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2016

## Reconstructing Meucci's Legacy: A Museum-School Internship Collaboration

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Macula, N. (2016). Reconstructing Meucci's Legacy: A Museum-School Internship Collaboration. *New York : Bank Street College of Education*. <https://educate.bankstreet.edu/independent-studies/409>

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Reconstructing Meucci's Legacy:  
A Museum-School Internship Collaboration  
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Submitted in partial fulfillment of the requirements of the degree of  
Master of Science in Education  
Bank Street College of Education 2016

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A Museum-School Internship Collaboration

Abstract

*Excellence & Equity* calls for partnerships between museums and schools that will better utilize the strengths of both institutions to encourage learning and fulfill the social calling of museums (American Association of Museums [AAM], 1992). Meanwhile educators are called to meet 21<sup>st</sup> century learners head-on using “constructivist, project enhanced, collaborative, and authentic curricula” (King, 1998, p.1). With these principles in mind, the museum-school partnership becomes a viable remedy to meeting this social obligation of museums while affording schools opportunities to better engage new learners. Through the lens of a particular growing museum-school partnership between the Garibaldi-Meucci Museum and Staten Island Technical High School, this study will combine a program progress narrative with similar studies and narratives in order to advise the future of the program and bring about new considerations for future museum-school collaborations. Beginning with the goals of both institutions, initial questions regarding program design will be addressed. From that point, the program as it progressed from July-August 2015 will be detailed. In delineating the particulars of this program, current strengths will be discussed, which will be capitalized upon with more organized and cohesive future design.

## Table of Contents

|   |    |
|---|----|
| Introduction  | 4  |
| Program Goals of both Institutions                              | 7  |
| A Discussion of CTE Standards                                   | 9  |
| Analyzing the Nature of Collaboration between both institutions | 12 |
| Narrative of Current Progress in Practice                       | 19 |
| Progress Analysis and Programmatic Considerations               | 24 |
| Role of Faculty Liaison - A Reflection                          | 28 |
| Recommendations   | 32 |
| References  | 36 |

## Introduction

In a climate of repurposing education toward college and career readiness, teachers and administrators seek new methods by which they can utilize the resources around them to meet their students' educational needs. In 1998, Kira S. King acknowledged that schools were "being challenged to adopt constructivist, project-enhanced, collaborative, and authentic curricula" with which students could better meet the demands of the world of the "Information Age"(p. 1). This still holds true today, as demonstrated by the repeated calls for learning which better serves all students. Echoing King's sentiments, Jessimi Jones (2014) calls for "essential 21st century skills" which involve "creativity, critical thinking, collaboration, empathy, problem finding, and question development" (p. 176). As educators begin to realize the increased interconnectedness of the world and how it is changed by technology, they recognize how valuable these skills truly are.

At the same time, museums face the challenge of attracting new generations and utilizing their collections and space to embrace the educational possibilities that they present to their communities. In *Excellence and Equity*, the American Association of Museums ( [AAM], 1992) identified that “many museums could be more effective in working with formal and informal educational institutions and organizations as partners in carrying out their public service” (p. 15). It is recommended that this is remedied through action oriented toward “[strengthening] the relationships with administrators, school boards, and other educators to develop better museum-school partnerships” (AAM, 1992, p. 22). It is with this action that it is hoped that “collaboration enhances the

ability of each participant and provides a unified, focused mechanism for achieving individual goals” (AAM, 1992, p. 21). As institutions of informal education, they find themselves more likely to be able to focus on their own desired learning goals while ultimately benefiting students for their future endeavors.

Essentially, both institutions recognize innate educational and organizational needs that must be addressed. It is in the intersection of these institutions' goals that one can begin to witness the potentialities of purposeful educational design which would ultimately benefit both institutions and their constituents. Such design represents a goal which is far from easy to achieve, though the benefits potentially reaped become manifold. John Dewey and many educational psychologists after him called for authentic learning opportunities which immerse students in practical experiences which help to form individual meaning, and it is through such partnerships that this vision can be reached. In such an environment, “process is privileged over content” and measurable outcomes become secondary to critical emergent tasks which may enrich students’ experiential learning (Wylder, Lerner, & Ford, 2014, p. 85). Through such methodology, students can be immersed in a rich, constructivist environment in which they will further refine content knowledge and internalize ability to meet real world applications using it.

With these principles in mind, this discussion will attempt to analyze the implications of already executed educational design and inform future practice through advising curricular design. From July - August 2015, Staten Island Technical High School (SITHS) engaged in collaborative educational and exhibition design with the Garibaldi-Meucci Museum utilizing 8 interns from the school, 3 teacher project managers, and select staff of the museum. This collaboration would proceed through

tasks in the school's Computer-Aided Design (CAD) lab as well as the museum itself which was located about 20 minutes away by car or 30 minutes by bus. Internship for the museum would form a small portion of the project-based internships that the school offered during the summer to willing students. Other projects included serving on a Health and Wellness Committee with local doctors and school staff to design initiatives that would better public health and a STEM camp where students would serve as facilitators in different engineering experiences for children aged 7-12.

Deriving its fame primarily from being a site where Giuseppe Garibaldi rested to recover after a failed campaign in Rome, the Garibaldi-Meucci Museum was opened in 1956 after 49 years of preservation of the historic house by the Order of the Sons of Italy (Garibaldi-Meucci Museum, n.d.a). Its collections range from Antonio Meucci's possessions that were preserved to relics of Garibaldi's stay to collected ephemera from the Order of the Sons of Italy in their efforts to preserve local Italian-American history. Located in the neighborhood of Rosebank after the relocation of the house from an adjacent neighborhood, the museum is primarily visited by tourists and school groups. From anecdotes from the curator and various other staff, one of the biggest audiences that the museum receives comes from Italian tourists who view the site as a site of pilgrimage, some moved to tears knowing that Garibaldi's respite at this site provided him the opportunity to later work toward real unification of Italy.

With the general concept of celebrating Meucci as an inventor as the overriding vision for the exhibit, participating interns had taken to the task diligently with great support from the museum. Student interns exhibited research and problem-solving skills as they met the demands of this job with real expectations of creative output. Resulting

from this experience, they have created reverse-engineered plans for Meucci's telephone, a layout for a proposed new exhibit, exhibit label text, 3-D models of the components of Meucci's phone as well as a candle mold, and candles manufactured utilizing the mold. Though these accomplishments may seem manifold, they have only begun to delve through the layers of the museum's ambitious designs. During the school year, further vision and guidance could allow the student interns to continue to manufacture, design, research, and evaluate this new exhibit. Initial goals have been identified as a) the completion of an interactive phone prototype, and b) the manufacture of candles to provide revenue for the museum and the project. Additionally, future plans include design demonstrations of experiments, such as electroplating, which Meucci performed. By the end of the school year, it is anticipated that the interns will aim for a completed, built exhibit that would then require evaluation and programming design. For the purposes of this study, description of the project, resulting commentary, and reflection will encompass the initial stage of the project from July - August 2015. Focus of this discussion will tend toward the potential exhibited by the program in its then amorphous design and how that may begin to be shaped into a more coherent and beneficial museum-school partnership. It is with hope that funding for the program continues to be able to see it through to this more enlightened stage for the years following.

### **Program Goals of both Institutions**

From the beginning, the Garibaldi-Meucci Museum has sought to very simply "collect, preserve, and exhibit material relating to the lives of inventor Antonio Meucci and legendary hero Giuseppe Garibaldi" (Garibaldi-Meucci Museum, n.d.b). Though it



has exhaustively demonstrated the achievements of Giuseppe Garibaldi and exists as a pilgrimage site for Italian tourists, as the home is where Garibaldi rested and recovered before winning independence for Italy, the museum has somewhat neglected Meucci, who was posthumously declared inventor of the telephone in a 2002 Congressional resolution (HRes. 269 on Antonio Meucci), in its exhibitions. This imbalance remains, despite the building being Meucci's home preserved and relocated in order to provide a more stable neighborhood for preservation. Currently, Meucci's main invention exhibition constitutes a corner of the museum which is dwarfed by a nearby gallery for the exhibition of local artists. Realizing this neglect, the museum has sought to further expand their exhibition on Meucci and present the hidden genius of his work, which until now has been largely outside of popular consciousness. As part of the program with SITHS, they have sought student intern aid in designing an interactive exhibition utilizing 3-D printed reverse-engineered fabrications of the inventions and potentially simple educator-led experiment demonstrations. This project would be the beginning of a longer partnership in which the school and museum would design components that demonstrate the works of other notable inventors of Italian origin, fulfilling the other goal of the museum in educating the public regarding Italian American heritage.

Recognizing the museum's goals, SITHS seeks to further its own mission in providing work-based learning to students in order to fulfill its Career and Technical Education (CTE) curriculum. Knowing the realistic opportunities afforded by the museum's goals, the school aims to provide students whose output and process will be valued throughout the duration of their work. In designing this collaboration, the school hopes that the project's output ultimately result in the discovery and creation of student-

led tasks which promote collaboration, research, and trial-and-error planning with their peers. Through the opportunities afforded by the internship, students will be thrust into a realistic work environment with realistic expectations. This furthers the cause of experiential learning for students and would provide a model for future collaborations, which could eventually be integrated into all students' learning within the school.

At the intersection of these institutions' goals lies the heart of the internship program. Both museum and school are engaged in a mutually beneficial partnership which will further the educational mission of both and allow for future growth on the part of the institutions' offerings as well as the individuals involved.

### **A Discussion of Career and Technical Education Learning Standards**

Although not drafted at the outset of this project, connections and pathways to essential standards for student learning can be understood within the implicit and later explicit design of this project. This discussion of standards will help demonstrate the internship's potential for further learning opportunities and fulfillment of school-related goals with the achievement of CTE principles for all students. Throughout this section it will be assumed that all standards are geared toward the Commencement level and Experiential level of the CTE standards, appropriate to both the age group and the nature of the internship.

The second CTE standard of Integrated Learning is best embodied within this internship opportunity, calling for utilization of academic skills in the workplace and understanding the connection between what is learned in the classroom and how it can be applied to future careers. This helps students understand the connection between what

they are learning and why they are learning it. Students demonstrate this standard through pursuing some form of project in which they engage in hands-on application of what they have learned and find a way to communicate these clear connections through some form of audio or visual presentation (New York State Education Department [NYSED], 2011). Utilizing historical research as well as scientific knowledge to better understand Meucci's invention, student interns will make these real connections between exhibition design and historical reconstruction with skills and concepts they learn every day in Social Studies, Science, and Engineering courses. They will then express this connection through the exhibition they help craft alongside the museum curator.

As part of CTE standard 3a, students engage in tasks which utilize their basic skills of reading, writing, and performing math, more focused observational thinking skills that rely on problem solving, personal qualities such as self-management, interpersonal skills to navigate varying settings and groups of people, use of technology to problem solve, figuring out systems of information management for easy modification and retrieval, time and material management, and understanding systems of goals toward improved performance (NYSED, 2011). As student interns begin to work with each other and the proposed task of crafting the exhibition, each of these different skills will be observed. Basic skills and problem solving skills will be called upon to initially consider how to address the dearth of information and material presented about Meucci. When the student interns begin to work with each other and the museum they will be challenged to maintain good interpersonal skills to maintain their relationship with the museum, demonstrate their progress, and best divide tasks among each other. With given tasks, self-management will become apparent as they need to plan out their individual tasks and

organize their own work to become part of a greater body of work. To facilitate good communication and research, they will need to figure out what resources they need to create for collaboration and management of new information and products of their engineering design. Finally, as they begin to produce tangible products for the museum, they will need to figure out a manageable schedule for their production as well as how the standards of that production best align with the museum's own goals to create a coherent and professional exhibit.

In addition to recognizing the connection between academic subjects and potential work, within standard 3b students are also challenged to engage in real experiences which will help demonstrate competencies in a variety of given facets of a plethora of potential career categories. Career Categories relevant to this task include Engineering/Technologies and Arts/Humanities (NYSED, 2011). These real experiences in engineering, particularly with sophisticated equipment such as 3-D printers and CAD software will impart to students necessary skills of operation and care for the tools of careers in engineering. Additionally, they will initiate product development through the designs which will eventually part of the museum's collection and presentation in its exhibit. Through accompanying material to that which is produced through engineering tasks, students will craft exhibit text to accompany research and development which will demonstrate necessary skills of communication in the arts and humanities as well as exemplary personal management by maintaining a high standard of explanation and research. With hope, they will also engage in activities which will determine the course of the exhibition, deeply involving them in the creative process and one day get to make

the results of their experience public, demonstrating their competency and dedication through the finished exhibition.

### **Analyzing the Nature of Collaboration between both Institutions**

To best place this partnership in a greater context and understand its components that need targeting for more coherent design and consideration, one must first begin to define what is necessary to best bring about effective museum-school partnership. From various sources, a communicative framework that acknowledges the desired institutional outcomes while acknowledging how far the institutions wish to define their partnership becomes key to creating effective practice. Although the literature concerning museum-school partnership does not always acknowledge internship programs such as this one, the knowledge that has been gained through these studies can still be applied broadly to any museum-school partnership. Focus on these programs, rather than solely on internship programs, becomes important as well due to the nature of collaboration having targeted educational outcomes that internships do not always necessarily define as they often are dictated by the needs of the client rather than the educational institution.

In her study on museum schools, Kira S. King (1998) defined a continuum with which to characterize the nature of collaboration between schools and museums. This continuum included steps which reflected increasing roles and interconnectedness on the part of school and museum administration and professionals, with particular focus on educational design and outcomes. Moving from the institutions as distinct entities to overlapping entities, the stages of increasing collaboration were identified as institutional cooperation, strategic alliance, and virtual corporation. Institutional cooperation maintains the distinct nature of the two institutions and reflects the professionals involved

continuing their distinct roles yet interacting with each other and potentially informing each other's practice. Strategic alliance begins to shift the nature of interaction to both institutions having a hand in designing curriculum and increasing the frequency and malleability of each other's interactions with the ultimate realization that the institutions are still distinct. Virtual corporation demonstrates an institution that has resulted from the synthesis of school and museum contexts, resulting in a partnership which successfully incorporates professionals from both settings in design and execution of curriculum (King, 1998). Thus, as institutional lines become more blurred and professionals of both institutions align their goals and programmatic design, their interconnectedness increases and they begin to become what King would characterize as a 'museum school'.

Overall, given the design and nature of this initial partnership between SITHS and the Garibaldi-Meucci Museum, one begins to see demonstrated institutional cooperation with the hopes of a strategic alliance in time. As will be demonstrated by the progress narrative, teachers and museum professionals retained their distinct roles yet allowed the student interns to move from institution to institution with ease, given the extracurricular nature of the program. As the school year iteration of this program approaches and the immanence of incorporating this project into a CTE-based curriculum, this design will need to be refined to better fit educational goals and push for a more strategic alliance as school and museum staff begin to strategize on how to push forward toward final outcomes for the project.

Additionally, elements of other museum-school collaborations prove most interesting for consideration of the programmatic design. At times, they reveal how one can begin to concretely characterize the nature of this collaborative project. In

considering the nature of museum-school collaboration during the planning and execution of field trips James F. Kisiel (2014) states,

Museum educators most certainly have ideas as to what successful field trip programming looks like as well. But are these perspectives similar to those of teachers? If expectations for success are not aligned between these two groups of educators, there then exists the potential for conflict and missed opportunities. (p.344)

This raises the importance of communication between museum and school professionals and highlights the necessity of elaboration on institutional goals from both sides as a good starting point for collaboration. Effective realization of this communication stems from the elaboration and identification on the nature of success, with regard to the vision of both institutions in project design. In order to best inform future design, this vision of success will need to be further defined beyond the creation of an exhibition and turn toward more student-centered goals as well as institution-centered goals. Of benefit to the institutions was this initial experiment which has begun to demonstrate that there exists certain opportunities for building student-centered growth and application of learned skills and material.

In order to best frame collaboration Kisiel (2014) identifies four main categories of interaction from which success can then be defined through intersection of teacher and museum professional expectations: capacity, authority, communication, and institutional complexity. Through better realization and elaboration on these factors and their inherent challenges, schools and museums can then create an atmosphere in which they are both oriented towards execution of well-targeted educational programming. Capacity refers to logistical and resource-based considerations of programming. Institutions cannot escape their limits and must make the best use of their limited resources and capitalize upon

available resources, such as time and effort. Authority acknowledges the multitude of boundaries implicit in the inter-relationship of institutions and comments both on administrative expectations of docents and teachers as well as interaction and establishment of equitable relationships between professionals of similar level across institutions. Communication, as expected, confirms the challenges inherent in asynchronous schedules of institutions as well as the need for boosting of awareness of offered programs and collaboration of docents and teachers. Finally, institutional complexity acknowledges the outside forces which begin to shape interaction between institutions such as acknowledging that not only teachers and docents are involved but rather reservationists, parent-teacher associations, volunteers, museum financiers, and various others make up the framework that affects the overall character of collaboration (Kisiel, 2014). These main principles establish good targets for future consideration and a basis for understanding the relationship between SITHS and the Garibaldi-Meucci Museum.

Using these categories, certain factors can be identified as worthy of further consideration. As the project continues, limited resources will become one of its main challenges. All funding has come from outside the two institutions and the nature of how much each institution can contribute in terms of financial resources has not necessarily been clarified. This touches upon challenges of capacity and complexity. As the institutions navigate their respective boundaries and connected contexts, they will need to seek funding through various means. Throughout the project, both institutions have maintained strong communication, but various challenges may arise when taking respective visions and beginning to create one coherent vision which can be embraced by



both school and museum. Despite these other issues, authority seems to be the least challenging of the situations, given the small cohorts used for this project and the ease with which professionals from both institutions have worked together, authority in the execution of the program may not be a problem at all. However, navigation of the administrative demands of both institutions may prove daunting and reveal previously unconsidered issues regarding authority. Given these main criteria, it becomes clear that various challenges have yet to arise but can be anticipated given the nature of the project so far.

In addition to Kisiel's recommendations for more coherent collaboration, Lorraine Foreman-Peck and Kate Travers (2013) utilized action-research methodology which calls for individuals to identify a problem, research methodology to deal with the problem, and then adopt research methods to measure whether the problem has been addressed. For them the problem became the outreach of museums to schools in a climate of heavy accountability. Such methodology is championed by these authors as contrary to the more common practice of data-gathering and meeting measurable goals which may not necessarily connect with ultimate educational outcomes but rather logistical outcomes. In this climate, justification of a collaborative program can be a point of frustration when the school looks to measurable goals and standards. When the focus is on numbers for either side, methodology turns broad and generic, discounting the unique potential that museums afford students. In the case of partnership with Garibaldi, due to the program being one of cooperation rather than admission-based, this creates a unique experience and experiment in which those involved can record the progress and begin to better design and steer the experiences toward desired outcomes. Outcomes which highlight the

unique opportunities afforded by the museum, as well as the resources offered by both institutions. This will become clearer in the narrative of the student interns' progress.

Although, these broader theoretical considerations make for more thoughtful and effective programmatic design, the entire process cannot be divorced from logistics. Such projects are admittedly very difficult given the *often* tense situation regarding accountability in education. Major issues derive from the valuing of school interaction with museums. Challenges such as teacher coverage and policymaker confidence in 'time away' from classroom instruction erode the willingness of teachers and schools to participate actively with museums. Many schools were labeled during a study concerning school collaboration with museum educators for field trips as 'non-active' and declined all attempts at contact due to these reasons (Foreman-Peck & Travers, 2013). Reinforcing these concerns, Bryna Bobick and Jenny Hornby (2013) connect schools' goals towards a test-based curriculum as a barrier to justification of using museum visits to improve student learning and achievement. Thus the push for accountability and exam preparedness coupled with misconceptions of what learning looks like, constructs a context in which one must make the case for the value of museum learning while facing the reality of needing to produce such a value in standard, tangible measure, so that any individual can witness it happening.

Converse to these issues, SITHS through the direction of its CTE program has begun to measure learning in career-preparedness. Through engagement in activities focused on the preparation and execution of practical experience, students are expected to begin considering their chosen direction in life through having as many opportunities as possible. Partnership with institutions and organizations becomes necessary in order to

generate these opportunities. One could argue that the school's relative performance puts it in a position insulated from heavy anxiety over test-based accountability and thus able to pursue such policy from a place of great academic privilege.

In addition, the internship nature of this project silences some of the concerns that would otherwise exist. These internships have the potential to “build effective bridges between theory and practice, and study and the workplace” (Hoy, 2011, p. 39). Providing alternate ways to gaining work experience and allowing students to see the connections between skills gained in the classroom and future work-related endeavors, more authentic learning and benefits for all institutions involved is sure to result (Hoy, 2011). In particular, the absence of work experience for youths in general is troubling as given the conclusion of Marian Hoy’s (2011) study of various internship programs with collections-based institutions, without these opportunities, students can be perceived as ill-equipped for the working world. In addition, the obvious benefit of being able to, in the future, recruit ready, experienced individuals becomes markedly more attractive (Hoy, 2011). Thus, the perceived benefits of a program such as this to prospective employers demonstrates underlying incentive to continue such programs.

Representing the beginning of a promising collaborative future, both institutions find themselves with unique challenges to address as time pushes forward. With the validation and possible refinement of their goals, they can continue to work together and better shape their projects toward a vision that will ultimately forge a mutually beneficial partnership.

### **Narrative of Current Progress in Practice**

The project began through outreach on the part of SITHS's Career Development Center (CDC). Looking for partner institutions, the school was met with enthusiastic willingness on the part of the Garibaldi-Meucci Museum. Knowing the pre-engineering nature of the school, the museum dreamed of being able to tap into the intellectual capital of these students to aid in exhibition design as well as major projects which would not be possible without suitably skilled interns. Appealing to the opportunity for practical work in a professional setting, the museum was able to initiate a partnership with the school.

Though the idea was sound and enticing, funding needed to be allocated to begin such a project. Luckily, the school's CDC was planning on a massive summer internship program with United Activities Unlimited, which acts as an intermediary in the Summer Youth Employment Program (SYEP). Due to the involvement of this program, students and teachers recruited for this project would receive compensation for their time and the school was given a materials budget for more involved internship projects. This would later prove beneficial in funding two 3-D printers which would be used in the prototyping process of the internship. With these material considerations secured, the next steps would be recruiting students and teachers to aid in the realization of the Garibaldi-Meucci Museum's vision.

Holding the idea for funded summer internships and waiting for the opportunity to devote considerable resources to the task, the school began the project in mid-July. Eight (8) students were recruited from a pool of hundreds, due to interest. As part of the application process, students were given a survey in which they were given a short

description of each program, they identified their desired type of program (working with others, working alone) as well as a list of the programs from the list in which they were most interested. Selection was facilitated by the assistant principal for CTE as well as a faculty member designated as CTE coordinator. Orientation took place for a week, facilitated by the CTE coordinator involving the basic tasks of keeping time cards and thinking about how to communicate with participating institutions. For this latter task, student interns prepared for their initial meeting with the museum curator. During this time, they were tasked with researching Garibaldi and Meucci and formulating questions to ask to clarify the task of exhibition design. On July 14th, the first meeting was held with all involved personnel at the museum. The curator led student interns through a brief tour of the museum and then began to discuss the parameters of the project. Student interns were to begin to draft ideas for a new exhibit centered on Meucci's inventions. Student interns' initial planning visit to the museum culminated in the beginning of research. Using certain curated documents and the actual prototypes of Meucci's *teletrofono*, his initial telephone designs, student interns began to investigate the story of Meucci's inventions as well as make some attempts at planning reverse engineering.

Back at the school, interns then began to plan the creation of a working prototype of Meucci's *teletrofono*. Using AutoDesk Inventor, they constructed digital models which reflected the measurements they took of the prototype in the museum's collections. This process highlighted new research questions for the student interns to pursue. As they began to model the different component parts, the interns realized that they needed to do further research as to the materials used by Meucci (which may affect acoustics) as well as the scientific processes which would shed light on how the invention actually worked.

Some of this would need to be investigated in Meucci's own notes and testimony in his case with Alexander Graham Bell. Understanding of the electrical circuit as well as the functioning of the power source needed to provide voltage would come with applying principles they had already learned in Physics, Chemistry, and Electronics classes.

Already at the outset, student interns found that they were practically combining many of the theoretical principles they had already learned in class to be able to create a coherent project. Eventually, they would realize that their knowledge would only take them so far and thus they needed to go back to the museum for additional information which meant formulation of new research questions.

Knowing that they needed to continue modeling while pursuing these questions, they began to designate different research teams. A few student interns were also chosen as liaisons between the museum and the project. They would be present during the next meeting at the museum to work with archival documents and shore up any measurements and study of the prototype that was needed. During the second meeting, the interns also had the pleasure of meeting the museum historian who was able to elaborate on Meucci's trial and give some insight into the trial documents they were reading. This would prove a key to understanding as the translation of Meucci's statements were flawed and these flaws were only later uncovered by those who reexamined the case. For example, the lawyer representing Meucci presented the device as having no wire insulation and stated that electricity would pass through a person's body harmlessly. This statement was contradicted by a true translation of Meucci's words and reexamination of some of the prototypes. Without this aid, the project would be doomed to inaccuracy and questions of the safety of creating a manipulative prototype. Overall, the second visit would serve to

shed further light on Meucci's invention and better orient the student interns toward authentic research and reproduction.

Meanwhile, following this discovery, the manufacture of component pieces of the telephone took place using the Inventor designs and the 3-D printers. Issues with scaling the objects for the printers and transferring real dimensions over to the software resulted. Continued trial and error led to multiple prints being abandoned before a more workable print could be obtained. During this process, student interns considered what issues were presented during a given print and using the software and their own developing knowledge of the printer itself began to tweak settings until they were able to manufacture pieces which could be used for display and manipulation.

At this stage, the models were being refined and the student interns were beginning to better understand how an interactive exhibit would work using a working model of Meucci's telephone. It was determined that that aspect was on a good course. However, a single interactive does not make an exhibit. Student interns realized this and pursued different patents made by Meucci as well as more in-depth research to expand their vision of a small interactive Meucci exhibit. A few candidates were determined such as copper nickel electroplating, theatrical acoustics, and the creation of smokeless candle molds. Plans were made using Revit Architectural Design program and student interns tried to brainstorm how this would look in the exhibit space. A culminating visit for the summer would take place in which the student interns walked the gallery which the exhibit would inhabit and began to describe their vision with the input of the curator of the museum. This session would prove the most inspirational. As the student interns walked the gallery, they began to see how they could mold the space to fit their aims and

tell a greater story of Meucci which the visitors of the museum would be able to experience.

In the last weeks of the summer session, much would be left for further work. Interns chose the smokeless candle mold to work on for two reasons: existence of diagrams which demonstrated the form of the object and the potential for using an extruded candle mold to create paraffin candles which could be produced by the museum as a source of interim revenue for the project. This would hold its own challenges, among them the usage of equipment to be able to produce such candles. The mold itself proved simple enough to reproduce in the architectural software. The student interns' real issue came with the production of candles. Issues inherent in the usage of the different material of the mold as well as varying tools to simulate the process created real detriments to the final product. They found that revision was needed to the object's design to account for these issues. This raised the question of whether the mold was an authentic reproduction or not and whether production would continue, an issue still left to debate as the project waits for new funding.

Overall, the results of the student interns' work from those few weeks are impressive. In a short window of time, they were able to reverse-engineer two distinct creations and begin to consider how they would work as part of a greater exhibit. Throughout this time, student intern diligence prevailed through varying trials. In return for these challenges, they were able to engage in authentic exhibition research and development activities and gain better insights into skills which would aid in their college and career readiness.



## **Progress Analysis and Programmatic Considerations**

Truly, the above narrative demonstrates the great potential for this project when working with student interns in this museum-school partnership. Throughout the multiple steps which were emergent from the student interns' own process three key elements become apparent: (1) incorporation of engineering curriculum and skills into the exhibition design process, (2) drafting of research questions and targeting investigation based upon the museum's archives, and (3) a trial and error approach became integral to the scientific method and the reverse engineering process. As new challenges were faced and new questions formulated, student interns, with teacher and curatorial guidance, found that they were ready to apply what they knew to find out what they did not know. If the students' natural inquiry process of learning as well as the products they create could be harnessed into a more organized program, the expectations of the museum could be better met as well as the efficiency of time for all individuals involved.

Building upon the student interns' background in engineering, the design of the Meucci exhibition gave them an opportunity to utilize already learned and potentially mastered skills to prove themselves as valuable interns. This contributes positively to the relationship between the institutions and gives them both reasons for continuing the project. In particular, this aspect proves the most interesting with respect to creating a clear curricular design for future endeavors with similar projects. Prior to future steps, the particular engineering skills and programs can be enumerated and then correlated with the steps of the process. If this were to be done, a more targeted and efficient process could probably result.

As new challenges were faced regarding the gaps in their knowledge of scientific processes or exactly how Meucci would produce his inventions, student interns began to organize their questions and put them aside for the days in which they would come to the museum for further research. This helped refine their research process and orient them toward more authentic reproduction of Meucci's inventions. This tangibly connected research to results in a way that few high school students experience. Often research proves more of a theoretical activity in which students primarily exercise the most cursory effort to uncover information in order to satisfy curiosity or some greater hypothesis-related goal. Rather, the opportunity here afforded them practical research with a tangible end product. By bringing these elements together, the student interns were immersed in a more valuable research experience which they could potentially transfer over to future endeavors.

Of special note was the emergent nature of the student interns' workflow, which best represented the scientific method. As the student interns observed the original prototype of Meucci's telephone, they were sparked with further questions about how it worked. This pushed them to testing certain hypotheses based upon their content knowledge against the possible outcomes in addition to previously mentioned archival research. Trial and error also resulted from the student interns and staff beginning to understand the 3-D printers and their software. Constant tweaks were made to produce a presentable print for the manipulative objects for the exhibition. This represented about a week's time of abandoned prints before a satisfying solution was reached. It cannot be ignored that it was through the mentorship of teachers that much of this was made possible. Teachers modeled the troubleshooting for certain problems as well as guided

the scientific method process as students hit greater challenges in research and scientific knowledge. Without this necessary guidance and modeling of use of the software and troubleshooting, students would not have been able to move beyond whatever task they initially engaged with. It is in this particular aspect that the student interns were able to gain more freedom in terms of their performance because they were allowed the room to try and fail which so few jobs in their future professional lives will not allow them. They were also able to see how professionals dealt with these very problems and collaborate with them.

The emergent nature of the work in which students engaged in raises concerns when taking these principles and weaving them into a more planned and organized format. The freer format of the program allowed for discovery, pursuit of student-centered aims and authentic learning outcomes which came with the direction of the project rather than the full dictation of small, measurable goals by those overseeing them. In essence, student interns took the project in directions authentic to learning processes with very little guidance, and the question becomes, if this is still able to be achieved as more structure is introduced to the process. With this in mind, future programmatic design should aim to address these more constructivist styles and goals despite more organized methodology. For example, these moments of challenge and troubleshooting can be acknowledged as potential learning opportunities built into a more organized program or even modeled during an orientation phase of the program.

Moving from broader interpretation, the initial considerations of how to bring about the project in a coherent structure become worthy of note. In their study of an elementary school curatorial project of similar structure to this, Viki Wylder et al. (2014)

noted 5 crucial logistical steps which would guide small groups of students in creating their own exhibitions:

- (1) introduction to the concept and environment of the permanent collection, (2) information and steps needed to select works from the permanent collection, (3) research in the classroom on potential exhibition works, (4) implementation of a catalogue for the exhibition, and (5) the process for opening the exhibition (p. 84).

These steps begin with introduction to conceptual understanding and physical environment of the permanent collection and culminate in opening an exhibition.

Throughout each of these steps, student interaction with the museum's materials was coupled with lessons which probed students' thoughts and demonstrated necessary skills. In shaping this program, Wylder et al.'s model seems apt. With future coherent design, this format could be implemented. The project flow can be charted and then mini-lessons could be planned which would help orient student interns toward their next goals.

Another aspect of this collaboration to note is the ultimate need for a school to have accountability and demonstrable learning in order to justify further exploration of the possibilities of museum-school partnership. Much of what was identified as the key elements of this partnership do not necessarily align with the need to produce a product. Rather, up until this point, much focus has been on the process, which though very crucial to a constructivist framework, may need to be unfortunately tempered due to current educational climate. The possibility of working alongside the two is more strongly discussed in the relation of CTE and Common Core Standards to this program. This is where one must begin to consider the learning activities afforded by the museum and align them with particular classroom goals. In design, this could take place with constructed assignments which could engage student interns in tasks which mirror

classroom assignments such as reflective writing, model-building, or process narratives to demonstrate and inform on the steps they took to get to their ultimate goal (Bobick & Hornby, 2013). In order to better incorporate the natural emergent qualities discussed previously, some of this reflection can incorporate predictive questions and introspection about challenges currently faced which are obstructing the ultimate goal of creating the exhibit.

In the end, the continuation of the project should incorporate more cohesive and coherent design in order to be replicated with future students. However, this design should not impede upon the natural direction of students' questions and research in order to create a more constructivist approach. To better coordinate constructivist ideals with school demands for demonstrable learning, certain structures can be introduced to marry these two concepts. Mini-lessons would be directed toward the stage of achievement toward end-goals that the students have reached and reflective assignments would help further tangibly synthesize accountable, demonstrable learning with students' naturally generated challenges and questions.

### **Role of Faculty Liaison - A Reflection**

Having established the long, involved discussion of the students' accomplishments, I have purposely set aside my own role and considerations for this section. When introduced to the project, I was given the impression from my Assistant Principal and Principal that this would truly be an opportunity to make history come alive and create necessary links between the humanities and engineering for students. We had decided that engineering would be the hook for students but humanities, my own

background and expertise, would be an underlying theme of the tasks in which students would be engaged. Obviously, engineering would be a necessary component of the project and I would find support from two fellow faculty members who were part of technology and engineering department. Most of these initial discussions took place as the school year was ending and I was promised that further delineation would come when we would begin the project in July.

Thrust into new territory while working alongside two faculty members I had known only in passing, I faced the challenge of acclimating myself to a new program, new students, and new coworkers. As we faced the demands of the museum and the school and discovered the potential of this program together, I was impressed with how much I had come to realize about my own capacity as an advisor and liaison. Among these realizations were the results of student immersion in an authentic task, the necessity of troubleshooting when problems arose, and the gratefulness of the opportunity to engage in a realistic, practical, and historical problem.

Student engagement with the project helped me realize the skills my students are gaining every day they diligently complete tasks in the varied academic disciplines that they study. Initial planning of 3-D printing of Meucci's phone demonstrated students' measurement skills as well as a conceptual knowledge that they had gained from Chemistry and Physics classes. Seeing them use this knowledge in an authentic way made me feel proud of them, but also underscored something very important for me: the reality that all students need a similar continuum of experiences to realize that what they are studying does not merely exist within a theoretical vacuum. Additionally, more experiences of this type could help prepare them for their future, which is a real curricular

concern, as highlighted by the CTE standards. In my own practice, I also need to consider how these experiences can be better conducted within the classroom as well as within further iterations of this program.

Although students demonstrated great connection of the skills needed to approach the problem directly, it is also worthy of note that troubleshooting needed to be heavily guided, illustrating why students need these practical experiences and how my own role can better defined. Given the summer nature of the program and the emphasis on student work, my own hand was not as visible at times in the work produced by the students. They were left to their own devices to create and research, and only really relied on my own modeling of skills when a problem had arisen and they could not figure out how to get out of it. For example, when beginning to design the space for exhibiting the reverse-engineered phone as well as various elements of the work that went into planning it, students began to work with an architectural design program called Autodesk Revit to construct a clear depiction of this space. Despite other Autodesk programs being in students' range of experiences, a new interface and commands that were similar but not exactly the same caused them to experience great frustration with the program. This provided the perfect opportunity to model my own patience and ability to navigate varying programs to the students, and they were impressed with how much they could do if they just took the time to look for commands and research what they did not know. Another example of this occurred during the second meeting at the museum. The curator had earmarked various archival folders for the students to parse through in order to find details of Meucci's invention. The wealth of documents was overwhelming and this was made known by the students. However, after a while they began to divide the task among

themselves and flag whatever documents they thought may be useful for their work back at the school. Where the Autodesk Revit troubleshooting was a success, I feel I could have done more with regard to this research activity. If I had either helped to model how to divide the task of going through the documents or assigned students to various tasks of managing workflow, we probably would have had a smoother and more thorough look through those resources. Instead, my own role in that activity was more passive as an organizer and more active as a researcher.

Given these two differing examples, my own cognizance of my role is definitely necessary. This may come from better planning as various tasks needed to make a project of this nature happen are no longer a mystery to me. In a way this firsthand experience has caused me to reconsider some of Lucy Sprague Mitchell's (1971) in *Young Geographers*, particularly her observation that teachers should keep most of what he/she knows to himself/herself. Teachers keep this knowledge to themselves "in order to place the children in strategic positions for making explorations...in order to use [their] environment as a laboratory" (Mitchell, 1971, p. 16). The teacher's own discovery of these relationships is an instrument through which curriculum is formed rather than as a text for class study. It forms the potential model for shaping class discovery of similar principles through molding of the classroom routine, environment, and experiences, centered on larger themes of human understanding which lead to deeper thinking. This reinforces the concept of a teacher as a facilitator, creating a process through which children first gather facts then transmit that information through a physical medium in order to actively reflect and begin to process the information to create greater understanding of relationships between these facts. An understanding of children's



development is crucial in this process, as it shapes the information that they bring back to the classroom as well as the appropriate media through which they will begin to express and process the information they have gained. Overall, a teacher shapes understanding of the environment, children's development, and appropriate information gathering and processing tools and activities into dynamic curriculum which will help in the formation of relationship thinking. Connected to my own practice, I must consider how to harness this process in order to make a more viable program for students' authentic experience and learning.

Even with my estimation of my own failings and triumphs, I must also consider the value of the experience itself. Too often, schools have been turned into passive factories of information rather than laboratories plumbing deeper questions of subjects such as History and Science. Through the improvement and continuation of this program, students will be able to see this latter model and gain valuable experience that will hopefully translate into their eventual destinations beyond schooling. True problem solving has the potential to create true problem solvers. As I think through the future of this program, I must keep that in mind.

### **Recommendations**

Over time, this program can serve to work with an expanded base of student interns and begin to meet greater institutional challenges faced by the museum. As the number of student interns expands, obvious questions of funding will continue. This challenge aside, greater questions of better structuring the program to meet institutional and student intern needs becomes apparent as this may be the basis of justification of

continued progress with the project and potential grant writing. Given this reality, the following recommendations can be made in order to produce a more coherent and cohesive programmatic structure: (1) divide the project into goal-oriented stages which correspond to particular final products, (2) align each of these stages with various instructor introduced mini-lessons, (3) allow for generation of students' research questions and potential avenues of exploration through guided reflective assignments, and (4) potential expansion of project parameters to better meet the needs of both institutions.

Although there are great exploratory moments to this project, as demonstrated in the narrative, it must ultimately culminate in something which will clearly benefit both the museum and school, as outlined in initial talks between the institutions. Thus, rough time tables should be drafted in order to better orient these projects toward the desired ends. In many of the studies cited, school-museum partnerships had some culminating activity such as a field trip or gallery walk of student-made exhibits. The same could take place in this project, probably with the final designs of the exhibition or, with hope, the exhibition itself.

At times, the role of instructors was not necessarily as defined and took place in response to students' inquiries. Anticipating the possible next steps, instructors can begin to redirect and target necessary skills in order to reach the aforementioned end goals. Both school and museum professionals could decide which skills need addressing and serve to brainstorm organized activities which would help orient student interns in taking next steps. This would become especially useful if there is changeover of student interns between the summer and the school year. Additionally, this becomes attractive as it

begins to meld school and museum professionals' roles in the collaboration, allowing for a more seamless process and working toward further overlap as detailed in Kira S. King's continuum of museum-school partnerships.

While reorientation toward measurable goals will take place to some degree, student freedom still needs to be acknowledged. With this in mind, a potential weekly or biweekly reflection can be given to student interns in the form of discussion, journal entry, or formal paper which will help in generation of questions and demonstration of process. This provides a tangible artifact to demonstrate student learning as well as help students connect their hands-on experience to what they have learned; presenting the connection between content, experience, and future work-related activities. In the case of the introduction of new student interns to the project, this can also serve to demonstrate trial and error already achieved, if the process is shared with new participants. Thus student interns have a combined library of experiences to draw from and will collaboratively build this project over time.

Finally, though ostensibly unrelated to the final goal of creating an exhibition, both institutions should consider what other opportunities could be afforded to student interns. Marian Hoy (2011) details the range of possibilities for student interns in her study which include providing opportunities for student interns to engage in visitor services, education services, researching holdings, and assisting in the organization of museum-held events. All of these are potential avenues of future exploration for both institutions. Though this is not necessarily initially connected to the creation of the exhibition, the exhibition will need an audience, and such activities as the last mentioned can help in building that audience. A greater audience means better research and

evaluation can be done once the exhibition is being previewed to further refine it, creating a continual, cyclical relationship between both the Garibaldi-Meucci Museum and SITHS.

Prevalent through this study is the hope for a productive future for this partnership. With these recommendations and introspective thoughts with regard to what has already been forged, it is wished that both can continue their collaboration and orient it toward excellence. Though lofty, their goals can be achieved, as demonstrated by other museum-school partnerships. It is with this joint knowledge that they can ensure a better future for both institutions.

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