Editorial Board Thoughts: Arts into Science, Technology, Engineering, and Mathematics – STEAM, Creative Abrasion, and the Opportunity in Libraries Today

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Over the millennia, man's attempt to understand the universe has been an evolution from the broad to the sharply focused. A wide range of distinctly separate disciplines evolved from the overarching *natural philosophy*, the study of nature, of Greco-Roman antiquity: anatomy and astronomy through botany, mathematics, and zoology among many others. Similarly, the Arts, Humanities, and Engineering developed from broad over-arching interest into tightly focused disciplines that today are distinctly separate. As these legitimate divisions formed, grew, and developed into ever-deepening specialty, they enabled correspondingly deeper study and discovery[1]; in response, the supporting collections of the library divided and grew to reflect that increasing complexity.

Libraries have long been about the organization of, and access to, information resources. Subject classification systems in use today, such as the Dewey Decimal system, are designed to group like items with like, albeit under broad overarching topic. A perhaps inevitable result for print collections housed under such a classification system is the physical isolation of items - and, by extension, the individuals researching those topics - from one another. Under the Library of Congress system, for example, items categorized as "geography" are physically removed from those in "science;" further still from "technology." End-users benefit from the possibility of serendipitous discovery while browsing shelves nearby, even as they are effectively shielded from exposure to distracting topics outside of their immediate focus.

Recent years have witnessed a rediscovery of, and renewed interest in, the fundamental role the library can have in the creation of knowledge, learning, and innovation among its members. As collections shift from print to electronic, libraries are increasingly less bound to the physical constraints imposed by their print collections. Rather than a continued focus on hyper-specialization and separation, we have the opportunity to rethink the library: exploring novel configurations and services that might better support its community, and embracing emerging roles of trans-disciplinary collaboration and innovation.

The Library as Intersection

Libraries reflect the institutional and organizational structures of their communities, even as the

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physical organization of the structures built to house print collections mirror the classification system in use. Academic libraries are perhaps most entrenched in the structural division: rather than intrinsically promoting collaboration and discovery *across* disciplines, the organization of print collections, and typically the spaces around them, is designed to foster increased focus and specialization. Specialized almost to the exclusion of other areas of study altogether, in branch libraries of a college or university this division can reach a pinnacle; libraries and collections devoted to exclusive topics of engineering, science, music, and others, exist on campuses across the country. Amplified by separation and clustering of faculty and researchers, typically by department and discipline, it becomes entirely possible for individuals to "spend a lifetime working in a particular narrow field and never come into contact with the wider context of his or her study."[2]

The library is also one of the few places in any community where individuals from a variety of backgrounds and specialties can naturally cross paths with one another. At a college or university, students and faculty from one discipline might otherwise rarely encounter those from other disciplines. Whether public, school, or academic library, outside of the library individuals and groups are typically isolated from one another physically, with little opportunity to interact organically. Without active intervention and deliberate effort on the part of the library, opportunities for creative abrasion[3] and trans-disciplinary collaboration become virtually non-existent; its potential to "unleash the creative potential that is latent in a collection of unlike-minded individuals,"[4] untapped. Leveraged properly, however, the intersection of interests and expertise that occurs naturally within the neutral spaces of the library can become a powerful tool that supports not only research, but creativity and innovation - a place where ideas and viewpoints can collide, building on one another:

> "For most of us, the best chance to innovate lies at the Intersection. Not only do we have a greater chance of finding remarkable idea combinations there, we will also find many more of them.... The explosion of remarkable ideas is what happened in Florence during the Renaissance, and it suggests something very important. If we can just reach an intersection of disciplines or cultures, we will have a greater chance of innovating, simply because there are so many unusual ideas to go around."[5]

Difficult and Scary

The problem? "Stimulating creative abrasion is difficult and scary because we are far more comfortable being with folks like us."[6] And yet a quick review of the literature reveals that knowledge creation, innovation, and success are inextricably linked[7], with the fundamental understanding of their connection having undergone a dramatic shift: "knowledge is in fact essential to innovate, and while this might sound obvious today, putting knowledge and innovation and not physical assets at the centre of competitive advantage was a tremendous change."[8] As our libraries move toward embracing an even more active role within our communities, our organizational priorities are undergoing similarly dramatic shifts: support for knowledge creation

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and innovation becomes more central, even as physical assets shift toward a supporting, even peripheral, role.

Libraries, as fundamentally neutral hubs of diverse communities, are uniquely positioned to be able to cultivate creative abrasion within and among their communities, fostering not only knowledge creation, but innovation and success. Indeed, the combination of physical, electronic, and staff assets can be the raw stuff by which trans-disciplinary engagement is encouraged. The active cultivation and support of creative abrasion, with direct linkage to desired outcomes, becomes arguably one of the most vital services the library can provide its community. Rather than deepening the cycle of hyper-specialization, the emergence of makerspace in our libraries is one example of a trend toward enabling libraries to broaden and embrace that support. Building on the intellectual diversity within the spaces of the library, staff members, volunteers, and fellow community members can serve as catalyst, triggering groups to "do something with that variety"[9] by engaging across traditional boundaries. Indeed, "by deliberately creating diverse organizations and explicitly helping team members appreciate thinking-styles different than their own, creative abrasion can result in successful innovation."[10] Strategic placement and staff support of makerspace activity can dramatically increase the opportunity for creative abrasion - and, by extension, the resulting knowledge creation, creativity and innovation.

Arts Bring a Fundamental Literacy and Resource to STEM

In recent years, greater emphasis on students acquiring STEM (Science, Technology, Engineering, and Math) skills has raised the topic to be one of the most central issues in education. Considered a key solution to improving the competitiveness of American students on the global stage, the approach of STEM education shares the common goal of breaking down the artificial barriers that exist even within the separate disciplines of sciences, technology, engineering, and math - in short, increasing the diversity of the learning environment. Proponents of STEAM go further by suggesting that adding Art into the mix can bring new energy and language to the table, "sparking curiosity, experimentation, and the desire to discover the unknown in students." [11] Federal agencies such as the U.S. Department of Education and the National Science Foundation have funded and underwritten a number of grants, conferences, and workshops in the field, including the seminal forum hosted by the Rhode Island School of Design (RISD), "Bridging STEM to STEAM: Developing New Frameworks for Art-Science-Design pedagogy."[12] John Maeda, the president of the RISD, identifies a direct connection between the approach and the creativity and success of late Apple co-founder Steve Jobs, with STEAM support "a pathway to enhance U.S. Economic competitiveness."[13]

Proponents go further, arguing the Arts bring both a fundamental literacy and resource to the STEM disciplines, providing "innovations through analogies, models, skills, structures, techniques, methods, and knowledge."[14] Consider the findings of a study of Nobel Prize winners in the sciences, members of the Royal Society, and the U.S. National Academy of Sciences; Nobel laureates were:

- twenty-five times as likely as an average scientist to sing, dance, or act;
- seventeen times as likely to be an artist;
- twelve times more likely to write poetry and literature;
- eight times more likely to do woodworking or some other craft;
- four times as likely to be a musician; and
- twice as likely to be a photographer.[15]

From the standpoint of creative abrasion, welcoming the "A" of Art into the library support of STEM disciplines increases the diversity of the library, and by default the opportunity for creative abrasion. From Aristotle and Pythagoras through Galileo Galilei and Leonardo da Vinci to Benjamin Franklin, Richard Feynman, and Noam Chomsky, a long list of individuals of wide-ranging genius hints at a potential left largely untapped by our traditional approach. Connections between STEM disciplines, Art, and the innovation arising directly out of their creative abrasion surround us: the electronic screens used on a wide range of technology, including computers, televisions, and cell phones, are the result of a collaboration between a series of painter-scientists and post-impressionist artists such as Seurat - a combination of red, green, and blue dots generate full-spectrum images in a way not unlike that of the artistic technique of pointillism. The electricity to drive that technology is understood, in part, due to early work by Franklin - even as he lay the foundations of the free public library with the opening of America's first lending library, and pursued a broad range of parallel interests. The stitches used in medical surgery are the result of Nobel laureate Alexis Carrel taking his knowledge of lace making from a traditional arena into the operating room. Prominent American inventors "Samuel Morse (telegraph) and Robert Fulton (steam ship) were among the most prominent American artists before they turned to inventing."[16]

In short, "increasing success in science is accompanied by developed ability in other fields such as the fine arts."[17] Rather than isolated in monastic study, "almost all Nobel laureates in the sciences are actively engaged in arts as adults."[18] Perhaps surprisingly, rather than being rewarded by an ever-increasing focus and hyper-specialization, genius in the sciences seems tied to individuals' activity in the arts and crafts. The study's authors cite three different Nobel prize winners, including J. H. Van't Hoff's 1878 speculation that scientific imagination is correlated with creative activities outside of science[19]; going on to detail similar findings from general studies dating back over a century. Of even more seminal interest, the authors point to a similar connection for adolescents/young adults where Milgram and colleagues[20] found "having at least one persistent and intellectually stimulating hobby is a better predictor of career success in any discipline than IQ, standardized test scores, or grades."[21]

Discussion

The connection between individuals holding a multiplicity of interests, trans-disciplinary activity, and success is clear; what is less clear is to what extent we are fostering that connection in our libraries today. The potential is nevertheless tantalizing: a random group of people, thrown together, is not likely to be very creative. By going beyond specialization and wading into the

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deeper waters of supporting and cultivating creative abrasion and avocation among the membership of our libraries, we are fostering success and innovation beyond what might otherwise occur. The decision to catalyze and foster the cross-curricular collaboration that is STEAM[22] is squarely in the hands of the library: in the design of its spaces, and in the interactions of the staff of the library with the communities served. We can choose to actively connect and catalyze across traditional boundaries.

As the head of a science and engineering library, one of the early adopters of makerspace and actively exploring the possibilities of STEAM engagement for several years, I have time and again witnessed the leaps of insight and creativity brought about by creative abrasion. From across disciplines members are engaging with the resources of the library - and, with our encouragement, one another - in an ever-increasing cycle of knowledge creation, innovation, and success. The impact is particularly dramatic among individuals from strongly differing backgrounds and disciplines: for example, when an engineering student, who considers themselves to be expert with a particular technology, witnesses and interacts with an art student using that same technology and accomplishing something truly unexpected, even seemingly magical. Or when a science student approaching a problem from one perspective realizes a practitioner from a different discipline sees the problem from an entirely different, and yet equally valid, point of view. In each case, it's as if the worldview of each suddenly melts: shifting and expanding, never to return to its original shape. Transformative experiences become the order of the day, even as the informal environment offers a wealth of opportunity to engage with and connect end-users to the more traditional resources of library.

By actively seeking out opportunities to bring art into traditionally STEM-focused activity, and vice-versa, we are deliberately increasing the diversity of the environment. Makerspace services and activities, to the extent they are open and visibly accessible to all, are a natural for the spontaneous development of trans-disciplinary collaboration. Within the spaces of the library, opportunities to connect individuals around shared avocational interest might range from music and spontaneous performance areas to spaces salted with LEGO bricks and jigsaw puzzles; the potential connections between our resources and the members of our communities are as diverse as their interests. Indeed, when a practitioner from one discipline can interact and engage with others from across the STEAM spectrum, the world becomes a richer place – and maybe, just maybe, we can fan the flames of curiosity along the way.

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