# A Thematic Approach to Teaching Liberal Arts

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**INTRODUCTION**

Undergraduate liberal arts education today is typically conceived along disciplinary lines. Students major in a particular discipline and often "fill out" their education with "gen ed" requirements chosen from a cafeteria menu of offerings from other academic divisions. These divisions often *divide* students from each other quite literally; treating such differences as those between the humanities and the physical sciences as unbridgeable chasms. Even in the relatively small, congenial context of a liberal arts college, such gaps—the science/humanities gap in particular—can loom large. Students must regularly hopscotch their way across it, as they work to create a major and fill those gen ed requirements; but they may do so in ways that require them to engage in relatively little cross-fertilization of ideas. This is because faculty, even at a liberal arts college, can (to introduce another metaphor) create silos for themselves populated by members of their own divisions, reducing the chances that they will have to talk or teach outside their disciplinary comfort zone.

Integrated general education curricula and interdisciplinary majors strive to offer a different approach to education, but these programs often struggle mightily to avoid falling into the usual disciplinary way of thinking. A course at our institution, Gustavus Adolphus College, offers an intentional opportunity for faculty and students to think collectively across disciplinary boundaries. The course, a senior capstone experience for the college's alternative integrated general education program (called the Three Crowns Curriculum, 3CC), is traditionally taught by a pair of faculty from different disciplines, usually a humanities discipline and a social or natural science discipline.

This brief paper describes a version of that course created by the authors, a physicist and a philosopher. We chose to focus the course around a theme—symmetry—that interested both of us, and that crisscrossed disciplinary and divisional lines. In order to avoid recreating disciplinary silos within the course, we looked for pedagogical inspiration from John Dewey. Dewey's educational philosophy—specifically his philosophy of elementary education—structured learning not by disciplines, but by themes. This paper will place our co-taught thematic senior seminar course in context within the curriculum at Gustavus, explore the basis of the John Dewey inspiration, illustrate an application of Dewey's pedagogical philosophy by using symmetry as the basis for a multi-disciplinary course, and finally examine lessons learned from the experience.

**General Education at Gustavus: The Three Crowns Curriculum**

Gustavus Adolphus College has long subscribed to the liberal arts tradition of building a curriculum that incorporates the notion of the one-third/one-third/one-third paradigm. Specifically, this paradigm espouses the idea that a student's total course of study should be roughly divided into three equal parts consisting of general education, major, and elective courses. At Gustavus, students may complete their general education requirement by participating in one of two general education programs; the Liberal Arts Perspective (LAP) or the Three Crowns Curriculum (3CC). While the LAP is closer to a traditional distributive curricular model, the 3CC pathway is based on a prescribed four-year integrated sequence of courses. Both of these general education programs are characterized not only by the desire to expose students to "various ways of knowing" but also to the philosophical underpinnings of and interchange of ideas among these intellectual perspectives. Indeed, the notion of "ways of knowing" is so central to the general education program at Gustavus that even in the more distribution based Liberal Arts Perspective curriculum general education courses are not tied to particular departments (e.g. courses that satisfy the "Mathematical and Logical Reasoning" or "The Arts" areas may be offered by a faculty member in the Philosophy Department). A curriculum built on "ways of knowing" rather than a set of departmentally focused requirements helps faculty and students fight against the natural insulating properties of the departmental focused organization so prevalent in higher education today.

As the Gustavus college catalog states, the 3CC curriculum "is a core curriculum in which integrated courses build upon each other to create a common body of knowledge. A theme of 'the individual and community' is seen throughout the program as it examines the Western tradition within a global perspective. Students are challenged to address ethical values questions both in class and the Three Crowns-sponsored cultural, social, and intellectual activities." While the Three Crowns curriculum is not an honors program and is thus open to any entering first-year student, enrollment is limited to approximately 60 students. This student cohort moves through an integrated set of courses (consisting of multiple sections) that, over four-years, expose them to the many different ways human understand their place in the universe. These courses include, Historical Perspectives I & II, Individual and Morality, Biblical Traditions, Individual and Society, Musical Understanding, Visual Experience, Theatre Arts, The Literary Experience, Natural World, and the capstone Senior Seminar course. The Senior Seminar course at Gustavus has traditionally been team-taught by faculty from different departments (often different divisions) within the College. While the specific topic or content that a particular seminar chooses to explore is quite open, the Senior Seminar course "calls upon students to contemplate questions concerning values in the context between the individual and the community." It is within this context that we, a philosopher and a physicist, following American philosopher John Dewey's lead, offered a Three Crowns senior seminar built upon symmetry as its central theme.

## John Dewey and Thematic Learning

John Dewey wrote on topics ranging from epistemology to aesthetics. However, he is perhaps most widely known to those outside of philosophy for his work on philosophy of education, particularly on what was known as "progressive education" in the early-mid twentieth century. Dewey, and a collection of (mostly women) teachers famously investigated, developed and operationalized this model of education at the renowned Lab School at the University of Chicago, a K-12 school still in operation today. When he later moved to Columbia University, he worked with other education theorists to create the Lincoln School, organized for similar pedagogical purposes. It should not go unnoticed that this work focused on *elementary* education. Be that as it may, the principles and approaches undergirding this model of education proved useful for us at the college level.

Three aspects of the Deweyan pedagogical model influenced the design of our 3CC course: a commitment to beginning inquiry from students' interests and knowledge; an emphasis on teachers not as "profess-ors" but as facilitators who are themselves learners; and a focus on topics or themes, as opposed to disciplines.

**1. Beginning with students:** At the heart of Dewey's philosophy of elementary education is his commitment to beginning inquiry at the point of students' interests and abilities, and then using that interest and curiosity as a way to prod them to develop and mature in their thinking. Taking a leaf from this model, the 3CC capstone intentionally prioritized students' interests, as well as their level of familiarity with technical concepts, for two reasons; first, because the level of familiarity with technical scientific concepts varied considerably from student to student (a consequence of their having majors ranging from mathematics to dance); and second, because the course sought to create a context for inquiry that treated disciplinary differences among students not as obstacles to be overcome ("she doesn't know much literature"; "he hasn't taken any math beyond finite math"), but as opportunities for more complex and integrated dialogue. To that end, it was vital that religion students and physics students felt equally invited to talk, and that all felt welcome to bring their knowledge and ignorance into the classroom. On this score, the course was advantaged by the fact that the students in this integrated curriculum had been taking classes with each other for three years by the time they walked into ours. They knew each other quite well—well enough, in fact, that they were sometimes unwilling to revisit old disagreements.

**2. Teachers as learners and facilitators:** In a Deweyan elementary classroom, ignorance and curiosity went hand in hand; students were encouraged to see their ignorance not as a shameful problem to be hidden, but as an opportunity for inquiry and investigation. In young children, fostering a connection between ignorance and curiosity may be simply a matter of encouraging, rather than stifling, a tendency they have been exhibiting since birth; as students mature, the challenge becomes greater, because students become more uncomfortable with their own ignorance.

Teachers thus played a crucial role in fostering student curiosity at all grade levels. In the progressive classroom teachers operated as learning coordinators, as facilitators who were themselves curious learners. Their most appropriate title might be "chief learner," since one of the most important things they were doing was modeling what it looks like to learn. Such a view of the educator stood in sharp contrast to traditional models of the day, which held that teachers were authoritative "content providers." In a Deweyan setting, teachers did not own the content, and likely would not even know everything that students would need to learn. Far from being a problem, however, teachers' ignorance was an opportunity for students to experience what genuine (not "pretend") learning looked like.

In an elementary school classroom, the things a teacher is learning will often be quite different from the things her students are learning. The latter might be struggling to learn to use a ruler to measure and cut boards for their boat, while she is learning about boat design in order to be able to guide their construction. However, in an interdisciplinary college classroom in which faculty members from different disciplines are teaching together, chances are good that some students and some faculty might be ignorant in the very same ways about the very same topics. For a faculty member, displaying such ignorance can be an unnerving experience. If one believes one's legitimacy in the classroom stems chiefly from one's knowledge, not having some requisite body of knowledge, and confessing one's ignorance (on a daily or weekly basis!), can seem suicidal—or at least very disempowering. Such a feeling might be particularly acute in a team teaching situation with faculty members from very different disciplinary backgrounds. "Nonscientists" might feel deeply intimidated by having to confess their ignorance of current scientific thinking; "nonhumanists" might feel embarrassed to admit that they have not read a particular text that is considered to be a "touchstone" of classical western education.

On a Deweyan model, however, such situations in the college classroom are perhaps the most valuable teaching situations of all, for they afford students the opportunity to see high-level learning happening, and to see themselves in their teachers. Fostering cross disciplinary expressions of ignorance and curiosity might be the most important things a faculty member might do for their liberal arts students—and, to move beyond the walls of the classroom, one of the most important things they might do to cultivate in their students the capacity to participate in public discussion and debate about, e.g., science-based issues, and to do so in ways that resist the "silo-ing" of knowledge.

**3. Themes, not disciplines:** Elementary school curriculum, at the time Dewey created the Lab School, was organized by subjects. Students' days consisted of blocks of instruction in particular, discrete subjects: each day, they went from reading to math, to penmanship. Any connections among these subject matters were happy coincidences, not coordinated efforts. In contrast, at the Lab School, students' learning was organized in weeks-long thematic units. All the elements of a day's instruction coordinated with each other around the current theme. Students learned requisite skills in arithmetic, spelling, social studies and science in an integrated way that focused their attention on concepts and content related to that thematic unit.

For instance, in a legendary unit on boats that was created for third graders at the Lincoln School, students built and sailed boats, visited the nearby Hudson River, and learned about the cultures of that river. In the process, they acquired skills and knowledge of history, geography, arithmetic, literature, writing, and art. (The students and their teacher, Nell Curtis, actually wrote a book about boats and boat making. (Third Grade Children)) Skills like arithmetic and spelling were not treated as separate subjects, but were understood organically, in context, and in relation to each other.

Frankly, this kind of non-disciplinary study might be easier for elementary school children than for college students. College students (and their teachers) are well aware of disciplinary divides. They can be persnickety about patrolling the borders of a discipline, and can also be nervous about venturing outside of the comfort zone of their own discipline. When one attempts to suspend disciplinary divisions altogether, in order to explore ideas "in general," it can make everyone in the room rather nervous.

The inspiration of Dewey did not quell our fears as we taught this course, but it did give us a sense that what we were doing had legitimacy, and gave us a way to think and teach that felt credible to us. The next section of the paper explores the particular theme we chose for the course.

## SYMMETRY

We chose symmetry as a theme for this course for a couple very simple reasons. First, it fascinated each of us independently. Second, it allowed for a tremendous range of flexibility and breadth; every field of human inquiry or creativity, from music to astrophysics, probably utilizes symmetry concepts in some way. These two reasons made it an ideal theme around which to structure the course.

We began the course by introducing students to a technical, scientific notion of symmetry. With this concept as a kind of touchstone or foundation for further inquiry, we spent the remainder of the semester exploring a vast array of topics using symmetry as our tool for investigation. We studied questions in physics (what role does symmetry play in the makeup of the physical universe?), in aesthetics (what roles does symmetry play in our experience of the beautiful?), in sex/gender theory (how do intersex and transgender, e.g., challenge notions of gender binarism and symmetry?), and in ethics (how does thinking of good and evil as a binary symmetry contribute to ethical reflection?).

**Symmetry and the Generalization of the Notion of Symmetry**

Many people have a colloquial notion of symmetry that is based upon their lived experience with two- and three-dimensional objects. For example, one might say a circle possesses rotational symmetry about an axis passing through its center. What is meant by this is that if you rotate a circle by any angle about the axis that is perpendicular to the plane of the circle and passes through its center the figure of the circle remains visually unchanged. It is this invariance of the circle upon rotation that leads us to say that "the circle possesses rotational symmetry." The same may be said of the three dimensional cylinder rotated about its central axis. In contrast, if one considers the rotation of a square about an axis passing through its center, it is easy to see that only rotations by 90, 180, 270, or 360 degrees, etc. will leave the appearance of the square unchanged. An observer who closed their eyes during the rotation of the square would be unable to detect any change to the square upon opening their eyes only if the square was rotated about the central axis by the indicated amounts (i.e. 90, 180, 270, or 360). These everyday examples contain the essential components of geometric symmetry. Namely, in each of these examples a geometric object (circle, cylinder, or square), had a specific operation performed on it (a rotation about a specified axis), and an observer noted whether or not the objected had undergone a detectable change (enabling the observer to determine if the given object is symmetric with respect to the specified rotation). While geometric symmetry may be familiar to many (whether or not they can define it formally), the generalization of the concept is perhaps less well known and certainly less discussed. It provides a powerful lens with which to view our world. Another way to emphasis the power of symmetry as a concept is to say that poets and physicists alike can understand themselves to be "up to some of the same things," when they realize that symmetry questions shape the endeavors of both.

The essential features contained in the geometric examples of symmetry cited above are (1) an object is specified, (2) the operation or transformation to be performed on that object noted, and (3) the invariance of the object under the specified operation is tested. This notion of symmetry may be ground and polished into a powerful lens by extending (1) to include *any* idea, concept, or equation rather than just geometric objects; and by broadening (2) to include cultural, religious, gender, temporal, mathematical transformations, etc. rather than just simple rotations. For example, one may study ethics by asking whether or not a particular notion of "fairness" would be invariant (symmetric) with respect to a shift in time or culture (the transformation). Additionally, one may explore mathematics by exploring the symmetry properties of music. Thus, one may study various traditional subjects in an integrated and interdisciplinary way by using symmetry as a unifying theme.

**Symmetry Topics**

Symmetry was in many ways an ideal theme for the course, for it so clearly arose as an important issue in multiple contexts, multiple disciplines. As such, it also served as an ideal theme with which to engage students; it offered endless points of entry, as well as endless opportunities to be specialized (if that was their preference) or to be broad and sweeping. This thematic versatility was displayed in the breath of topics that students chose for their final reflection papers (discussed below). A specific example, taken from physics, may help to illustrate the expanded definition of symmetry.

Symmetry holds a central place in physics that goes to very core of the discipline. While some symmetries in nature are easy to observe as they provide a visible display of underlying order (e.g. the cubic crystal structure of ordinary table salt is a macroscopic manifestation of more distant microscopic symmetry), others may be more abstract and require broadening our notion of symmetry beyond the geometric. The concept of time-reversal invariance is one such symmetry. Using our expanded definition of symmetry discussed above leads us to identify "the equations of physics" as our "object" to be transformed and reversing "the arrow time" as our transformation.

As a specific example, let us consider what happens to the equations of classical mechanics, as embodied in Newton's laws of motion, when we reverse the arrow of time (let time run backwards). Mathematically this is accomplished by replacing every time-variable $( t )$ in Newton's second law of motion with its time-reversed counter-part $( -t )$ and asking if the equation remains unchanged (is symmetric) with respect to this transformation. It turns out, that in the absence of friction; the time-variable $( t )$ only appears in squared form (i.e. $t^2$) and thus when we replace $( t )$ with $( -t )$ the equation remains unchanged (since $( -t )^2 = t^2$ leaving the equation unchanged). Hence in the absence of friction, the direction of time makes no difference in the equation of motion and both forward and backward in time motion is allowed (Newton's laws of motion without friction are said to be symmetric with respect to a change in the direction of time). This effect is physically observable when we consider your local applied physics laboratory (the local pool hall). In the motion of billiard balls on a pool table the drag caused by friction may be neglected over small distances and therefore this is an excellent model system to test this symmetry. Consider the collision of two-billiard balls filmed from above. If someone projected the film for you, would you be able to tell whether or not the film was running forward or backward? The fact you would be unable to tell which direction represented the actual experiment performed is a real life manifestation of this time-reversal symmetry. (As a counter-example, consider being shown a forward and reverse film-sequence of an ice cube melting. Could you tell which represented the actual experiment performed?)

Symmetry proved to be an enormously fruitful topic to explore. Giving ourselves the freedom to "play" in the classroom, we spent days watching physics demos, listening to music, reading poetry, looking at art, watching mathematics videos, and just generally "playing" with the concepts of symmetry. Using the general concept of symmetry as an anchoring point, we would frequently come back to ask ourselves—in the midst of reading a poem or looking at a piece of art—"what's the transformation here?", a phrase that reminded us that we *were* indeed dealing with "the same" kinds of things, and that also gave us considerable practice in moving flexibly among deeply disparate topics.

## LESSONS LEARNED

### Students as Teachers

For us, evidence of the success of our thematic approach to the 3CC capstone lies in the research projects students prepared for the class. Students (for the most part) chose topics that emerged from their disciplinary perspectives, and then presented the results of their research in both oral and written form at the end of the class. One mathematics student's research question was, "which do we find more aesthetically pleasing, a tree branch with high symmetry, or a branch with broken symmetry?" She wrote a computer program to create fractal images, and then conducted some qualitative research to find out how others responded to the images. A dance student led the entire class in simple movements, designed to give us an understanding of how our bodies create, disrupt, and reestablish symmetry in dance. A biologist looked at the moment in embryonic development when the embryo exhibits its first asymmetry. A chemist decided to break out of his major, to explore the relationships between Old and New Testaments as symmetry relations. Discussions of each project were freewheeling, multi- and inter-disciplinary—though admittedly the most technically scientific talks still tended to get the most timid responses from nonscientists.

### Team Teaching

Lisa reflects: Paul and I are both regarded as excellent teachers. So why were we both so terrified about teaching "in front of each other" in this class? This question fascinated and frustrated both of us for the duration of the semester. Only toward the very end of the semester did each of us finally find ourselves comfortable being our "pedagogical selves" in the classroom. For me, the nervousness sprang largely from a kind of internalized dismissal of the legitimacy of philosophy, when compared to the "hard science" of physics. I found myself imagining and anticipating criticisms from Paul before he even had a chance to read the material I had assigned. I simply assumed that he would think philosophy was "stupid," that its questions were "the wrong ones," or that "physics could deal with them better." Of course my nervousness wasn't entirely fantastical; we are living in an era in which prominent physical scientists regularly declare philosophy "dead." But Paul is not among those scientists—and this was not a philosophy class, even though I brought my philosophical self into the room with me each day.

I believe that the profundity of this challenge also represented one of the most important pedagogical opportunities of the class—for us and for the students. As noted above, the model of inquiry advocated by Dewey emphasizes the teacher as facilitator and learner. Arguably, this role is nowhere more important than in a college classroom where students can witness well-educated professors from different disciplines express their ignorance to one another, and learn from each other.

One memorable conversation, for instance, explored the question "what role, if any, does 'truth' play in scientific inquiry. The conversation took both instructors down to the barest bones of our respective disciplines, and left us understanding a little bit more about the way that we and our students *live* the gap between the humanities and the physical sciences. (It left me pondering the question "whose disciplinary standards are in play when everyone is trying to have a conversation outside of their home discipline? What, if any, are the underlying assumptions upon which we can build our discussion?") It is not an exaggeration to suggest that such conversations can model for students what it means to be an active and informed member of a democratic society. For Dewey, democracy *is* education; learning to be actively ignorant is thus a vital skill for any member of a democratic society.

Paul reflects: As a faulty member who is perhaps most comfortable at a blackboard filled with equations or down in a dark basement optics research laboratory, this seminar course both challenged and provided an opportunity for growth. For me, the challenge lay both in the varied course content as well as its format. The breath of content explored in the course was expansive not only because the instructors came from disparate backgrounds, but also since students were encouraged, and indeed required, to explore the notion of symmetry in their respective disciplinary homes and encouraged to make connections with those of other seminar participants. One day might find the group discussing symmetry in literature or poetry, while another might find us in a dance studio exploring the symmetry inherent in our own biological form and movements, and yet tomorrow may bring a student led discussion of bio-chemistry or religion. The benefits of Dewey's notion of shared multifaceted learning are clearly on display in this type of theme-based seminar course.

As a physicist, the other lasting impression that I take away from this course is an appreciation for just how freeing the experience was. In my discipline there are certain canonical sub-fields that must be taught to prepare students for graduate school and within each of these there are a set of topics that must be addressed. While each instructor has some freedom as to how to best facilitate learning, at the end of the semester students are expected to have attained a certain level of understanding as the sequential nature of the discipline makes it likely that student proficiency will be probed in the next course by the subsequent professor. The wonderful amorphous nature of symmetry as a theme allowed us to introduce personal passions into the seminar (e.g. poetry and guitar). Rather than being seen as "self-indulgent", students appreciated the personal nature of this "sharing" and, at least some, inherently understood that it represented a model of life-long liberal learning.

## CONCLUSION

John Dewey is often invoked as an inspiration for contemporary conceptions of the liberal arts, and their connection to the institution of democracy. We find inspiration for contemporary liberal arts education in a different aspect of Dewey's thought, however-- namely, his philosophy of elementary education. We have explored the way in which conceptual or thematic focused courses may be used in the liberal arts college setting to great effect. The team-taught seminar course explored the unifying concept of symmetry from multiple vantage points and disciplinary and interdisciplinary perspectives. With symmetry, in all its conceptions, as the organizing principle our course explored such diverse topics as space-time, the nature of reality, matter and antimatter, sex and life, beauty, morality, and meaning and being. We found this theme-based approach to multidisciplinary teaching to be challenging, engaging and freeing for both students and us, in ways that embody the spirit of the liberal arts. We believe that it may serve as a model for others as liberal arts colleges move into the $21^{st}$ century.

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