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Lasallians in the Lab: The Distinctively Lasallian Character of Undergraduate Research

Christopher Jordan[2]

"Example makes a much greater impression than words."[3]

One Friday afternoon in February 2018, I met four senior students in a chemistry lab in the Science and Learning Center at Saint Mary's University of Minnesota. This particular lab, tucked into a corner of the third floor of the building, is typically home to two or three sections of upper-level chemistry classes each week. No laboratory classes meet on Fridays, however, so on days like this the labs all along the hallway are taken over by senior students, eyeing the upcoming end-of-semester deadline for their senior theses, and anxious to collect more data. My four students were no different, and when we met, three of them went to their drawers to bring out a recently synthesized product – the fourth was there for emotional support. The three samples were dry, crumbly powders; two a dull gray, but the third a vibrant yellow-orange. Each one represented several weeks of hard work to synthesize, purify, and characterize. All three were examples of "polyoxometalates," or "POMs," for short. My students and I study POMs because several are known to have useful therapeutic properties, particularly in their ability to interfere with the inner machinery of bacteria and other pathogens by disabling key proteins. What was – and still is – unknown is how this interference works, which would be a useful thing to know for anyone interested in designing stronger and more selective POMs.

Our goal that afternoon was to attempt a "photochemical reduction," in which ultraviolet light would catalyze the conversion of the three compounds into a slightly modified chemical form which would be more amenable to future experiments we hoped to carry out.[4] If all went well, a change in color would indicate that such a modification had indeed occurred. To do this experiment, the students took turns dissolving their hard-earned solids in an organic solvent, wrapping the flask with aluminum foil, and positioning a pen-shaped ultraviolet lamp so that it dipped through the neck of the flask and dangled an inch or two above the surface of the liquid. Once the setup was complete, they turned on a power source and waited for thirty long minutes. Only then could they power down the lamp, unwrap their flask, and check the progress of their reaction. As the purchase of a single lamp had been a bit of a splurge, the thought of having a lamp for each student was out of the question, so each student had to perform this ritual in sequence. One by one, they progressed through dissolving, wrapping, lighting, waiting, powering down, and unwrapping. And one by one, they looked in at their flasks to see that nothing at all had happened.

While the results, or lack thereof, vary considerably from week to week, this story is representative of the undergraduate research experience. Scientific research can be slow, cumbersome, and prone to failure. More relevant for the purpose of this reflection is the fact that

it can also be a transformative and experiential endeavor, one in which students apply in a very personal way the concepts and theories they are subjected to throughout their undergraduate education. When students sit in classes, they merely *learn about science*; put them in the research lab, and they start to *become scientists*. Thus, the research experience is a capstone of their education, and represents their transition from passive learners into active doers.

When the second cohort of the John Johnston Institute began in June 2017, I was one month removed from completing my second year at Saint Mary's and watching my first two research students graduate. Over the last two years, I have worked with eight additional students, each of whom have impacted my understanding of the value of undergraduate research and the role of intentional mentorship. Simultaneously, the Institute has helped me engage with the unique qualities of the Lasallian charism, and the diversity of ministries that together and by association carry out their work in creative fidelity to a shared mission and inspiration. During this time, I have been struck by the similarities of the relationships that Lasallian education encourages between students and faculty to the mentoring relationships I am engaged in, and the effective examples offered by my former professors and current colleagues.

Unfortunately, these two spheres of influence do not seem to communicate with each other effectively! My descriptions of working with undergraduates are rarely couched in particularly Lasallian language, and conversations with colleagues across campus or with college administrators are more likely to center on my research's scientific impacts than its personal ones. I suspect that these experiences are not uncommon for scientists at Saint Mary's or any other Lasallian institution of higher education. *For this reason, undergraduate research is a critically underappreciated avenue in which Lasallian education is manifested.*

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Over the course of two years, those of us in the John Johnston Institute have participated in six sessions discussing everything from the history of the Lasallian charism to its preferential option for the poor; from pedagogy to the vocations of our students and ourselves. Even in hindsight, with the ability to rationalize it all that I want, I am still astounded that the connection between the Lasallian charism and undergraduate research resounded most strongly with me during our session on catechism and evangelization. Having spent most of my life in Protestant circles – and not the type of Protestant circles that thought much about overly fancy words such as *catechesis* – I did not know what to expect from this session. From a strictly literalist standpoint, these terms had little to do with my day-to-day, secularized job. Yet the way these terms were discussed showed that here, they were not strictly limited to, nor divorced from, spiritual matters. The things that I teach in the chemistry curriculum are not part of any religious instruction, yet the passion I have for the subject is due in part to the deep awe I have for the infinite intricacies of creation itself. I have no interest in a catechism that draws strict boundaries around what is or is not religious, nor an evangelization that fails to recognize the "good news" that suffuses the entire world around us. If we actually *remember that we are in the holy presence of God*, the most mundane experiment becomes liturgical, not through the ostentatious addition of the trappings of formal religious language, but because science is a way of working directly with a creation that has been declared "good."[5]

The origins of my interest in my discipline are deeply personal, and surely differ from those of my students, who come from a variety of faith traditions, or none at all. Despite this, we are united together by our belief that what we research and how we research it are meaningful. Therefore, we share a common goal that we work toward, even as we work from a diversity of motivations. In this regard, there is a clear analogy to the way the Brothers have come to engage Lasallian Partners in an increasingly heterogeneous society. Indeed, the *Rule* of the Brothers states:

> When they work with Partners with different beliefs and religious traditions, the Brothers seek to establish common ground for co-operation on the basis of the promotion of human dignity, solidarity among all human beings, and the integral development of the individual.[6]

Our research is the "common ground" that I share with my students. The work is ours; and it is shared among us, even as we have different reasons for picking it up. Evangelization is merely our *telling* others about the irresistible joy of discovery.

Catechization, on the other hand, is *sharing* this walk with students, involving them as fully in my professional, scholarly, and personal life as I would any other colleague or collaborator.[7] This requires vulnerability and humility, because by necessity it rejects the hierarchical relationships that are the stereotype of faculty-student interactions. In this sense, proper catechesis requires insistence that my research students do not "work for me," but "work with me." For that to be an honest sentiment, then our goals must be shared goals that we arrive at together, rather than the imposition of my will on the students. An unequal distribution of experience among us does not preclude our equal dignity. Brother Álvaro Rodríguez Echeverría describes this dynamic beautifully:

> Our mission … is to be companions on the search, humble guides who aid in the discovery of a path and in finding meaning in life. Rather than teachers who teach from above or judges who judge and condemn from outside, we are called to be brothers and sisters who mentor young people from the inside.[8]

Despite the fact that our research takes place outside the classroom, this is absolutely related to pedagogy. For hundreds of years, the Lasallian community has stood in solidarity with the poor and disadvantaged, and explicitly acknowledged education as a means to improve their *physical and spiritual* well-being. Education cannot be Lasallian unless it acknowledges and engages both of these dimensions. Furthermore, teaching is not restricted to the formal education that students receive. It cannot be reduced to a standardized test at the end of the semester. Too often, science at the post-secondary level is contrasted with the liberal arts (as if mathematics and astronomy were not part of the *original* liberal arts!) through a pair of toxic stereotypes. Majors in the physical sciences – or, better yet, engineering – are seen as a practical means to a high-paying job; the humanities are reduced to luxuries that may be theoretically meaningful but are not worth the financial implications of student debt. Both stereotypes are harmful! Since I teach primarily science students, I see the effects of those stereotypes, the expectation that, "If I just manage to memorize these equations, I will graduate and make a six-figure salary and be happy." Even were that true, an education that did not address the development of students' ability to

think like scientists would be a stunted education. Teaching our students to seek out and address a problem that can materially benefit humankind helps them better gauge the scope of their own abilities and responsibilities, and reduces the chances that they acquiesce to the life of a number-crunching automaton.

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Unfortunately, the world of higher education is more prone to see the endeavors of research and teaching as a competition. Colleges and universities are stratified by the scholarly productivity expected of faculty members, with more prestige awarded to those institutions that expect the highest quantity and quality of publications. Other schools – including Saint Mary's – navigate to the other end of the spectrum, encouraging faculty to invest their energy in the classroom and expecting minimal research activity as a result. In the sense that resources, including the university's finances and the faculty's time, are undeniably limited, there is an aspect of this that appears to be a zero-sum game. It is easy to misconstrue an argument in favor of one side of the research/teaching dichotomy to therefore be an argument against the other.

To combat this mindset, we need to remember that when students are engaged in undergraduate research, they are learning how to navigate the transition from student to colleague. This represents the pinnacle of their disciplinary education, where they take content from the courses that have filled their schedules for so many semesters and apply it to discover something new. It is also a key to their economic mobility. In his time, De La Salle scandalized his society by allowing instruction in his schools to be given in the practical language of French rather than the sacred Latin, a decision that was

> defended by advancing the most practical reasons. The emphasis was on useful subjects – reading, writing, mathematics, and other skills that would be helpful in gaining a livelihood.[9]

Similarly, when we offer students from disadvantaged backgrounds or underrepresented demographics the opportunity not just to study in our classrooms, but work alongside us, we have a very real impact on how they are seen by employers and admissions committees at graduate and medical schools.

Caring for students as holistic, complete people means more than just improving their future earning potential. I have already discussed the importance of my relationship with the students, but their relationship with each other is also crucial for their well-being. Each cohort of students that begins research is embarking on what can be a stressful, anxiety-ridden journey, because the process is so much more open-ended than their previous schooling. It helps for them to recognize that they are part of a community of past, present, and future students in ways both light-hearted (e.g., our now-annual March Madness pools, as we compete for the "golden POM") and practical (e.g., sitting through others' presentations and offering critical feedback and advice). Even when students leave Saint Mary's behind for graduate school, medical school, or industrial labs, they leave behind a very tangible record of the mark they have made on those who remain. When a current student needs assistance with a method that our group has previously carried out, I am not the expert that they must consult; their answers are in the theses and lab notebooks left

behind by their predecessors. Similarly, they know that they do not maintain their own laboratory records for their own convenience – and certainly not for a grade – but because they know that some unknown number of years down the line, any stray observation of theirs could prevent several weeks of floundering for a fellow student they may never meet.

The research experience is also crucial for vocational discernment. The determination that students must possess in order to spend hour after hour in the lab perfecting a technique or hunched over a computer screen does not always correlate with exam scores or other means of assessment. Students can be surprised to find that their disposition is more suited to research than classroom work, or vice versa. Either way, it is important for students to spend some time attempting research for them to determine if they actually want to spend their lives in this profession. This is not just my personal sentiment or soapbox; it is echoed in advice given by faculty to students everywhere. Even the American Chemical Society joins the chorus, with some surprising wording:

> If science is *truly your vocation*, regardless of any negative results, the moment of discovery will be truly exhilarating (emphasis added).[10]

This serendipitous overlap of the language of the John Johnston Institute and the American Chemical Society is not as uncommon as we might expect. Indeed, the arguments I've been advancing primarily from a Lasallian perspective have been made for decades by the chemistry community. For example, Lasallians express a preferential option for the poor, and an emphasis on serving students from underrepresented groups. Fittingly, undergraduate research helps in student retention, particularly those students who are women and/or people of color, an effect that has been attributed to the close working relationships developed between students and their faculty mentors.[11] Lasallian or not, those who care strongly about the well-being of their students during and beyond their undergraduate years are stressing undergraduate research as a pillar of this effort.

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What are we to do with these observations about the importance of research in undergraduate education? Through numerous conversations with the other members of my John Johnston Institute cohort over the past two years, I have found it abundantly clear that the actualization of Lasallian values is neither uniform nor static. How Lasallian principles are applied varies from school to school and from year to year. Indeed, Saint Mary's is currently in a heightened state of flux, less than one year into the tenure of a new President and in the process of drafting a new Strategic Plan that will guide university decisions far into the future. If there is a time to propose an increased emphasis on engaging our students in undergraduate research, this would seem to be it. Nevertheless, I confess that it feels impertinent, or at the very least audacious, to raise these concerns at a time when budgets all across higher education are pinched by declining enrollments, shifting demographics, and changing social attitudes toward what post-secondary education should provide.

This brings to mind another experience I have had at this Institute, a conversation with Michael Bulfin as we walked the grounds during a break at the Dunrovin Retreat Center in March.

Michael, a doctoral student and coordinator of the Writing Center at Lewis University, was the only other instructor from Lasallian higher education in the Midwest District's cohort, so we have had several discussions from which I have benefited immensely about the nature of Lasallian undergraduate education. Although the details of the conversation escape me, I recorded a brief entry in my journal about the conversation and a concept I have come to call "institutional courage." Describing it, I (in retrospect, rather bluntly) wrote:

> In any way that our institutions drift from the primary goal of serving our students, they run the risk of poisoning their own evangelization and catechesis. Just as we should critique a theology that plasters over our faults and weaknesses in lieu of a façade of perfection, we should also resist any changes that hollow out the education our students receive, even if this resistance comes with financial costs or risks.

There is no doubt in my mind that investing in undergraduate research is a risky proposition. Yet it is also a non-negotiable component of the undergraduate scientist's experience. If we fail to properly invest in that experience, we have no business attracting or retaining young chemists; should we do so anyway, we would be putting them at a disadvantage relative to their peers.

Fortunately, the Lasallian community has a tradition of institutional courage that spans more than three centuries.[12] Measured, principled risk-taking is part of the legacy of the Brothers, who have never feared to prioritize their shared mission over the safety of the status quo. This adaptability is also a crucial component of the history of Saint Mary's, as many now-celebrated milestones in the university's history – its acquisition by the Brothers, the transition to a co-educational institution, the development of what is now the School of Graduate and Professional Programs in Minneapolis – were only made possible by the institution's willingness to be bold in the presence of uncertainty.

This is certainly not the venue for detailing the ways in which my university could make progress in encouraging undergraduate research – that could fill several more personal reflections. Instead, I would point out that one of the virtues of the John Johnston Institute is the way in which it intentionally creates time and space for its participants. By including time for meditative and interior prayer and regular reflection, its leaders have allowed this cohort the opportunity to step away from the hectic pace of daily life at our ministries. This structure prevents us from keeping one foot in a session and the other foot in our regular world; instead, we are fully immersed in the Lasallian environment long enough for its lessons to take root. The physical spaces used, whether universities or retreat centers, have been consistent with this design, allowing for repose and contemplation. The result, for many of us in this cohort, has been a deeper learning that allows us to syncretize the Lasallian charism with our own unique roles.

I sincerely wish for the same time and space for the undergraduates with whom I work. We will always strive to make good use of the resources we have, but students have so many demands on their time during the academic year that they find prioritizing research as difficult as I find prioritizing "Lasallian formation." At the start of this essay, I told the story of how I came together with four of these students for an afternoon of work, but when that afternoon was over, we parted. The students returned to their homework, exams, and essays; I returned to grading and preparing for classes. Research was an excursion, not an immersion. One approach to fixing this

would be the development of a summer research program, as that would allow students the time to make research a priority just as this cohort has done with the John Johnston Institute. Taking the time for this deeper learning would also require us to adapt the space to our needs, rather than squeezing into whatever vacant laboratory space we can find on a Friday afternoon. Although these goals seem lofty, I am optimistic. Progress does not grow linearly; it comes in fits and starts. The evolution of any department, school, or university is as messy and individualized as any research project. In either case, any setback is temporary with enough persistence and patience. Take, for example, an experience I had *this* February, when one of this year's seniors synthesized her pale, white POM and began the same photochemical ritual as last year's seniors: dissolve, wrap, light, wait, power down, and unwrap. And this time, sitting at the bottom of the flask was a pale, blue crystal: the reaction had succeeded. If we – both the faculty and administration at Saint Mary's – display a similar persistence in our efforts, we have the opportunity to discover success as well.

Let us remember that we are in the holy presence of God.

Yes, let us remember –
We share this space with the God of creation;
The God who weaves together the atoms and molecules,
Who dives into the infinitesimal smallness and plucks the very strings of existence;
And the God who dances with galaxies,
Painting stars in the sky and stretching His wings from quasar to quasar.

Let us remember –
That sitting beside us is the being that stitched together our proteins,
The architect of the spiral staircases of our chromosomes.
He stands over each synapse,
Guarding the sparks of consciousness
As they skip from neuron to neuron.
He courses through our blood,
Fills our lungs with breath,
Pumps our heart.

Let us remember –
That our lives are governed by the same God that has seen the dawn of civilization
And knows the hour that it will set.
Our days are an instant to Him,
Yet He tarries with us through each second.
Our words are heard by the power behind all prophets and poets;
Our music is played for the One who composed time's first melody;
Our sculptures and paintings are but echoes of His creation.

Let us remember –
That walking alongside us is the god of history;
Of kings and kingdoms, politicians and popes,
Renaissance and revolution, economy and ecology.

He has wept for our wartime,
And offers repose when we listen to His words.
He preaches the redemption and reconciliation of all human endeavors in their proper time.

Let us remember –
That living within our hearts is the fullness of creation itself;
From everlasting to everlasting.
Let it burst forth in love, in floods of mercy that flow
From us to those entrusted to our care.

Saint John Baptist de La Salle, pray for us.
Live Jesus in our hearts, forever.

Endnotes

1. This reflection was originally prepared by the author as a Capstone Reflection at the conclusion in spring 2019 of the second cohort of the John Johnston Institute of Contemporary Lasallian Practice (2017-2019), a national program for educators that is sponsored by the Lasallian Region of North America.

2. Christopher Jordan is an assistant professor of chemistry at Saint Mary's University of Minnesota. He earned his PhD in 2015 at University of Wisconsin-Madison.

3. John Baptist de La Salle, *Meditation* #202.3.

4. If it seems like I am being vague about the chemistry involved, I confess that choice is deliberate.

5. This sentiment was powerful enough during the March 2018 meeting that it compelled me to scribble down a prayer, in my journal. I have included that prayer at the end of this reflection.

6. From *The Rule of the Brothers of the Christian Schools* (Rome, 2015), article 17.2.

7. The Brother John Crawford points this out when he writes, "The catechist [has] to be more than the one who [monitors] the accuracy of repeated questions and answers. The catechist [is] called upon to model the practices, behaviors and actions that [represent] a lived faith." Cf. John Crawford FSC, "Evangelization and Catechesis" in *AXIS: Journal of Lasallian Higher Education 7*, no. 2 (2016), page 60.

8. Álvaro Rodríguez-Echeverría FSC, "Young People and the New Evangelization" in *AXIS: Journal of Lasallian Higher Education 4*, no. 3 (2013), page 24.

9. Luke Salm FSC, *The Work is Yours* (Romeoville, IL: Christian Brothers Publications, 1996), page 56.

10. Cf. "Undergraduate Research in Chemistry Guide" in *American Chemical Society*, 18 March 2019, www.acs.org/content/acs/en/education/students/college/research/guide.html.

11. See, for example, Amanda J. Reig et al., "The FUTURE Program: Engaging Underserved Populations through Early Research Experiences" in *Best Practices for Supporting and Expanding Undergraduate Research in Chemistry*, edited by Bridget L. Gourley and Rebecca M. Jones (American Chemical Society, 2018), pages 3-21.

12. Indeed, if Vuyart, Drolin, and De La Salle had been assured of the eventual success of their Institute, the Heroic Vow would have been substantially less … well, heroic.