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Object Lessons: 3D printing and inter-professional collaboration between the library and the literature classroom

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Abstract: While the digital revolution has been readily embraced by the hard sciences, adoption by the humanities has been somewhat more delayed. A number of factors have prevented wide scale inclusion of technology into humanities coursework including, but not limited to, a lack of training, resources or support for professional development. The new Makerspace at the Drake Memorial Library provided the chance to unite 3D printing technology, pedagogy, literary criticism, information literacy, and historical context into a children's literature course at the College at Brockport. Students were charged to locate a single object from a work of children's literature and to analyze its importance to the plot of the novel or the development of a character. Selected objects were then 3D printed by the library Makerspace. Students then met with a librarian to reinforce threshold concepts set forth by ACRL's Framework for Information Literacy for Higher Education through a unique gamified Harry Potter-themed lesson. Students were able to successfully synthesize the relationship between object and text, culminating in the display of their objects in the library along with their written assignments.

Keywords: *makerspace, 3d printing, children's literature, library research*



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Since the foundational work of Murray's (1998) in *Hamlet on the Holodeck: The Future of Narrative in Cyberspace* and the advent of digital humanities scholarship coming out of places like Virginia, Maryland, and Michigan Universities, humanities professors have become interested in challenging their students (and their discipline) to embrace the opportunities offered by technology for greater efficacy in teaching and learning.¹ Technology has long been a tool utilized by our colleagues in the sciences. McGahern, Bosch, and Poli (2015) point out how their biology assignments were "transformed" by adopting 3D printing technology:

We have begun printing the proteins to help students understand molecular processes like respiration, photosynthesis, transcription, and translation. We have also begun designing incomplete 3D structures that require the student to construct the rest of it, as a way to enhance true learning in a way that memorization of terms and locations cannot. (p. 377)

The marriage between technology and science may seem a natural one, but for the humanities, this type of union has a more troubled history. In an era of massive open enrollment courses and the push toward online instruction, some faculty members have reacted with suspicion, skepticism, and even mild panic to certain technologies. McGann (2004) identifies a discipline-wide "malaise" taking place in the humanities in the face of the digital revolution. He argues that "[f]orce of circumstance today calls us to develop scholarly tools, editorial and hermeneutic, in digital forms. But few scholars are undertaking this work" (p. 411). Lack of training, institutional resources, or support for professional development for teachers can be factors. Keengwe (2011) concurs that "Teachers are constantly challenged to teach with technology yet the teachers themselves are new to various technology uses and may have had no personal experiences as students themselves in technology-infused classrooms" (p. 4-5). These anxieties surrounding techno-pedagogy and techno-literacy, while understandable, have prevented wide scale adoption of some of the goals Spiro (2011) outlines for digital humanities: providing wide access to cultural information, transforming scholarly communication, enhancing teaching and learning, and making a public impact.

To realize the bright, early promise of the digital revolution, perhaps the answer is not more

¹ As a Council on Library Information Resources postdoctoral fellow in 2005, Dr. Norcia gained exposure to the ways in which library and technology (LITS) partnerships with faculty could bear rich fruit. The experience has shaped the pedagogy and archival research for Dr. Norcia in the years since. Thank you to Deanna Marcum, Chuck Henry, and Elliott Shore for making this possible, as well as to the inspiring CLIR fellow cohort and the librarians and technology professionals at Lehigh University Library and Digital Projects team.

training, but more strategic partnering. Through collaboration with a team of librarians and technology professionals, humanities faculty can design assignments and high-impact learning experiences² that will prepare students to take their place in a digital world. This article details one such team-based approach to the creation of 3D-printed objects as a gateway to learning in the literature classroom. After all, libraries and the humanities have a great deal in common, as Vandergrift & Varner (2013) are quick to point out. “Each in their own way, they are tasked with collecting, organizing and preserving our shared, collective memory” (p. 67). The kinds of projects one typically sees from this collective memory rarely, if ever, include 3D printed objects, which is something that makes this project unique.

The idea, however, was originally born of what Posner (2013) calls the anything but unique “service-and-support model.” In April 2014, the library’s 3D Printer Committee presented an overview of 3D printing and modeling technologies to the College’s technology council. The council is a diverse group comprised of students, faculty, and staff across campus, and is charged with advising the College and the Chief Information Officer on directions in future technology and information resources. It was during the committee’s presentation that council chair, Dr. Norcia, was first taken with the idea of incorporating 3D printing into an English class, and to explore the unique application of this technology to the humanities. The first semester the project was executed, the model followed was very close to the dreaded “service-and-support.” Our library’s Makerspace featured 3D printers and the chance to unite technology, pedagogy, literary criticism, and historical context in a meaningful way. Rather than becoming one of the humanities scholars described by Nelson (2016) who do their research in relative isolation, Dr. Norcia reached out to librarians and technology professionals to develop an extended assignment incorporating library research and the 3D printer. The result was a learning experience that enabled students to contextualize objects historically and to display their intellectual labors for the wider campus community.

The adventurous spirit of this enterprise was mirrored by the quest, fantasy, and teamwork elements of the children’s literature course, which revolved around the theme of “Magical Journeys” into parallel, magical worlds: Wonderland, Oz, and even Hogwarts. Many of the characters learn to fly—

² High-impact practices “include such things as first-year seminars, service-learning, writing-intensive courses, learning communities, undergraduate research, and capstone experiences [...] An array of evidence points to the value and utility of HIPs in providing an improved learning experience for all students. In fact, HIPs can provide students exactly the kinds of active and engaged learning experiences that help them develop the skills and knowledge essential for success in work, life, and citizenship” (McNair 4). McNair also includes collaborative assignments and projects, internships, and diversity/global learning activities as those which fall under the umbrella of high-impact practices.

Dorothy in a tornado-borne house and later with sparkly silver shoes; Carrie, Paul, and Charles on an enchanted bed; and Harry Potter on his broomstick. This flight operates as a metaphor for empowerment as the child characters learned to direct their journeys and control the “technology” that enabled their flights of fancy. After discussing these novels over the course of several weeks, students were charged to select a single object from one of these texts and to analyze its importance to the plot of the novel or the development of a character; students also had to situate the object culturally and historically. In other words, how did the object matter to the novel and to the world? Students were encouraged to select an object from these texts that related to big concepts we had acknowledged in our discussion of course texts, such as industrialization, economics, mobility, gender norms, the home, magic, access to education, etc. Students then 3D printed these objects, participated in an information literacy session to locate scholarly books or articles to support their claims about the object’s historical and literary importance, and presented them to one another, some voluntarily displayed object & abstract in the library. By 3D printing their objects and presenting them to one another, students took the objects out of literary context, placing these broomsticks, spectacles, playing cards, bones, mushrooms, etc. in a broader cultural, historical, and campus context. The assignment caught the attention of these technologically savvy students with the 3D printing technology, and directed it back to the research, thereby rescuing the traditional “debates and questions that animate... research” that Nelson (2016) worried had been relegated to the periphery of digital humanities work (p. 131). One could claim, in other words, that the humanities were brought to the digital, instead of the standard digitization of the humanities.

The first time the course was offered, the “support-and-service model” was invasive enough to have involved a here-is-how-you-search-the-database one-shot session. Students weren’t being told something they didn’t know in a way they hadn’t already heard it. In other words, they may have been told, and even shown how to search in multiple databases, but they still didn’t fully understand why this is the only way to get a complete context for their object and develop a full argument. As one of the students from the second instance of the class put it in an anonymous online survey administered after the IL session: “I have had several different lessons in how to research with a database and I still struggle with researching.” Certainly, they would get to the point of understanding the complete picture. How could they not, given the nature of the assignment? But, it goes against a librarian’s creed to watch someone struggle when they could be taught how to do something. Being able to explore not only how their object played a role in the novel, but also in a real-world cultural and

historical context would require a mental flexibility and creativity that would take much longer than a simple fifty minute demo to teach. Some students may never feel like they are completely done with this inquiry. All the better, as that level of analysis plants them firmly in the soil of scholarship and creates the transformation requisite to fully internalize a threshold concept.

It wasn't until the second semester the class completed this assignment that each member of the team truly became a partner, and each partner began to follow Posner's (2013) cue to focus "as much on the process as on the end result" (p. 50). As Posner (2013) contends, "[m]any of the problems we have faced 'supporting' digital humanities work may stem from the fact that digital humanities projects in general do not need *supporters*- they need *collaborators*" (p. 45). Our inter-professional collaboration brought multiple knowledges, skill sets, and perspectives to the assignment and helped students situate their work *horizontally*. Routinely, course assignments are *vertical*—stacked up in a silo of increasing complexity and percentage points as the end of the semester nears; such work often does not seem to directly relate to what is being done in other classes and labs across campus. It is no accident that the ivory tower metaphor has dogged professors and students; the work we do is important, but we have not always done the best job of marketing it to the community beyond the gates, or even within the same colleges with their multiple "towers" and silos of knowledge, what Cook-Sather (2001) calls "the established divisions and hierarchies that structure the production and reproduction of knowledge in traditional college settings" (p. 121-122). Not only does this interfere with productive collaborations, but it also blocks students from the type of high-impact learning that occurs when students participate in an "integrated collegiate environment that promotes connected learning and takes full advantage of the wide range of learning opportunities their college or university offers to its students" (Wawrzynski & Baldwin, 2014, p. 52). Wawrzynski and Baldwin's (2014) research shows that the silo model of knowledge production means that "opportunities are lost to bolster, deepen, and generalize learning beyond the immediate setting where it occurs" (p. 51). These thoughts about collaboration and what the digital humanities can accomplish are echoed by Spiro (2011), and by the Association for College and Research Libraries (ACRL). By involving librarians and technology professionals, this assignment would eschew the silo model and integrate student learning horizontally, linking it to other disciplines such as history, library science, and computer science, as well as literary analysis.

Step One: Choosing an Object

After a review of the assignment, students met in the 3D Makerspace in the library where Systems librarian and Makerspace administrator, Kenneth Wierzbowski, introduced them to the 3D printer, describing its operations as well as the high stakes of its use in the science and medical fields, and its application for campus projects: everything from models of molecules to art students' sculptures to desktop accessories for staff members. Wierzbowski described the different successes and failures found in performing 3D scans of objects to print. The students were then led to a computer lab where they were instructed in how to search to find existing blueprints for the objects they had chosen. Also pointed out were the basics of computer-assisted design (CAD) for the more intrepid students.

During the summer of 2013, the library took receivership of a Makerbot Replicator 2 3D printer from the campus Information Technology department. Soon thereafter, the library formed the 3D Printer Committee to decide what to do with the new printer and to plan for how it would be incorporated into library services. While on first glance it may seem like libraries and makerspaces may not have much in common, there is a closer relationship between them than one might realize. As Fisher (2012) points out "libraries are perfectly positioned to fill a gap in our education system and expand our reach by providing materials, spaces and support for collaborative making." From bibliographies, to writing novels, to term papers, knowledge creation has always been a fundamental part of libraries. While digital humanities often include projects like digitizing archives, coding, and other very specialized knowledge, incorporating 3D printing into the humanities is a relatively new concept. It does, however, provide an opportunity for "tying the library's strengths, people and ideals to tangible products of scholarly work," as Vandergrift and Varner (2013) suggest (p. 69).

At first, the 3D printer and a recently acquired 3D scanner were set up in a narrow anteroom outside of staff offices in the library. While not ideal, the glass enclosed hallway allowed the patrons to observe the goings-on in the space and offered security when the equipment was not in use. As demand for printing and scanning services expanded, so did the need for a larger more permanent home for the equipment. The committee argued its need for such a space, and through meetings and negotiations with campus administration it decided that a permanent Makerspace would be constructed on the main floor of the library. The Drake Memorial Library Makerspace officially opened its doors during the spring 2015 semester, and its establishment made possible larger scale collaboration with the campus community, mimicking the sentiment of Vandergrift & Varner (2013)

that “pairing with the digital push in the humanities, the library can reinvent its place in the cycle and production of scholarship” (p. 68). Although not a very large space, the enclosure boasts three 3D printers, a 3D scanner, four PC workstations, and a filament recycling machine. The Makerspace itself was at the time staffed by between one and two student workers, supervised by Wierzbowski.

While the Makerspace was still in the development stage, the committee determined that it would be best to reach out to faculty members to garner their interest and support in the new technological capabilities coming to the library. This makes sense, as Ryan and Grubbs (2014) point out that “as academic libraries have transitioned from repositories to learning centers, librarians are increasingly encouraged to pursue collaborative and interdisciplinary learning projects” (p. 13). In creating an open invitation to collaborate, it was the hope of the 3D Printer Committee that by the time the new Makerspace was completed, the space would see lively usage as soon as possible.

Prior to this collaboration, the Makerspace had completed hundreds of successful prints requested by individuals, and worked on a large scale 3D scanning and printing project with a sculpture class in the art department. By the Fall 2015 semester, the level of expertise of the Makerspace staff grew to a point that would allow for a larger scale collaboration with the English department. After a brief email exchange in which goals and expectations were outlined, a date was set in late September to bring students into visit the Makerspace. During their visit, Wierzbowski and a student worker provided a brief history of 3D printing and gave an overview of both current and future applications of the technology.

Once the overview was finished, the class moved out of the Makerspace and made their way to a thirty workstation computer lab, which could accommodate each student in the class. Here, students were instructed to log on to Makerbot’s Thingiverse website to begin their search for potentially relevant objects for their assignment. With thousands of models available to download, most students found little difficulty in locating an object relevant to the children’s books that they read. In an unexpected, yet positive twist, one student who was not able to find their desired object on the Thingiverse instead opted to design her own from scratch using Tinkercad, a free web based 3D modeling tool.

After the session in the Makerspace, students were hooked. As class proceeded, one declared proudly to her seatmate that she was planning to give 3D printed gifts to her whole family that year! Though some may question if the public good can be served by gifting a Stormtrooper pen holder to

relatives, the counterargument is that this offhand comment demonstrated a student's willingness to put her classroom learning into dialogue with her broader life. In talking about the assignment later with friends and relatives, she would become an ambassador both for the cutting-edge technology she had used, as well as for the way she had read the literary text, mined it for objects, and contextualized it historically and culturally. This is the first, necessary step toward high-impact learning. Wawrzynski and Baldwin (2014) found that "[w]hen students are able to make the connections between the learning that occurs in the formal academic program and the informal learning that takes place throughout the college experience, then learning can become a comprehensive, holistic, and potentially transformative activity" (p. 55). By drawing students into the Makerspace and the larger thingiverse, we provided students with formal and informal spaces where linked engagement and learning could take place. Or, in other words, the students were encouraged to adopt Vandergrift and Varner's (2013) implication that "making 'stuff' indicates effectively that there is work being done to provide valuable, useful, interesting content to an information-hungry world" (p. 69). The Makerspace, and the assignment at hand, provided the students with Vandergrift & Varner's (2013) "place where scholars can try new things, explore new methodologies and generally experiment with new ways of doing scholarship" (p. 72). Is "try[ing] new things" in the humanities strictly necessary? What risks does it run?

Nelson (2016) criticizes the use of technology and indeed, accuses some digital humanists of employing technology as "a blunt instrument that ignores context" in their projects (p. 134). Digital humanists and librarians alike are often accused of shoehorning technology into their instruction to create something of a Frankenstein's monster with no practical place in the real world. This begs the question: could the assignment have worked without the printing of the objects? While students certainly could have satisfied course requirements to write a paper about an object in a literary text, the actual creation of 3D objects made this process much more effective, and indeed more collegial and fun. Also, employing the use of the technology before the traditional act of research provided the students with a tangible focus around which to build a context. The printing of 3D objects worked effectively because it met the pedagogical goal of engaging students in active, constructivist learning. Constructivist learning, as the name suggests, encourages students to build or construct something, whether it's a website or a poster or a film clip or a presentation. The theory is that the engagement of "doing" deepens student engagement and long-term learning more effectively than rote memorization. As Keengwe (2011) characterizes it, "Constructivism is an educational theory that

emphasizes hands-on, activity-based teaching and learning during which learners develop their own frames of thought” (p. 2). Constructivist theory assumes three basic principles: “learners forming their own representations of knowledge”; “learning through active experience and exploration”; and “learning within a social context, with interaction between learners, peers, and other members of the learning community” (Keengwe, 2011, p. 3).

Projects of this scope can sometimes be professionally risky for the instructor as they require time and energy for creative thinking, careful planning, and room to make mistakes. Yet this investment of energy and resources paid off because students “bought in” to the assignment in a significant way. Research has demonstrated the “strong connection between student engagement and student learning and development” (Wawrzynski & Baldwin, 2014, p. 60). Students became engaged in the project because they had the agency to choose and print their own objects—in effect, selecting the “souvenir” they would take away from the course and the one that would represent their work in the library display case. The selection and production of this “rhetorical form” acknowledges that “[m]aterial culture is a fundamental and powerful force in our lives. Three-dimensional compositions shape attitudes, beliefs, values, behaviors, and identities—all of the ‘stuff’ of culture” (Sheridan, 2010, p. 262). By analyzing material objects from literary texts and then reproducing them in 3D-printed forms, students took ownership of their assignment.

Step Two: Researching and Contextualizing Objects

From the students’ perspective, the heavy lifting for the assignment came when they produced abstracts identifying their objects and beginning to articulate their arguments, incorporating secondary sources to support their claims. They would later develop these abstracts into longer papers, but at this initial stage, they were encouraged to consider the object’s importance to the plot, character, and/or key conflicts. Rhetoric professor Sheridan (2010) insists upon the key role that three-dimensional objects play:

“[In] producing ideologies, values, identities, attitudes, and social structures—the very stuff of culture. This work shows that gender, race, class and other fundamental cultural categories are reproduced by and embodied in material objects, from t-shirts to toys, from coffee makers to cars.” (p. 255)

Once students produced their objects, they had to consider their literary and cultural import, and all the traditional “debates and questions” that Nelson identifies (2016, p. 131). How, for instance, did the

object represent characters' dreams, emotions, struggles, growth, or failures? Then they also had to think about how the object figured historically, culturally, or socially. Did it reflect technological advances? Structure leisure time? Affect daily life? Represent struggles for equality, enfranchisement, or social justice? What is the legacy of the artifact?

To assist students in tackling these questions and embarking on their research, our juvenile collection specialist and instruction librarian, Laura Dumuhosky, led a fruitful library session which modeled good searching strategies for students. For instance, one student who had chosen the broomstick in connection with Mary Norton's *The Magic Bed-Knob* was at sea about how to find critical articles on her book. This highlighted a disciplinary problem: Norton's work has not achieved the critical recognition it merits in the still-developing field of children's literature criticism, a field which has only arisen since the 1970s when it was reasoned that sustained analysis of works for young people was a valuable pursuit. Together, we helped the student to see that the broomstick could represent the larger issue of transportation and mobility, and then the instruction librarian pointed her toward resources that would help her research what women were up to in the 1940s. As a result, the student contextualized the broomstick as symbolic of women's mobility and access to job opportunities during World War II. This student's engagement demonstrated that "[a]ctive learning is primarily concerned with what students do with information as opposed to how much information the teacher and the learning environments can provide" (Keengwe, 2011, p. 2). With Dumuhosky's aid, students were shown that they already had access to almost of quality information, much like Dorothy discovering that she had the power to go home all along. The challenge that made the learning active was charging them to use the information in the service of the paper's object-driven argument.

One challenge to Dumuhosky, and perhaps all librarians, was "making information literate beings from technology savvy students" (Krajewski & Piroli, 2002, p. 178). The Association for College and Research Libraries (ACRL, 2014) is very clear that "[t]eaching faculty have a greater responsibility in designing curricula and assignments that foster enhanced engagement with the core ideas about information and scholarship within their disciplines" (p. 2). The call to this action was clearly understood by faculty member Norcia. Dumuhosky felt keenly the pressure to respond to this clever assignment with an equal level of quality.

Teaching the tools is no longer strictly necessary for most college students these days. Instead, librarians involved in all levels of higher education have begun to focus upon concepts rather than tools. This is why the essential work for most instruction librarians is the ACRL Framework for

Information Literacy for Higher Education, which is built upon six threshold concepts, and will hereafter be referred to as the ACRL framework or simply the framework. For anyone who hasn't read said ACRL framework, a threshold concept is defined as "those ideas in any discipline that are passageways or portals to enlarged understanding or ways of thinking and practicing within that discipline;" these concepts are in turn focused upon "*knowledge practices*, which are demonstrations or ways in which learners can increase their understanding of these information literacy concepts, and *dispositions*, which describe ways in which to address the affective, attitudinal, or valuing dimensions of learning" (ACRL, 2016, p. 2). This complicated model was described above as eschewing the silo model, or horizontal learning. The framework had been so deeply embedded into the assignment itself, it would have been all but pointless to try to cover each threshold concept in the library information literacy session.

If the first round of the information literacy class had demonstrated anything, it was that the students in this course were perfectly poised to embrace the ACRL framework and its threshold concepts. With their pre-chosen and fixed object anchoring them, they could allow themselves the freedom to explore a bevy of new ideas. The framework demands that "students have a greater role and responsibility in creating new knowledge" (ACRL, 2016 p. 2). These students had been given an assignment that forced this responsibility upon them and they were quite literally creating knowledge via their 3D printed object. The idea of a 3D object as knowledge may not initially sound very plausible, but consider the important context of children's literature. Within this field, the idea of *picturacy*, or the study of how images create meaning has been studied by scholars such as Perry Nodelman and Peter Hunt. Within this context, 3D printing operates as a new mode of illustration of a concept. Perhaps Golden (1990) best defines the concept that "printed text and visual image work together to reveal the story. In this visual-verbal context, each medium is modified by the other as a result of the synthesis" (p. 9). Once their abstracts had been created and added to their objects for the display, the idea of separating the text from the object becomes as incomprehensible as reading a picture book with the drawings removed.

The challenge was how to reach the entire class when each student's visual-verbal context was so vastly different. Instead of fighting against the tried and true, the sample search was employed. When preparing for a class like this, many instruction librarians think long and hard about which complex research topic "*it*" would explore, and which and how many databases and different search terms and tactics might be required. Since the class was working with Harry Potter, that provided

fertile ground for a theory lending itself to a complex search.

The use of Harry Potter also provided an opportunity for something that is sadly misused and often shoehorned into sessions: gamification. Gamification can be a big gamble, and is often a hot-button issue among instruction teams. People have their own ideas of what it means to gamify a lesson. As gamification authority, Scott Nicholson (2015) points out, “gamification is a word that has become synonymous with rewards” (p.1). To be clear, gamification in this circumstance is not meant as a fully encoded online virtual instruction session, nor were dice and game board involved. In fact, the idea of developing a comprehensive system of badging and rewards does not support the goals of the course or the research session. Deci and Ryan discovered that giving an external reward will actually *replace* intrinsic motivation over time. Since intrinsic motivation is key to lasting knowledge, this lesson would require a more meaningful gamification.

Nicolson (2015) defines *meaningful gamification* as “the use of gameful and playful layers to help a user find personal connections that motivate engagement with a specific context for long-term change.” (p. 1) Long term change, in the form of information seeking behaviors, was the goal. Students were to walk out of the room understanding that research isn’t a straight line to their perfect source, but an opportunity to find their own voice; databases, while they can be difficult to communicate with, like any good and trusting relationship, are worth the extra effort. These particular students were not novice researchers. They were in an elective, upper level class, and knew some of the tricks and tips already. What they needed was a new, and hopefully deeper understanding of when and why these concepts become relevant during their research. As the ACRL (2016) framework phrases it- that research is iterative, scholarship is a conversation, and searching is a form of strategic exploration.

Since these were intermediate researchers, it was important to cultivate the ability to “design and refine needs and search strategies as necessary, based on search results” (ACRL, 2016, p. 9). More often than not, it becomes the librarian’s job to redesign the need and help determine a new interpretation of what is significant, rather than to find an article that precisely reflects the student’s opinions. This can be more than challenging with many more traditional assignments. Examples abound of assignments with instructions like “you will use this many of this type of source” or “you will respond to this passage” with an unspoken but sometimes implied “with the opinions I have given you in class” to follow. Fewer assignments challenge to students to call out long-standing authorities as potentially biased or privileged, or even drawing attention to the fact that there can be many (often competitive or downright confrontational) authorities as part of a scholarly conversation. Most likely,

they had been told by this point that putting quotation marks around something keeps it together as a phrase. A few had maybe even changed a Boolean operator before out of frustration or curiosity. Did they really understand what these things did to a search, though? Were they aware of how and when certain features were interchangeable between databases; why you might not use a literature database even though you're in a literature class? With these vague concepts set up as sketchy student learning outcomes, the next step was to contact Norcia to make sure that she was on board for a gamified lesson. When approached with the suggestion of trying something new and different from the previous session, the response from Norcia was an enthusiastic "Yes!." This set off a chain reaction of excitement and creativity to which resulted in a lesson that involved several elements of meaningful gamification.

In order for gamification to be meaningful for the player, it should create- or at least encourage- intrinsic motivation, which Deci and Ryan (2004) found required mastery, autonomy, and relatedness (as cited in Nicholson, 2015). Nicholson (2015) further contends that six concepts should be involved: Reflection, Exposition, Choice, Information, Play, and Engagement. Some of these concepts, like reflection, and information, are inherent in good information literacy instruction and consequently don't really have a place in this article. Others are a little less obviously involved, or a little harder to create organically, like play, choice, exposition, and the ever-elusive engagement. In order to understand how they all fit together, they will first be treated one by one, beginning with play.

We all know what play is, and since the intended outcome was a more complete and multifaceted understanding of research, the Sutton-Smith idea that "playing creates opportunities for evolution" was employed (as cited in Nicholson, 2015, p. 5). The hope was that they would begin to evolve their search strategies into what the ACRL (2016) framework calls a strategic exploration, or again, Posner's (2013) focus on the process. In order to complete the tasks set to them they would need to brainstorm, select the best (and not always the most obvious) sources, be able understand that you don't always "get it" on the first try. If you hit what appears to be a dead end- great! That means you've found something new to talk about. It's time to grow or change the scholarly conversation. If play leads to change, and playing toward an end is a part of any game, Nicholson (2015) suggests that allowing students to play is perfectly acceptable when the actual goal is learning. The worst thing that could happen is failure of the intended lesson, and we are reminded that "one of the concepts behind play and games is that they are based in failure; learning occurs by trying something, failing, reflecting, and trying again" (Nicholson, 2013, p. 6). This sounds like a perfect

reason for a librarian to attempt play- because if that scientific method approach doesn't describe the research process, there are several library science degrees that should never have been conferred. The trick was to allow the student the control to change their outcome a bit. That might be a difficult concept for instruction librarians, but it is upheld by Buchanan and McDonough (2014) throughout their book *The One-Shot Library Instruction Survival Guide*. Asking your students to click where you click, see what you see, and trust blindly that this will help them in the future "falls far short of an authentic learning experience." (Buchanan & McDonough, 2014, p. 24). Play as described above can help contribute to a more authentic learning experience, but often only if some or all of the other elements of gamification are involved.

Play without exposition sometimes hinders adequate engagement with the game. In order for the play to feel real to the player, there must be a "world" or narrative setting in which the play exists. (Nicholson, 2015, p. 7) Given their basic familiarity with Harry Potter, the natural choice was to utilize what is called an evoked narrative, or a narrative which already exists (Brand & Knight, as cited in Nicholson, 2015). While this exercise proved for certain that these students were intermediate researchers, many of them had not made any kind of meaningful connection to library resources- including a librarian. By introducing a new authority into the research equation, in the form of not one but two librarians, the support system for the students grew. All three collaborators became a part of the narrative, in a way. Or, rather, our lessons did. To successfully use exposition, one has to feel that the narrative is connected in some way to a real-world setting, as the Stormtrooper pencil holder will attest.

The Makerspace lessons needed no more narrative or exposition than a simple directive to choose their object and make their request. There are few things more exciting than to create a concrete representation of your intangible thoughts. The information literacy lesson, however, needed that extra edge to make them realize that, yes, this IS important work that will help you in this class and beyond. The chosen sample search explored the idea that the sorting ceremony, and by extension the Sorting Hat as a 3D object, represents attitudes about how personality and socioeconomic status affect one's ability to learn. The first step was to brainstorm as a class for alternative search terms, partly because this is always the best first step in research, and because it was the best way for Dumuhosky to guarantee that they would arrive at a few exact terms they would need to use in their searches. All that was left now was to decide how to get them to engage with it.

There are many reasons to rely on group work, not the least of which is time constraint.

Perhaps the most important, however, is the purpose of engagement. The merit of using the jigsaw here lay in grouping students to create “experts” in a specific search, and then regrouping so they could share what they learned. There is strong evidence to support peer learning and teaching, and finding out about the jigsaw method from Buchanan and McDonough (2014) offered what appeared a perfect format³. With the additional layer of the Harry Potter evoked narrative, giving students an “avatar” in the form of a house affiliation worked out perfectly. This was, perhaps the biggest gamble of all-- but how could we expect students to learn from potential failure, without being willing to undertake the same risks and open ourselves to discovery through flailing?

Without further ado, the evoked narrative proper took the following form: Please, pull one slip of paper from inside a magic, pointy hat. Whatever house is represented on the crest you just pulled is now your group. The first student to pull a paper chuckled and hid her paper from her neighbor until that neighbor had pulled as well. Then, they compared and giggled a derisive giggle. *Pause*. The next student pulled a paper and gave an angry “ugh!” *Pause, with baited breath*. “This isn’t my *real* house!” she said to the next student. Relief-- this was going to work! They were already emotionally invested in whatever it was they were about to do. You could hear the buzzing of comparison and indignation as the rest of the class waited to pull out their house designation. It was a truly thrilling moment: engagement through the creation of peer groups. Check!

Each house was given a separate structured search to help add to their “real-world” problem of research, and a designated database in which to become an “expert.” Gryffindor were told to search in a psychology database for personality and NOT disorder. Slytherin took the library homepage, which searches through a discovery layer for everything the library owns. Their initial search was for cognit* with the later addition of socioeconomic status. Hufflepuff were sent to a literature database to search for the exact phrase “sorting hat,” purposefully not getting very many results (more on that later). Ravenclaws were to explore an education database for articles on personality and learning styles. They were specifically not given any extra limiters or changes because they were expected to be the most motivated to follow the last piece of the instructions: while you are searching, experiment! The groups were also reminded that they would need to know enough about their search to be able to share it later with people who hadn’t been there, and would therefore need to agree as a group on what they should do.

³ For more information about the jigsaw method, see “The jigsaw classroom (gummy bear style) video file on youtube: <https://www.youtube.com/watch?v=MpF9t-mrO98>

Enter choice. The encouragement to try their searches again in different ways allowed them flexibility and autonomy they desired as humans, but the structure needed for the lesson to succeed. It wasn't a directive to follow this explicit set of instructions. It was a set of instructions yes- but there was no enforcement. Nobody floated from group to group asking if they needed anything or making corrections. They worked and hopefully, they would explore beyond what was set down in front of them. In the end, the students decided their own level and manner of engagement, as well as how success was measured, just as Nicholson (2015) suggests they should. Each group was asked if they thought their search was successful as it was written, and whether or not anything they changed or added limited or multiplied that success. In fact, the Gryffindor group eschewed the instructions all together! The only thing they did choose to follow from their worksheet was which database to use. It was thrilling! So, then why use a worksheet at all?

Nicholson (2013) warns of games with too much flexibility for students who lack the requisite self-motivation. Just because the lesson was more fun than some of the others they had experienced, the students could not be expected to automatically find a perfect level of intrinsic motivation. Consider the worksheet an insurance policy if you like, or a method for grounding their learning in the real world to balance their exposition. In a bold, Gryffindor-like move, that group had flouted authority and struck out on their own. It actually fit into the lesson perfectly, because the search they tried didn't bring them as many useful results as the prescribed one, which was discovered during the reflection period. All the students were, in fact, more willing to take on their house qualities than had been anticipated.

Predictably, the students who had been assigned to Slytherin House either held their hands and head high or slumped down in their chairs when they were asked to identify themselves; Gryffindors were proud and unafraid of the challenge (even the one who insisted she was *actually* a Ravenclaw); Ravenclaws set right to work when they found their group; but the Hufflepuffs... well, they fell apart. This was one of the few things that will change fairly drastically about this lesson before it is repeated. A reminder will be issued that the Hufflepuff house is known for dogged determination, fair-mindedness, teamwork, and being unafraid to do what is right. Instead, they felt immediately like underdogs who had been set up to lose. Their search was presumably more straight-forward than the others, and when it (purposefully) all but failed they determined that none of their results were worth finding. Not even the dead-on, first search result discussing educational testing and the sorting hat. It's true that they had set up to find *fewer* results, but they were meant to see that just because there

aren't many, doesn't mean the search was fruitless. They were meant to embrace the idea that a lack of abundant resources on your exact opinion means that you get to determine your own path.

The power of the "new" areas for academic explorations is well known to established scholars and researchers. For students, however, it is often frustrating and confusing when they can't find someone who "agrees" with them. It can be difficult to convince them that their voice may have just as much, if not more, validity as those who have already spoken profusely on the topic. In the post-graduate world of research, you have time to develop a certain amount of healthy skepticism, and an understanding that certain voices have been, and in many cases still are, privileged. This level of confidence is asking an awful lot of some undergraduate students, though. They come along through their entire education being told they need to give credit where it is due, and make sure they don't plagiarize. They become so concerned about acknowledging the voices of others, they forget to exercise their own, which can be especially important for literary analysis.

After reading their abstracts and asking some follow up questions, however, a renewed hope emerged that maybe that point had been clear after all. The previous student quote about having been in several information literacy instruction sessions in the past actually concluded as follows: "This one lesson was pretty helpful compared to the others...I think the main concept that stuck out to me was that you won't find an article that explains your exact topic of research... That's probably why I don't really like research." Alright, so not a complete success, but it seems unfair to say that our job as librarians is to convince them to *like* research. It is, however, in the job description to help them *understand* the research process- hence the change to a new framework.

In writing the abstracts and later the papers, students demonstrated a sophisticated ability to focus on an important aspect of a literary text, then to use evidence from the primary text as well as secondary sources to perform a contextual analysis, linking the objects to the plot of the novel and to the social history of the time in which the novel is written. The resulting papers and presentations to classmates were some of the best Norcia has ever seen. One student printed out a pocket watch complete with chain links and then wrote about the watch's importance in *Alice in Wonderland*, locating it as a symbol of the age of industrialization and the frantic busyness that overtook nineteenth-century citizens who were ruled by time, production, and value. The novel also offered the opportunity for a student to print a playing card, the Queen of Hearts, and then use that to talk about the "gamble" of getting justice that English citizens faced in the nineteenth century, as satirized in the courtroom scene at the end of the novel. Another student selected a leg bone and discussed a chapter

in *The Magic Bed-Knob* in which characters visit a Pacific Island and characterize the inhabitants as “cannibals” with the only evidence being the color of their skins. The student discussed accusations of cannibalism within a postcolonial framework, as part of the discursive thrust of the British Empire. Finally, a whole cadre of students focused on the objects in *Wizard of Oz* that the characters desire—the heart, brain, courage, and the ruby slippers that send Dorothy home. They linked these objects to the Gilded Age, the economy’s dependence on the gold standard, the migration away from farms to industrial centers, and the corruption of political leaders during this period.

Step Three: Displaying the Objects

The final phase of the assignment involved the presentation of the objects, first in a classroom setting and then to a broader campus audience. Since studies have suggested that deep learning occurs when students reflect upon their learning process and metacognitive experience, this would be an important part of the assignment. The idea of constructivist learning within community goes back to Keengwe’s (2011) reminder that:

Piaget’s notion of constructivism theory [which] assumes that learners have to construct their own knowledge, individually, and collectively. [...] The role of the community, other learners and instructors, is to provide the setting, pose the challenges, and offer the support that will encourage construction of knowledge. (p. 2)

To satisfy the goal of constructing knowledge collectively, students united literary and historical contexts by presenting their freshly printed objects to their classmates, and passing them around for others’ inspection, input, and approval. Without students’ discursive remarks, listeners may have wondered what a theater marquee or an owl or shoe had to do with a course in children’s literature. This gave students’ remarks important stakes because they had to introduce the object and then make it meaningful by assigning it literary and historical importance. This type of discourse and reflection are what Wawrzynski and Baldwin (2014) identify as “a key task for educators” seeking to make education more effective, integrated, and engaging for their students.

The goal for the classroom presentation of objects was to have students engage in a casual discussion rather than a formal presentation. Every student spoke without prepared notes and then went on for several minutes, discussing his/her process, the choice of object, and how it made him/her think differently about the text. They spoke with such authority and engagement that two student panels for conference presentations in the following semester were formed, which students were very

eager to participate in despite the extra work it would involve for them (and without the reward of extra credit or a final grade since these presentations would take place long after the dust had settled on the semester). Their willingness to participate in a scholarly conference affirms the suggestion from Krajewski & Piroli (2002) that active learning is the difference “between lessons that were drudgery and those that were exciting and engaging. The point of this teaching strategy is to infuse students with enough enthusiasm to encourage them to become active partners in the learning process” (p. 178). Students became “active partners” in the creation of their objects and the focus of their papers, and then they went on to represent themselves and their work in professional venues.⁴ The benefits of this participation go beyond two semesters, however. Brownell & Swaner (2009) assert that “Students who participate in *undergraduate research* are more likely to continue on to graduate school, are more satisfied with their overall educational experience, and demonstrate greater problem-solving and research skills” (p. 27). In an era in which enrollment numbers are declining and the workplace is demanding more critical-thinking skills, assignments that challenge and engage students are necessary. Research has shown that “students who participate in these activities consistently persist at a higher rate than those who do not” (Brownell & Swaner, 2009, p. 27). Furthermore, as Sheridan (2010) puts it, the assignment helps with this challenge an engagement:

Students to feel authorized to engage in as wide a range of rhetorical practices as possible [and to]... think of themselves as authorized to engage 3D rhetorical practices more generally. They will think of material culture as a domain that they, to some degree, own. (p. 261)

This ownership of material culture is increasingly important in helping humanities students participate in broader campus dialogues about the practical value of a liberal arts education.

After reflecting on this learning in the classroom setting, students were offered the opportunity to have their objects arranged in a display case in the library alongside copies of course texts and the written abstracts they had produced about the objects. The library displays typically include books of a certain theme being highlighted, but this display was different. It opened a door to student work being highlighted, and the library has enjoyed several other student-generated displays since! They are incredibly well received by all the library patrons, and the 3D objects in particular produced several

⁴ Six students presented at our campus-wide Scholars Day, a conference showcasing undergraduate, graduate, and faculty research. Five different students presented their research at Mornings with the Professors, a program in which members of the broader community pay for a series of lectures on Tuesday mornings throughout the semester. One student presented her work at the National Conference for Undergraduate Research in Memphis, TN.

wonderful questions.

Inclusion in the library display case was a particularly exciting part of the process because literary studies are often “invisible” to other disciplines beyond the written paper produced at the conclusion of the course. Unlike their colleagues in the sciences and the arts, humanities students are not easily photographable when they are in the process of doing literary analysis—they cannot be seen *thinking* or *creating* as those who are involved in collecting specimens from marshes, peering through microscopes, dancing on a stage, or sculpting a clay bust. What this project did for those students is to make their literary work visible, to offer a tangible manifestation of that intellectual exercise. As Fitzpatrick (2012) has it, “[c]losing our work away from non-scholarly readers, and keeping our conversations private, ... might protect us from public criticism, but it can’t protect us from public apathy, a condition that is, in the current economy, far more dangerous” (as cited in Vandergrift & Varner, 2013). Vandergrift and Varner immediately add that “[l]ibraries are well positioned to help the humanities open up to the broader public” (p. 70).

Inclusion in the display cases also publicized this work to other campus constituencies, an important step in advertising the value of collaborative work across disciplines and professions.⁵ The display case showcased the products of this pedagogical philosophy, and on a larger scale it underscored that intellectual endeavors are a public act and part of the larger, interdisciplinary campus discourse. The results support a vision of an “integrated collegiate environment that promotes connected learning” (Wawrzynski & Baldwin, 2014, p. 52). These “object lessons” enabled and empowered students to connect literature with historical research and digital technology, relying on knowledge professionals from the literature classroom to the library—from the computer lab to the research databases to the Makerspace.

The stakes of “prepar[ing] active learners for a digital global economy that is characteristic of the 21st century” (Keengwe, 2011, p. 2) cannot be underestimated. It is also not unprecedented. Sheridan (2010) grounds the importance of 3D printing within the historical stream of discourse, pointing to a shift from the codex to a growing awareness of other texts including film, websites, and comics (p. 258). Sheridan (2010) asserts that “The rest of the world is moving on to the sophisticated multimodal rhetorics of video and new media, with or without us” (p. 258). Rather than frame these advances through fears of extinction, faculty need to see them as opportunities to foster deep, relevant learning for their students and cross-professional partnerships with librarians and technology

⁵ Krajewski cites the importance of marketing to gain buy-in for active learning experiences (184).

professionals. This means taking advantage of the broader college setting and the different knowledge and skills sets of colleagues. McGann (2004) considers the situation historically, noting that humanities scholars see the “explosion of digital textualities” but asks, “how prepared are we to emulate the humanists of the fifteenth century who were confronted with a similar upheaval of their materials, means, and modes of knowledge production?” (p. 411). We live in a shifting world with increasing access to once-specialized technology of production—think about the production of videos from cell phones or how desktop uses routinely make choices about layout and color which used to be the province of graphic designers. This “fundamental literacy” of “three-dimensional products” is what Gershenfeld, Director of the Center for Bits and Atoms at MIT calls a “fundamental ‘literacy’ practiced by everyone” (as cited in Sheridan, 2010, p. 250), and it matters immensely as our students go out into the world. As McGahern, Bosch, and Poli (2015) note, “Visual aids are often necessary to make a critical point during a job presentation, when giving instructions to coworkers, or in a classroom, and therefore this is a unique skill to possess upon graduation” (p. 376). By equipping students with digital literacies, confidence in their abilities to research, evaluate, and then present information, we are helping to create new humanities professionals, digital citizens who show that liberal arts learning is learning for life.

Challenges, Limitations, & Moving Forward

At the close of the initial Makerspace search session, staff found themselves with about thirty objects to print with a deadline of just a few short weeks before students were to present their objects to their classmates. The greatest challenge in completing the project on time proved to be the logistics in managing each student request. This was especially challenging as the Makerspace was staffed by a skeleton crew of two persons that semester. It was quickly determined that the best way to keep track of the prints would be to use the existing 3D printer project submission form. This web form was previously developed to keep track of individual printing requests. It logs the submitter’s name, contact information, link to the 3D model, and dimensions of the print. The only modification needed to the form was the addition of a comment field, so that students could identify that their request was part of this class project.

Each project was printed in the order it was received with close attention paid to the color and desired dimensions that each student specified in the submission form. Many students were unsure of what appropriate dimensions for their object should be, while others requested a size that would be

much too large and time consuming to print. Given our many hours of previous experience, we assured them that we would give our best guess to the appropriateness of the object's size unless they specified otherwise. One way to address this would be to bring a number of rulers and example prints to the computer lab while students searched for their objects. Bringing measuring instruments and setting a size limitation would not only help the students better understand what their final object would look like upon completion, but would assist Makerspace staff during the production process.

While the 3D printers in the Makerspace have the capability to print multiple objects of the same color at the same time, our experience showed that such an approach usually lead to failure. The printers in the Makerspace are consumer grade machines, and as a result are often more finicky than their more expensive counterparts. When printing multiple objects at once in the Makerspace, if one of the prints fails, the rest have to be discarded as well. This ultimately wastes more time and materials and although single object printing is more time consuming, it has proven to be much more advantageous in the long run.

The most crucial change would be to increase the amount of time given to complete the prints. Although we were able to successfully deliver the printed products to the class on time, the timing came down to the wire due to the typical issues involved with 3D printing and the limitations of the Makerspace's equipment. As each print was finished, Makerspace staff sent an email indicating that the project was available for pickup from the library circulation desk. With the deadline met and each student project successfully printed, the project produced a satisfactory outcome overall on the part of the Makerspace. On the day of the class presentation, the last remaining prints were picked up to take to the class. This caused some anxiety among the students as they had been waiting for an email to let them know that their project was available to be picked up. Although an email was sent to those remaining students informing them that the objects would be brought to class, this was a less than ideal way to communicate with the students and inform them in a timely fashion of the situation. This could have been remedied with more effective communication and more time to complete the objects.

There are a few things to change for the next information literacy lesson as well. In addition to reminding Hufflepuff house members of their many noble and wonderful qualities, they might given a more exciting search, with the more precise search as a brief reflection at the end. Also, since Nicholson (2015) suggests that an important part of choice is allowing for students not to participate at all, there may be a small group of students allowed to do things their own way. Roles will be assigned to members within each group, which should not only create leaders and add to the ease of searching,

but will also make regrouping much simpler. Instead of having to explain to students who are reluctant to leave their newfound brethren how to regroup, all the 1st years can simply be put into one new group and so on.

One other thing that was cut from the information literacy session due to time constraints, that will be a higher priority in the future, was to ask each group to choose one source by consensus and create an annotated bibliography together as a class. This might have helped to drive home a few more of the framework knowledge practices like using different types of sources and better understanding authority and privilege.

As for the assignment itself, next time, they will be pushed to consider the fetishization of the object in the wake of commodity culture. How does the production of such commodities connect us to the sites where they are produced, the ways they are marketed, and the means by which they are available? Think about the meaning of objects and their availability over the last fifty years—from the Sears catalog to the Amazon interface. The way we encounter objects, purchase them, review them, and use them to connect to others is an important consideration that reveals so much about our own cultural moment. The students who wrote about *Harry Potter* looked at the mail delivered by owl post and then connected that to the communication revolution in the 1990s with the advent of email; or, another student discussed the rat Scabbers and how its unsightliness was representative of attitudes about poverty and social class, issues which Rowling herself faced as a low-income single mother. The papers were fascinating, original, insightful, and they showcased students' investment in their chosen topics and their desire to acquire expertise to support their reading of the objects. In a future iteration of the assignment, students will be encouraged to connect their object lessons to the cultural and historical moments in which the novels were written as well as the one in which we study them.

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