reviewed is a very comprehensive categorization of characteristics, methods, and

metrics of Discovery learning. We note here that the Center for Teaching and Learning defines Discovery Learning more broadly than the working group with the top of the matrix of features that identify Discovery learning as the “generation of new *self*-knowledge.” Our working group suggests a higher threshold, as discussed below. Our thanks to Sean Burns for his expansive work in promoting Discovery through the Office of Undergraduate Research & Scholarships, Undergraduate Research Apprentice Program and Golden Bear Orientation as well as numerous papers that both identify and initiate Discovery activities across campus. We also meet with two groups of impressively motivated students arranged through the Student Advisory Council on Undergraduate Education (SACUE) as well as with Victoria Robinson to discuss Discovery initiatives in American Cultures.

What is Discovery?: A Focus on Intention, Immersion, and Reflection

Partners in the Discovery initiative have defined the “Discovery Experience” in a number of ways. These include descriptions of “a wide range of immersive learning projects” in which students are “challenged to question, design, implement, and iterate toward a thoughtful and creative culminating project” that generates “new knowledge.” Discovery has been articulated as a four-part process: connect, discover, engage, reflect. Discovery Experiences have been identified as the product of Discovery Learning and as consonant with an Arc of Discovery. Like others tasked with organizing and implementing Discovery on campus, as our working group’s conversation grew broader, we found ourselves continually returning to and needing to hone a definition of what Discovery is. The aim of universal access and participation makes a very broad definition attractive, while the aim of communicating the call for Discovery to the whole campus community requires a much sharper definition.

The consensus of our working group is that the definition of Discovery needs to be digestible and clear rather than amorphous and big, and that the project depends on focusing its objectives and articulating what Discovery contributes to the student experience. To this end, we gravitated to Discovery as an immersive learning experience that is framed by an originating intention and culminates in reflection. In other words, **intention** launches the student into a Discovery experience, **immersion** enables learning in deep and consequential ways, and **reflection** allows the integration of those lessons and fosters an ongoing process of translating what has been learned and experienced into practice.

Intentionality became an important factor in our conversations because, while we aim to make a Discovery experience part of every student’s experience at Berkeley, it is counter-productive to have students feel that it is another box to check. Students’ intentions need to be genuine and self-motivated, leading them to think about why they are pursuing this knowledge, in this way, at this time. These questions promote a self-awareness that we feel is intrinsic to Discovery. They offer a lens through which students can approach the experience, and a mark by which they can measure their own transformation. It is true that discovery can sometimes occur serendipitously. However, we concluded that a more structured approach will make the experience more accessible and recognizable to students, since many students who experience “serendipity” already have the preparation and resources to profit from it as such. By promoting intentionality,

we can encourage students to articulate and experience the full scope of their Discovery experiences.

We characterized Discovery experiences as immersive. Students should be fully engaged in the exploratory nature of this kind of learning: intellectually, imaginatively, and personally. In this way, the learning exceeds the boundaries of the classroom and becomes a meaningful part of the student's life as the Discovery experience unfolds. Immersion in a project allows a student to test and experiment with all parts of it, in contrast to following a prescribed and linear path of knowledge acquisition. A campus culture of Discovery will promote and inspire invested, dynamic, and evolving relationships between students and their work, resulting not only in accomplished projects, but also in transformed students.

Our working group focused on reflection as definitional to the Discovery learning experience. Students must be able to tell themselves the story of what happened to them intellectually and creatively, and to frame it for themselves as a Discovery experience. Discovery does not truly happen without this element of metacognition. Therefore, reflection is not a mere report, but rather a vital part of the learning itself. As students learn how to mark, name, understand, and claim their Discovery experiences, they gain the kind of insight that leads to lasting empowerment. Reflection should promote a new self-conceptualization, connect what we learn to why we learn, identify the discovery of new knowledge, and link that knowledge to questions and issues in the larger world. Our thinking about the importance of reflection led to an extended conversation about how to implement this key step. That conversation is reflected in the section "Assessing Discovery" below.

The working group also spent time testing and expanding on the concept of "new knowledge." What is the threshold of new knowledge to be considered Discovery? Is it a personal recognition that is new to an individual, or is it an innovation that contributes to a societal need or to a discipline? We concluded that Discovery is the **pursuit** of new knowledge — a contribution that provides social benefit, new information to a research domain, or fulfills an unmet need. Not every project will generate something wholly new, but we felt that a goal of Discovery should be to explore, develop, and extend knowledge beyond the self.

While the working group fully supported a discovery process wherein students "question, design, implement, and iterate," we primarily characterized Discovery learning as intentional, immersive, and reflective. Through intention, immersion, and reflection, we believe that students will take greater ownership of the experience, and that this kind of ownership is essential to the transformative learning and informed practice to which the Discovery project aspires.

Arc of Discovery: The Question of Mastery

Our group soon came to agree that an "Arc of Discovery" that ends in mastery is both limiting and unrepresentative of Discovery experiences. Beyond the fact that we cannot accommodate the requisite mastery in our curriculum, mastery and Discovery are not necessarily or even preferably aligned. The goal of mastery presumes a linear narrative that resolves in a state of

completion. “Mastery” can also be inhibiting, discouraging students who might otherwise be willing to take what could feel like a risk in committing themselves to a project. In contrast, we imagine Discovery as a more open-ended and creative process that affords intellectual flexibility, adaptation, and continual adjustment; that includes unlearning as well as learning; and that gives students the responsive mindset needed to engage with a diverse and changing world. We endorse the defined parameters of “an experience” (hence our recommendation to emphasize intention and reflection), but we believe that mastery should not define its character.

Fundamental pedagogical features of a Discovery experience include the mentorship, hands-on activities, and sustained projects that can be delivered in small seminar and studio formats. Perhaps this is why the report on the “Arc of Discovery” focused on the culminating capstone. Capstone experiences are important for many of our students, and are what many will remember as the measure of their intellectual growth in their undergraduate years. But the “Arc of Discovery,” which posits a sequential passage through three phases, is too uniform to embrace Discovery’s broader dimensions, and too restrictive to communicate the dynamic nature of Discovery experiences. Because of this, the use of the “Arc” model may limit, cloud, or seem to rank the meaning of Discovery on campus. For example, students may have a genuine Discovery experience early in their time at Berkeley, and that experience may set their expectations of what college will be about. Students may have a Discovery experience outside the major in which they are taking deliberate steps toward mastery, as in the example of an Engineering student who joins a summer archeological dig in Greece. Certainly, that student is not aiming at mastery and certainly that student is having a Discovery experience. Discovery can be a leaping-off point for a student, giving the student a vibrant sense of potential that may express itself in a variety of ways. In no way diminishing the sound benefits of a four-year trajectory, we agreed that the Discovery initiative involves a broader field of possibility.

Discovery in the Curriculum

The “Arc of Discovery in the Undergraduate Curriculum Report” surveys and collates how different disciplines define Discovery and the place of Discovery in their curriculum. Departments reported that Discovery experiences come through research opportunities, capstone courses, lab sections, design and other creative projects, and the overwhelming majority identified research as the main pathway. Participants in the survey worked with the definition of an “Arc of Discovery” that culminates in mastery. Within this definition, results show that, upon graduation, 70% of freshman entrants and 67% of transfer entrants have taken at least one Mastery-level Discovery Learning Course during their undergraduate tenure at Berkeley. When adding data from a January 2017 campus survey examining capstone offerings in the curriculum, 78% of freshman entrants and 71% of transfer entrants take a Mastery-level Discovery Learning course or a capstone. When adding all 199 “independent study” courses (not just those that were identified by departments as Discovery Learning courses), participation grows to 79% of freshman entrants and 72% of transfer entrants. Given these numbers, one of the first questions posed in the working group was: if so many students across campus are already “doing Discovery,” what’s the problem? With some frequency, we ran into this issue of the status quo. Is “Discovery” just another name for committed teaching and learning, that is,

another name for good education? Will the majority of faculty say, “I already do this?” Is this a case of re-branding? We took these concerns seriously.

The fact that there is already so much Discovery Learning happening is excellent news. It means that the priorities of our students, faculty, and departments are already geared toward what we consider the most meaningful forms of pedagogy. We think that the Discovery initiative will play an important role in defining, supporting, and extending this work, and in making sure that these opportunities are reliably available to the greatest possible number of students. To the question of the status quo, we responded by affirming the innovations of the Discovery initiative that distinguish it from “research” in a generic sense. First, Discovery learning encompasses creative, self-initiated, and outward-facing experiences, whether in addition to or integrated within the classroom. Second, rather than primarily aiming to fulfill requirements, students engaged in Discovery learning aim for a broader understanding of their interests, potential, and future. Third, as articulated above, deliberate reflection is key to Discovery; this opportunity is rarely offered to students, and certainly not in a comprehensive way. Fourth, when a department self-identifies Discovery opportunities, that does not ensure that all enrolled students are having a Discovery experience. Students experience classes in vastly different ways, and common content does not make for a common learning experience. Finally, regular curricular offerings are taught by different faculty members, each of whom will approach the course with a different capacity or desire to mentor in the way Discovery learning demands. For these reasons we concluded that, even with the very high percentages of students enrolled in departmentally-defined Discovery courses, there is still room for the Discovery initiative to make a significant impact in the curriculum. In order for this to happen in a comprehensive way, we need to do more research on how students perceive their current research opportunities, and which students are not engaged in curricular Discovery and the reasons why.

In our discussion of the survey, we explored both best practices and “pain points.” In the former category we were impressed by those departments with intentionally scaffolded curricula including IEOR, Bioengineering, Political Science, and Public Health. Such scaffolding promotes inclusivity, as all students are given a common entry point and therefore don’t need to self-select in order to benefit from their department’s richest offerings. We also admired many departments’ thoughtful definitions of Discovery, and their commitment to provide the frameworks, resources, training, values, and vision that together transform students’ lives (see Appendix). In this, the study shows that many objectives of the Discovery initiative are indeed closely aligned to the deeply-held beliefs and long-standing academic practices that represent the best of Berkeley, especially those in which students are mentored by invested faculty members who follow and support the development of their work.

In the category of “pain points” however, we saw limits to bringing Discovery opportunities to scale in the curriculum, particularly in providing them as capstone experiences. Smaller units face the problem of insufficient populations, while larger units face the problem of untenable student/faculty ratios. Some curricula are impacted and others are too complex; both problems would mean having to remove something to make room for a capstone course. There are also obstacles around cost, lack of staff, and lack of curricular space. For example, Bioengineering can offer a freshman seminar, 8 weeks of immersion study for underfunded students, and a

capstone course with the support of the NIH. This is an excellent program and a good model, but it is highly funded. Thus, the “pain points” demonstrated not a lack of will, but rather structural problems. Departments would be very willing to provide more Discovery opportunities in their curricula, but need larger institutional commitments in order to make the changes that would allow them to do so.

The goal of grounding Discovery in major curricula is logical, and would appear to be the most direct way to ensure a diverse set of Discovery experiences that are appropriate to different fields of study. Within the curriculum, each unit might ensure Discovery learning, assess and monitor the experience, provide faculty with time to mentor projects, and potentially reach the majority of its students. However, we concluded that while departments have clearly articulated goals pertaining to Discovery, they have unequal capacities to bring this experience to all Berkeley students, especially when that goal is modeled through an Arc of Discovery.

Discovery Beyond the Classroom

As with the curriculum, extra-curricular life on campus is already filled with opportunities for Discovery experiences; we recommend that the first coordinated effort should be to incorporate existing activities around campus into the undertaking. We might support growth in standing campus-wide programs like the American Cultures Engaged Scholarship (ACES) program, the Adobe Fellows Program, URAP, DeCals, Berkeley Collegium, the Data Justice modules, and the Data Science connectors. These are already well-organized entities on campus, and we could articulate and strengthen their Discovery opportunities. With additional TAS funding, we could pair internships and research placements with Discovery-based independent studies. Berkeley Connect can help students understand what it means to be at a research university and how they can best begin identifying and pursuing their unique path toward Discovery. Currently in Art Practice, groups of students curate museum shows; we can build on this example to sponsor other applied, team-based projects that engage with campus centers or resources. We can bring a Discovery framework to the completely immersive learning experience of studying abroad. We can also build Discovery elements into successful programs like the Freshman and Sophomore Seminars. On that model, new Discovery Seminars could gather a group of students for a course of study linked to hands-on experiences based in campus-based libraries or museums, or community-based sites or projects. These could be led by faculty members, graduate students, librarians or post-doctoral fellows, but we feel that the largely untapped community of emeriti might be particularly interested in this kind of interaction with students. The vision for the Center for Connected Learning at Moffitt Library is a space where undergraduates can engage in, reflect upon, and share results of their Discovery experiences through credit-bearing courses and extracurricular interests. The CCL’s planned active learning classrooms embedded in the library will have unique access to resources and technology that will inspire new types of learning experience, and could become a hub for showcasing Discovery. It is clear that there is no single pathway to Discovery and, while the curriculum will play a central role in promoting Discovery experiences to all students, the field of play will be, and already is, much broader than that. We should make sure that Discovery takes its lead from Berkeley students, engages their initiatives, and respects their input.

In order to connect with and inspire students we should also be inspired by them. We recommend that communications around Discovery should focus on the many places where students are already finding it, and prioritize curating, broadcasting, and enhancing where Discovery is already happening on campus. The discovery.berkeley.edu site, developed under the leadership of Sean Burns, has begun to showcase online stories of individual student's experiences. In order for the broadest range of students to connect to this initiative, they need to see new possibilities for themselves in the successful experiences of their peers.

Expanding Access

The ambition of the campus is to make Discovery the “heart” of the student experience. Thus, the goals for a Discovery framework are to ensure campus-wide programming with significant to full student participation. This programming needs to be meaningful to students, to be diverse and abundant, and to be universally accessible. In order for Discovery to be seen as part and parcel of a Berkeley education, it must be understood as a right and not a privilege. However, while some students will immediately see Discovery as an opportunity, others will find it to be opaque, foreign, and daunting. While we might easily reach students who are predisposed to recognize and pursue enrichment, the initiative will only be a success if it involves students who do not feel entitled or endorsed in this way. In order to engage these students, communication about Discovery has to happen from the very beginning, with the message: “if you are part of the Berkeley student community, this experience is for you.” This will require making strong and consistent efforts to involve first-generation and underrepresented students, and providing them with many points of entry.

Campus should provide robust and ongoing resources, a clear place for students to start, and dedicated staff to help develop ideas and direct students to resources. This is especially necessary for co-curricular and extra-curricular experiences. Beginning with Golden Bear Orientation, every student needs to be aware of and connected to Discovery opportunities. That connection should continue through Student Advisors, the new Major Maps, and a new advising framework dedicated to Discovery. Berkeley Connect provides an excellent model for giving students information, practices, and support; perhaps we could dedicate a similar mentoring system to Discovery. We might also reach a broader range of students through partnerships with campus centers for student development and support, such as GenEq, Multicultural Student Development, and the Educational Opportunity Program. Some students who face logistical pressures or who might perceive Discovery as a luxury could be compelled to engage in Discovery if it is articulated in the spirit of their motivations to gain knowledge and skills that they can take back to help benefit their communities. While providing these rich resources and guidance, we should also be aware that students receive most of their information from other students. In our conversations with student focus groups, we learned that peer networks were students' primary and most valuable source of information regarding all the opportunities and benefits of a Berkeley education. Indeed, almost all the students we spoke with felt ill-informed about or overwhelmed by other means of communication. Therefore, in addition to highlighting student stories in all Discovery communications, peer-mentoring will be a crucial factor in achieving high levels of participation. Finally, student projects need financial support, so that no

student is excluded or limited due to lack of funds. Students who work to support themselves and others face barriers of time as well as expense. Discovery would become available to them if some mentored experiences offered stipends. For example, the Berkeley Collegium's grants program supported a project in Engineering whose main aim was to set up work-study students in work-study positions that provided Discovery opportunities. The College of Natural Resources also recently initiated a grants program to help low income students participate in internships. The ACES program, embedded in the campus graduation requirement as credit bearing curriculum, addresses the barriers often present for students who want to discover how their identified community can support their knowledge paths on campus. The Adobe Fellows Program embeds digital design into the undergraduate curriculum, supporting students who might not have access to creative design tools, in considering how storytelling, narrative making, and collective creative works bridge autobiography and knowledge domain mastery. In all, we should remember that expanding access requires a commitment to multiple layers of support. These include consistent and ongoing communication, dedicated advising, robust support of existing programs as they integrate Discovery into their missions, outreach to peer networks, and financial support to overcome financial barriers.

Building Incentives

The broadest aims of the Discovery initiative call for a culture shift. While there is no singular way to nurture a campus culture of discovery, we discussed some approaches to spur and support engagement. Recent developments regarding the financial reform model have significantly dampened our hopes for incentivizing Discovery. We touch on the issue in this section of the report, but the co-chairs will offer further reflections in the epilogue.

The working group posited that if faculty members truly value Discovery, students will too. However, in order for faculty members to consistently dedicate their efforts in this direction, those values need to be recognized and rewarded by the University. Creating, offering, and overseeing Discovery learning experiences demands a great deal of imagination, time, and labor, and draws deeply on the faculty member's commitment to his or her students. This will necessarily contend with other endeavors. Currently, the incentive system is not structured to support this kind of teaching. In order to secure faculty buy-in, Discovery teaching needs to be explicitly recognized in merit and promotion, and supported at the level of the Budget Committee. Beyond securing the commitment of individual faculty members, however, there is a broader campus disincentive to supporting Discovery. By their very nature, Discovery experiences require a low student-faculty ratio, but the incentive structure that is currently in place and ever more on the horizon rewards the accrual of student credit hours. The SCH metric, increasingly important in the assessment of faculty work and departmental health, does not value the kind of teaching Discovery requires. Thus, the financial structures of the institution are misaligned with the Discovery initiative. A different structure and set of incentives would have to be offered to invite buy-in from departments and to encourage people to invest in creating a culture of Discovery. These fundamental issues would need to be addressed before undertaking a whole-campus campaign.

The working group did discuss more local means of providing incentive. On the model of American Cultures, campus should give fellowships for course development, and awards for innovations in teaching. This would have the double benefit of setting the bar for what defines Discovery learning, and gathering exemplary cases of what that looks like in practice. Likewise, graduate students could guide and mentor Discovery experiences. Indeed, they already do a great deal of mentoring, and many seek out these experiences for both personal and professional reasons. Graduate students would have incentives to create and lead Discovery experiences if such work was linked to funding and campus recognition. Again, Berkeley Connect offers an excellent example of a system in which faculty, graduate, and undergraduate incentive flows all line up. Discovery might also seek to establish such mutually-rewarding systems.

For students to engage with Discovery, they need to feel that it is within reach, and seeing a broad landscape of successful and gratifying student experiences will allow them to think they can do it too. We recommend a range of generous awards to recognize inspiring Discovery experiences: for lower-division, transfer, and upper-division students; for curricular, co-curricular, and extra-curricular work ; for research endeavors, creative projects, and social engagement. We might have a Day of Discovery, including a public arena for displaying Discovery projects, that would be both celebratory for the involved students and informative for the campus. Such an event could also be incorporated into the community of the departments. In all these ways, it is important both to recognize students who are already engaging in Discovery and to provide vivid, achievable models for students who have not yet engaged. Discovery will reach its best definition through the lived experiences of students; they will provide the nodes for synergistic expansion.

Assessing Discovery

We know that Discovery requires reflection, but what shape should that reflection take, and where would such reflections go? Beyond reflection, does Discovery require assessment or evaluation? The working group felt that some formalized reflection by each student was key, and discussed what form such reflections might take. We discussed constructing a template of a selected open-ended questions. Questions might include: What were your aims when you started this project? What do you now know that you hadn't realized before? What is the importance of what you've done? How will you apply what you've learned? The template would have two benefits: it would give coherence to diverse Discovery experiences by focusing on key characteristics, and it would guide students to reflect on the most expansive aspects of those experiences, so that the outcome was not simply a report. To be effective, the template would be open to a diversity of disciplines and experiences, but rely on a shared sense of desired outcomes. Without imposing a uniformity of experience, it would make the goals of Discovery speak meaningfully to each student. Thus, a template would help both define and disseminate values, while also allowing students to connect more deeply with their unique experiences.

Discovery would become an experience that each student could narrate, and thus carry along to the next level of learning.

While these reflections could not be universally required, they might become the norm. The templates could be handled through a portal on a central Discovery website and a growing repository of such reflections could contribute enormously to our understanding of and ability to support Discovery on campus. This corpus could be used for programmatic assessment, and would allow us to collect data to support sustainability. Such reflections would also be used to apply for student prizes and awards mentioned above.

Student Interviews

We gained important perspectives on the Discovery initiative by convening focus groups with students from the Student Advisory Council for Undergraduate Education. Our discussions were free-ranging, but loosely organized around a group of questions about the definition and meaning of Discovery, the value of reflection, and opportunities and obstacles to Discovery on campus.

We first gave a short definition of Discovery. Subsequently, while no consensus emerged about the meaning of Discovery, students often framed it as either “discovering” opportunities to enrich their undergraduate experience, like how to become involved in certain classes, clubs, or internships; or “discovering” what they want to do at Berkeley more generally, like finding out their interests or choosing a major. Overall, they posited “discovery” as a first, or even preliminary, step, akin to “finding out” about something. One student expressed that culminating experiences came too late to qualify as “discovery.” A few mentioned specific programs -- L&S W1, ROTC, URAP, the Transfer Center -- but above all they understood “discovery” as an autobiographical trajectory, part of a longer process of figuring out who they are, rather than a distinctive experience or event. Taking a broad understanding of the concept, a number of students felt like they were “discovering” many times a day.

As noted earlier, students frequently reported that they connect informally with other students or turn to upperclassmen for mentorship and advice about navigating Berkeley. This was crucially important to them, as they feel simultaneously overwhelmed by and unaware of the myriad opportunities for students on campus. They craved more of this peer exchange. There was a strong consensus that reflection was key, both to individuals and to the student body at large. One suggested the perhaps “discovery” wouldn’t really exist until the moment of reflection, but above all were excited by the prospect of a large, public bank of student reflections that they could learn from. There was great eagerness around this. Again, their desires for student reflections spanned from “this is what I did” to “this is what I learned this year.” Students wished not only to be mentored, but also to provide mentorship to others. The value students saw in reflection was one of the most important things we learned in these conversations. Talking with students, we came to see that the working group’s attention to “intention” was less important

than reflection, or the ability to recognize and narrate the experience of Discovery to oneself and others.

Students mostly shared extra-curricular activities as sites of discovery. In terms of the curriculum, many felt their classes were too big (“like a YouTube video”), too focused on content delivery, or too professionalizing to accommodate what they were coming to understand as a Discovery experience. They suggested a classroom of about 12 students as the perfect size for Discovery, and noted the importance of faculty mentorship. A few also proposed that such an experience should come in the sophomore year; this was met with accord. They also wanted their faculty members to be more involved in guiding them, even by making classroom announcements about outside opportunities. Those most supportive of curricular options had already had meaningful experiences in the classroom, identified by either an outward-facing class structure, robust student participation, or especially involved and responsive faculty. While students wanted greater access to faculty across the board, some wondered if faculty would take on the work of such a program.

Students felt strongly that Discovery should not be mandated. Some suggested that career-oriented students would be unlikely to be interested; others described working hard enough to keep up with their classes, or needing to spend their time in paid employment. While universal participation seemed impossible, they thought that giving course credit for Discovery or a credential on the transcript might garner student interest. This, they said, would mean tagging the course schedule or even streamlining major requirements to give students opportunities to engage. Other forms of public recognition might incentivize students, but they emphasized that a streamlined, centralized Discovery hub would be necessary for equal, workable access.

What did we learn from students? It is clear that the institutional definition and messaging regarding Discovery must be clear, consistent, and easily telegraphed, especially since students get most of their information from each other. The value and feasibility of Discovery should be communicated in a way that doesn’t make it seem “privileged”, “extra” or like “one more thing.” In the curriculum, explicit faculty commitment is key, and small classes are most conducive. Students also want Discovery to happen early in their time at Berkeley, so that they can enlarge upon the experience in their later years. For many reasons, reflection (and especially public access to those reflections) is universally valued and this should be a priority moving forward. Finally, student participation and access rely on building a central, networked source of information.

Future Directions

- Identify undergraduate students who are appropriate stakeholders and meet with them to discuss the re-framing of the definition of Discovery and Discovery experiences. Within this new framing of Discovery, pose questions such as: Have students had a Discovery experience? How do students recognize when they have had a Discovery

experience? This should be a set of discussions with a wide variety of students and be student-forward, not faculty-forward.

- Engage with undergraduate students to explore access to Discovery experiences as well as the obstacles to such opportunities. Review Discovery initiatives with Diversity, Equity and Campus Climate.
- Incorporate graduate students into discussions about a framework in which they can serve as mentors to undergraduates.
- Review the UCUES module with Discovery Questions in light of new questions raised by the working group.
- Promote Discovery with Faculty and Departments as a multi-faceted framework and share some of the practices developed by the Center for Teaching and Learning and the resources at the Discovery Center. Explore additional routes and incentives to increase faculty engagement, drawing on the experiences of faculty members already providing Discovery experiences. Value Discovery initiatives in faculty merit and promotion cases. Gain a voice in financial reform options to avoid disincentives to smaller classes and programs of Discovery.
- Increase accessibility through introducing Discovery opportunities through Golden Bear Advising (GBA), Golden Bear Orientation (GBO), and Major Maps.
- Develop an administrative Discovery center to coordinate, promote, maintain, and monitor Discovery activities throughout campus. This should serve as the hub for developing, collecting, archiving and promoting student Reflections. Managing the center should be approached as a living activity that is bound to shift and change yet still hold a core, shared definition that is uniquely tied to undergraduate Discovery at Berkeley. (At the time of the final writing of this report, the Discovery Hub has been started and may serve as this center.)
- Offer teaching grants, Discovery co-curricular and extra-curricular grants as well as a range of Discovery Awards. Feature the award-winning projects prominently in the context of broader showcases of Discovery on campus.

Epilogue from the Authors

In lieu of a Conclusion, the co-chairs have decided to write this epilogue, which adds our own reflections to the work of the group. One reason for this is that the co-chairs were able to learn more about the breadth and depth of Discovery on campus than the larger working group. Another reason is that the campus financial reform model, which is becoming codified, impinges on the model of Discovery we have been studying.

There is a varied and fruitful landscape of Discovery already active on campus. Extensive and sustained administrative efforts have been devoted to developing this project; they include mounting substantial surveys and studies, carefully analyzing the same, instituting committees, dedicating positions, and many other significant investments. A broad range of co-curricular bodies have actively offered students Discovery experiences and have shaped the value and potential for Discovery from the ground up. With support, these bodies aim to grow and help the initiative take hold. Across the entire university, departments have participated in detailed self-assessment with the goal of understanding the role Discovery plays, and might come to play, in the curriculum. We admire all this work, and are glad to contribute our efforts to it.

In addition to helping to define Discovery, we were charged to look at its place in the curriculum in order to support the kind of culture shift necessary in order to bring the experience of Discovery into every student's education. At the time when we began this working paper, the group hoped strategic actions and added incentives might be enough to spur this kind of culture shift. However, the current financial reform model being discussed that favors student credit hours as the financial metric will be a major disincentive for Discovery in the curriculum. Indeed, it is a structural opposition so strong as to be potentially preventative. As an immersive experience, Discovery learning typically requires a low student to faculty ratio. The emerging financial remodel does not support this form of pedagogy, and in fact will have negative consequences for those departments that undertake it. There are a wealth of reasons to encourage departments to provide these offerings, to support faculty members who lead them, and to invite a broad range of students to participate. But there is one easily identifiable reason to avoid such offerings: Discovery learning necessarily lowers student credit hours. Departments that stand to gain more institutional support, and especially departments that stand to lose it, both understand how raised or reduced student credit hours will affect their status. Additionally, the low student-faculty ratio this learning requires will calculate as a reduced faculty workload when, on the contrary, providing Discovery experiences is decidedly labor-intensive. The financial reform model brings a very particular measure to what happens in our classrooms, and this measure will exert a strong influence over how departments shape their curriculum. That shaping force is detrimental to Discovery.

We are excited by the proposition of a culture that promotes and endorses Discovery experiences, especially ones tied to students' intellectual growth. There is still work to do, especially in communications, consolidation, and scalability. We see rich opportunities in co-curricular and extra-curricular realms. We note that Discovery is currently possible in the curriculum itself through advanced student research or creative leadership. However, existing curricular options are neither available to nor appropriate for every student. And while the university might offer incentives for individual faculty members to develop new curricular options, such classes are unlikely to grow in number or kind in the current climate. As the new financial model effectively discourages them, departments will not support them.

Given the enormous amount of work dedicated to the Discovery project by so many people, we are disheartened to come to this conclusion. Is it possible that financial reform can take this

campus-wide educational initiative into account? If not, we fear that Discovery will lack coherence and intellectual investment for a great many students, and will become aspirational rather than universal.

Acknowledgements

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Appendix

Previous Reports and Research on Discovery

A Concept Note for UC Berkeley Faculty, Staff, Undergraduates, and Graduates/Postdocs
(March 2017)

The Berkeley Undergraduate Discovery Experiences

<https://vcresearch.berkeley.edu/undegradDiscovery>

<https://vcresearch.berkeley.edu/undegradDiscovery/events>

Discovery and the Undergraduate Student Experience

Discovery Learning in the Undergraduate Curriculum - Data Portal

January - March 2018

<https://ucbsurveys.berkeley.edu/Discovery/results.html>

The Arc of Discovery in the Undergraduate Curriculum

August 2018

<https://ucbsurveys.berkeley.edu/Discovery/FINALDiscoverySurveyReport8.31.2018.pdf>

Discovery Web Tools Research and Design Plan

[Draft](#) November 2, 2018

UC Berkeley Strategic Planning: Student Experience Working Group Final Report

December 2018

https://strategicplan.berkeley.edu/wp-content/uploads/2018/12/Enrollment_Working_Group_Report.pdf

[Benchmarking Report](#): Discovery Programs and Summary of Findings

Sean Burns, Leslie Harlson, Noah Wittman

February 20, 2019

Campus Undergraduate Cohort Program Summary

[Draft](#) March 8, 2019

Discovery Around Campus

Adobe Fellows Program

<https://americancultures.berkeley.edu/uc-berkeley-ac-adobe-fellows-program>

The American Cultures Engaged Scholarship (ACES) Program

<https://americancultures.berkeley.edu/aces>

Berkeley Collegium

<https://vcue.berkeley.edu/collegium>

Creative Discovery Grants: Arts + Design

<https://artsdesign.berkeley.edu/design/news/2019-creative-Discovery-grant-recipients>

Creative Discovery Courses

<https://artsdesign.berkeley.edu/Creative%20Discovery>

Letters & Science Discovery Courses

<https://lsDiscovery.berkeley.edu>

L&S Arts & Humanities: Undergraduate Discovery Experiences

<https://artshumanities.berkeley.edu/why-arts-humanities/undergraduate-Discovery-experiences>

Data Science Discovery Program

<https://data.berkeley.edu/research/Discovery>

Data Science Discovery Program Projects showcase

<https://bids.berkeley.edu/events/data-science-Discovery-projects-showcase>

Psychology: Research & Discovery

<https://psychology.berkeley.edu/students/undergraduate-program/research-Discovery>

URAP

<https://urap.berkeley.edu/>

Golden Bear Orientation (GBO)

<https://orientation.berkeley.edu/once-here/orientation>

Center for Teaching and Learning

<https://teaching.berkeley.edu/current-past-pcf-projects>

Addendum: Definitions of Discovery from the “Arc of Discovery” Survey

“By the end of the program, students learn how to look at the world through an anthropological gaze, a process that involves a range of discoveries about the person's interactions with and critical, multi-scalar, analysis of the world around them. Students leave the program as engaged citizens with the tools to analyze social and political systems they live in.” **Anthropology**

“In these classes students discover or realize their own interests and motivations, essentially discovering themselves and what will sustain them as potential future artists, designers, and

arts professionals. ...Students discover that art beyond their initial preconceptions of art as free expression is a rigorous discipline fully engaged with other aspects of their lives and in the world, that art can be aligned with other university departments as research-based, and that it has a critical relationship to other forms of material and discursive culture....Discovery is essential to the arts, and while students discover many visual regimes, media, modes of expression, and audiences, the most important thing they discover is their creative voice, their change-making identity, and their ability to invent new visions and myths for cultural innovation.”

Art Practice

“For bioengineers, a discovery experience is an opportunity to apply and synthesize their technical knowledge through mindful and ethical application. Students engage in scientific discovery (to learn something unknown) or engineering design (to meet an unmet need). By the end of their degree program, they should be able to recognize if a solution to a problem is likely to have a significant positive impact. If so, they should have the tools and experience to approach an optimal solution.” **Bioengineering**

“Students who study classical philosophy will discover that there are only questions: perennial questions, reiterated in new ways by new generations. Through reading and discussing the way these questions have been framed and answered by ancient philosophers, they will develop respect for difficult ideas and they will learn to ask themselves what they think, as the individuals they are, both about how humans do live in the world, and how they should live.” **Classics**

“The curriculum in each major encourages students to grapple with the urgency and significance of current challenges in “the environment,” in the broadest sense, including the biosphere, biodiversity, ecosystem services, including food, fiber and forests, as well as wellness and humanity. Discovery experiences encourage synthesis and application of knowledge obtained through the curriculum to research, outreach efforts, exchange, internship, fieldwork, and other experiences, and the reflection that follows.” **ESPM**

“The overall goal of our instruction is the cultivation of the ability to read actively, to identify problems, to weigh evidence and discriminate between sources, and to unlearn what we think we know.” **French**

“Our language learning programs focus on cultural discovery from day one.” **German**

“Upon completing the program, students will be able to look at art objects with a clear and educated eye, analyze them and associated textual material with the goal of posing an argument about their position in the history of art, understand how the exhibition of art colors and frames individual works, and gain a sense of how art has been used in society to sway opinion. Students will have a good grasp of how to use visual and textual evidence to better understand the past and they will have learned to grapple with works of art from a diverse range of cultures.” **History of Art**

“By the end of our degree program, a typical student who has engaged in a “discovery experience” will have had the experience of assisting in research in a faculty member’s lab, and ideally will have had the experience of proposing, formulating, and conducting a research project of her or his own in that context.” **Cognitive Science**

“Students independently examine and conduct a critical analysis of a social welfare topic of their choosing. Students gain communication skills and strengthen their writing abilities through their participation and they take advantage of one-to-one mentorship with a member of the faculty. The honors experience is open to approximately 12 eligible students each year. Other discovery experiences include students’ engaged scholarship opportunities wherein students select community agencies with which to partner and conduct voluntary service with supervision provided by agency staff. Students enrolled in community service engage in a reflective exercise to integrate their knowledge of social welfare history, values, and ethics, social welfare policy and practice, and their activities in support of vulnerable community members.” **L&S Social Welfare**

“Discovery learning in linguistics may have a theoretical or an applied trajectory; these are not distinct programs or “tracks,” but represent research goals and styles. Along each trajectory, “discovery” emphasizes data discovery or creation, analysis in the context of subdisciplinary expectations, and expository clarity.” **Linguistics**

“Students engaged with discovery experiences will gain an additional appreciation for and ability to apply their mathematical training. Mathematics is very broad, and the types of discovery experiences will vary significantly within subspecialties. Some students may engage with computer experimentation or applications to other fields of science, while others will get a taste of the process of mathematical research in areas without such connections. Whatever the details of the discovery experience, however, students will gain a deeper appreciation for and understanding of mathematics as a vibrant and developing field, and be able to apply their mathematical training in more novel and creative ways.” **Mathematics**

“Students will be able to recognize a problem or a not understood phenomena and ask the question “why.” It is the most important element to get students self-motivated and interested in the why. Further the students will be able to answer this question with the resources on hand or are able to obtain the resources needed.” **Nuclear Engineering**

“This hands-on exposure to cutting edge research topics and methods, varied professional and research environments, multi-disciplinary collaborations and personal interactions with faculty, professionals, graduate students and postdocs offers for many students a transformative experience that helps to shape their career goals and future outlook.” **Nutritional Sciences and Toxicology**

““Discovery” in the philosophy major takes the form of sustained exploration, in both writing and discussion, of either a philosophical question or problem, or a major philosopher’s treatment of

such a question or problem. (However, since any discussion of a philosophical question must take into account what other philosophers have said about it, and since any discussion of a philosopher's approach to a question must understand the question in its own terms, the difference will likely be a matter of emphasis.) A discovery experience would involve the student doing the following: --- Formulating the philosophical problem or question, defining its terms and context, and explaining its interest and importance, with a sufficient degree of independent mastery that they can successfully communicate it to their peers: other advanced majors who will be familiar with philosophical reasoning, but not necessarily familiar with the specific topic. --- Finding, reading, and synthesizing relevant literature. --- Writing an article-length (15-20 page) or thesis-length (35-45 page) essay. --- Presenting their work in progress, in writing and orally, to faculty and fellow students. --- Learning to take in and respond to criticism, through *several* rounds of revision. (One thing that students should discover, and which they can only discover by experiencing it first hand, is how long it takes, how many false starts, dead ends, mistakes, etc. are inevitable in the process.)” **Philosophy**

“Students will learn and apply a broad understanding of the physical principles of the universe, to help them develop critical thinking and quantitative reasoning skills, to empower them to think creatively and critically about scientific problems and experiments, and to provide training for students planning careers in physics and in the physical sciences broadly defined.” **Physics**

“We encourage our language students to participate in study abroad programs, which, in addition to promoting linguistic mastery, exposes them to the importance of cultural difference, inclines them to tolerance and allows them to function more fluidly in an increasingly interconnected world. We consider all of this a quintessential discovery experience.” **Slavic**

“Discovery Learning for Sociology then is the same as our main Undergraduate Student Learning Goal, to apply sociological concepts and methods to the real world, to analyze data as well as to apply sociological theory, and to understand the various components that make up sociological research.” **Sociology**

“For most undergraduates the focus is on the acquisition and mastery of a vernacular language, often that of their heritage roots. The mastery of this language is not an end in itself, but a tool to engage the respective culture and history. Particularly meaningful for our students is time spent in the country or countries whose language they study and whose culture, literatures, religions and history they study. The stay there allows them to deepen their language skills and immerse themselves in the given culture. The point is that such a stay builds upon the studies in our department and allows the students to make sense of what they have learned and to incorporate this into their personal lives and experience. A comparable discovery experience can result from the writing of an honor's thesis. It also allows the students to build up on what they have learned as majors. They draw upon the language and other skills they have acquired so as to explore a theme of their choice, guided by their advisor. Often writing such a thesis is an empowering experience where the students realize what they have learned in our

department and how they can employ this beyond their studies.” **South and Southeast Asian Studies**

“Written work highlights the methods of the interpretive humanities, where theoretical and historical paradigms inform students' encounter with unique, singular works of art and literature. Students discover their voices as informed, critical, and self-reflexive interpreters of culture. In writing-intensive courses, students learn about themselves as researchers and writers through multi-draft projects that are peer reviewed, edited and rewritten such that creative critical thinking, interpretation, argumentation and persuasive writing comes to the fore. They do all of this in a non-English language that prepares them for our multi-lingual, multi-cultural world. They discover, analyze and fully inhabit cultural and linguistic worlds that initially seem distant from their everyday experiences. Students who pursue honors' theses additionally develop these skills in the context of an original, individual piece of research.” **Spanish and Portuguese**

“Students take Discovery Courses in order to plan and carry out a specific research project; synthesize a set of diverse educational interests; achieve a certain level of mastery in their area of focus in theater, dance, or performance studies; or add a significant accomplishment to their résumé so that they are well prepared to enter the professional world after graduation from UC Berkeley. Some Discovery Courses are focused on reading, critical thinking, and academic writing; others emphasize performing or creating new works for the stage; others allow students to teach, or travel, or intern with professionals in the working world. Students choose the experience that best suits their academic and artistic interests, and will give them the experience that they need to transition successfully from Berkeley into the world of graduate study or professional work.” **Theater Dance and Performance Studies**