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Using Digital Images for STEAM Education and Discovery Through Fiber Art

Julie Carmen
carmen.julie@gmail.com

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Abstract

This article proposes using digital images as a pathway to study science, the arts, and technology by way of embroidering enlarged images from illuminated manuscripts. Art galleries, libraries, archives, and museums (GLAMs) can provide this learning opportunity within makerspaces, as a service for users to create patterns for embroidery. Should makerspaces install stations for embroidery pattern creation based on concepts only? Will GLAMs offer more of their local historical images for users based on this method? What will come first, the images to engage users or the demand for historical images from users? This process is a dynamic approach to simultaneously teach some computer/software skills and information literacy, including fair use and citations, via digital image use to create artistic derivatives inspired by historical drawings. Based on the author's own creative experience and promoting this method in conferences and articles, she presents an approach to teach pattern creation in makerspaces as a method of increasing digital image use for the study of STEAM subjects, offering opportunities to reach more users and help them understand art history, fiber art, digital images, and heighten research skills.

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Author Bio & Acknowledgements

Julie Carmen is an independent research librarian living in Ellensburg, Washington with her husband, five cats, and two dogs. For the past 25 years, her focus has been using digital images from two 13th century manuscripts to create patterns for embroidery while practicing the medieval stitch, laid work. Her interests include history, music, organization of metadata, and archival applications to special collections for further preservation and study.

After practicing the ancient embroidery technique of laid work[i] for over 20 years, the responses from many are striking, from exclamations of awe and wonder, to incredulous and curious questions: "How do you do that?" "Is that a kit I can buy?" "It looks so complex; is it difficult?" These responses reinforce the attraction and desire of many to embroider historical images on fabric and enjoy the result, and the delight of those who see the embroidered copies of historical images but were not previously aware of the original drawings. Because the original drawings are often "hidden" in manuscripts or on websites, most of our population in any geographic area is not in tune with the many historical drawings available in hundreds of thousands of manuscripts produced before the electronic era. Teaching users how to create their own patterns for embroidery from the generous digital resources now available saves users money by avoiding expensive embroidery kit purchases and allows them the ability to create embroidery patterns more unique to them (Davies 2018; Van Lit 2019).

Once people are aware of the interesting drawings in centuries of manuscripts, combined with fiber art opportunities, they will embrace the educational experience offered to them within makerspaces (Sheridan et al 2014; Halbinger 2020). The drawings in illuminated manuscripts, most from 1000 to 1700 C.E., are not only beautiful but offer insight into how artists saw life in their era. Images of insects, birds, animals, people, buildings, clothing, etc. are documentations of the daily lives of various cultures in that time (Olasina 2020). One book published this year showcases a multimedia approach to pattern creativity, focusing on famous women (Frazer 2021). Comparing the drawings of one subject over time is an exciting study in science, technology, engineering, arts, and mathematics (STEAM) (Salvador-González 2021). When people learn of the drawings in these manuscripts, now online, there may be more demand for works from fiber artists.

The goal of this article is to propose a new makerspace program that will offer methods that enable users to engage in a pathway to making authentic cultural artefacts while simultaneously developing their research skills (Sheridan et al 2014; Salvador-González 2021). This program would provide needed materials for a small fee while supporting students and others who may not have the technological ability, space, equipment, or proper training to create a pattern for embroidery, and yet would benefit from the creative experience. The hope is that many art galleries, libraries, archives, and museums (GLAMs) with special collections will consider this program, develop it in their institutions, and report their findings. Digital archives that make their collections open access will add significant value to the institution's holdings by enhancing the use of their collections (Hoster 2020; Karlsson 2020; Van Lit 2019; Willey 2017; Shulman 2014; Kelly 2013; Tanner 2004). Makerspaces, or hackerspaces, are considered a movement that engages social change, affecting people on a personal level (Davies 2018; Buchholz et al 2014; Kafai et al 2014). When people create their own patterns for embroidery with historical digital images, they will share them on social media, with family and friends, and perhaps display them in art galleries or even sell them.

This type of educational program is a pathway for educational discovery, especially in STEAM subjects (Barniskis 2014). The ability to compare drawings of flora and fauna over centuries is one possible way to study science, art, and history, helping more people understand the human journey. The simple process of creating individual patterns for embroidery with digital images easily found on the internet presents ideas for creating fiber copies of historical drawings that intersect and share discoverable aspects in STEAM.

Within the Makerspace
According to hackerspaces.org, there are currently 2,410 listed or planned hackerspaces around the globe. Makerspaces offer a communal space for tools and machinery to promote innovative activities and creative experimentation in any form in the areas of science, art, and technology (Davies 2018; Halbinger 2018). The unique combination of applying ancient stitches to enlarged

drawings from illuminated manuscripts, affixed on fabric by way of iron-on transfer paper, is a straight-forward and seamless approach to creating new fiber art based on old drawings. The process frees rare drawings from their original format into one that is easily displayed to the public's eye as a wall hanging, on a pillowcase, quilt, etc. If a person can draw their own images on fabric, great; however, the purpose of embroidering an image directly from a drawing is to create a fiber copy. Using a digital image with iron-on transfer paper allows for enlarging a miniscule image and creating a larger copy of it. This produces an image clear enough for embroidery. Embroidered copies of a digital image provide new ways to observe history by comparing documentation of different times in history and across geographical areas, thereby exposing those drawings to more people which leads to more STEAM discovery (Willey 2017).

Teaching anyone to create their own pattern for embroidery has many benefits; firstly, it offers a variety of unique and different patterns that can be created using the plethora of digital images available. Secondly, embroidery kits are expensive and mass produced, which often limits those who cannot afford kits to less unique patterns. Thirdly, during a challenging pandemic, offering the software, space, technology, and help in one space will undoubtedly inspire users to go to makerspaces for creative inspiration. Creating enlarged images from tiny drawings found in illuminated manuscripts, beloved photographs, or memorable images from their own lives, will provide endless resources for artistic outlet. Using any drawing or image to create new patterns for embroidery can ultimately reduce stress through creative relaxation (Czamanski-Cohen and Weihs 2016; Fontichiaro 2018). As digital technology continues to grow, academia recognizes the importance of preparing students to use digital technology to address relevant innovation challenges and develop their skillset for current career demands, and makerspaces offer this education (Willey 2017). Pattern creation for embroidery is a unique approach to developing a digital skillset combined with information literacy, and supports personal creativity (Davies 2020; Halbinger 2020; Olasina 2020; Hughes and Morrison 2018; Kafai et al 2014).

Introducing basic copyright issues will assist makerspace users to relax with this creative project by showcasing resources with Creative Commons licenses.[ii] Libraries are developing LibGuides or research guides to point users to collections under Creative Commons licenses (University of Chicago Library 2021; ELON University 2019; Whitman College Penrose Library 2019; Carnegie Mellon University Library 2021). Creating a list or guide for users to access for research would be most helpful in the pattern creation process. Because there is a lack of a consistent cross-citations or Library of Congress Subject Headings (LCSH) numbers in many catalog records and metadata within libraries and archives (Willey 2017), teaching users how to search for specific subjects within digital manuscripts is a necessary element of information literacy (Kim and Yang 2016; Olasina 2020). GLAMs are discovering that providing makerspaces for creating personal and portable computational projects with materials can connect a student or user to everyday experiences and domestic activities such as crafting and sewing while providing a new understanding of the general and personal relevance of computing (Hughes and Morrison 2018; Buchholz et al 2014; Kafai et al 2014).

Makerspaces may help in some facets by providing equipment, technology, and needed materials for those who wish to create their own embroidery patterns (Barniskis 2014; Davies 2018; Halbinger 2020). Making one's own patterns from digital images offered through the forethought and organization of makerspaces provides a plethora of creative stimuli, and saves money compared to the expensive embroidery kits designed for mass production and high profits. By choosing their preferred images from history and creating their own patterns for embroidery, the user will become connected to their artwork as it becomes unique to them (Hielscher and Smith 2014). Any

handicraft can help a student or user find purpose which supports them in other aspects of learning (Fontichiaro 2018).

When it comes to artistic creativity, many are challenged to create patterns due to lack of drawing skills and may not have the opportunity to pay for art classes. However, creating fiber copies of simple drawings does not require an expensive kit with colors outlined and precise stitches. Would it not be more creative for a user to choose their own image, create a pattern, and apply a free-style way of stitching with colors they want to use? Would more people, in general, even if they were not a scholar or student, benefit from a new way of creating historical copies with needle and thread? Makerspaces are a place to start.

Figure 1: "The Medieval Screen," 10 x 7 feet, made by Julie Carmen, showing the first nine out of ten panels. Photo by Marc Wiley.

Using themes for STEAM study and fiber art creation offers cross-disciplinary focus and involvement (Fontichiaro 2018; Salvador-González 2021). For example, "The Medieval Screen" (fig. 1) is focused on music, musicians, and musical instruments, from two 13th century manuscripts (Carmen 2021). The images were chosen because they are drawings depicting the daily life of people with their instruments from within the castles of Castille & León (O'Callaghan 1989). For a STEAM focus, the drawings show instruments, some no longer in existence and some that are earlier variants of current instruments. Other research using historical images may include comparisons of how an insect or bird is drawn in different countries over the centuries. Will we see drawings of dodo birds or other species long gone but captured in these drawings? There are many entertaining images found within medieval manuscripts, such as human faces with snail or other animal bodies. These interesting drawings could be regarded as medieval science fiction. Ultimately, the hope is that creating fiber art copies of images and sewing them onto a movable screen, hanging them on a wall, or creating a quilt of the embroidered patches, will inspire others so that more groups and individuals will enjoy the benefits of creating their own laid work patches.

Some may be inspired to use themes of comparisons within STEAM, over centuries of time, to display on such a large foundation as a screen. Others may be satisfied in making a few designs, framed to hang on a wall, which can also lend themselves to studies in STEAM. Below are some examples of miniscule art that can be cropped, enlarged, and embroidered to display drawings from artists' documentation of historical observations and events. Images from illuminated manuscripts include so much of the human journey. Drawings and paintings of dragons, demons, insects, animals, clothing, madness, illness, and plant life could, over the centuries, be an artistic journey of comparisons. How did different countries see these concepts over time?

Horse

Subject searches within each database included: "horse," "9ᵗʰ century horse," and "medieval horse," to find images for comparison over time.

Figure 2: Queen Mary Apocalypse, The rider on the white horse and the rider on the red horse, MS Royal 19 B. XV. British, c. 1310-1325. University of Chicago. (Cropped from image of a page.)

Figure 3: Falconer Riding a Horse, from *Book of Hours*, May Calendar. Flemish-French, late 13th century. The Walters Art Museum. (Cropped from image of a page.)

Figure 4: Il fior di battaglia / Fiore dei Liberi Italy. MS M.383 fol. 5r. Italian (Venice), early 15th century. The Morgan Library & Museum. (Cropped from image of a page.)

Figure 5: Detail of the Rider on a pale horse, emerging from a hell-mouth, with John, Royal MS 15 D II, f. 129r. 1310. The British Library. (Cropped from image of a page.)

Figure 6: Commentary on the Apocalypse, MS. Bodl. 352. German, first half of 12th century. Bodleian Library, University of Oxford. (Cropped from image of a page.)

Figure 7: The Battle between the Horsemen and the Beast. English, c. 1255-1260. J. Paul Getty Museum. (Cropped from image of a page.)

Fantastic Beasts

Subject searches within each database included: "fantastic beasts" and "dragons."

Figure 8: Leaf from a Beatus Manuscript: at the Clarion of the Fifth Angel's Trumpet, a Star Falls from the Sky; the Bottomless Pit is Opened with a Key; Emerging from the Smoke, Locusts Come Upon the Earth and Torment the Deathless. Spanish, c. 1180. The Metropolitan Museum of Art. (Cropped from margin of a page.)

Figure 9: The Beast from the Earth and the Adoration of the Beast from the Sea, Ludwig III 1 (83. MC.72), fol. 25. English, c. 1255–1260. The J. Paul Getty Museum. (Cropped from margin of a page.)

Figure 10: Hours of the Virgin (Use of Rome), Christ Church MS 94. French, c. 1450-1499. Christ Church, Digital Bodleian, University of Oxford. (Cropped from margin of a page.)

Figure 11: *Psalter ("The Luttrell Psalter").* English, c. 1325-1340. The British Library. (Cropped from margin of a page.)

Figure 12: *Psalter ("The Luttrell Psalter").* English, c. 1325-1340. The British Library. (Cropped from margin of a page.)

Figure 13: *Psalter ("The Luttrell Psalter").* English, c. 1325-1340. The British Library. (Cropped from margin of a page.)

Butterflies

Subject searches within each database included: "butterflies."

Figure 14: *Psalter ("The Luttrell Psalter").* English, c. 1325-1340. The British Library. (Cropped from margin of a page.)

Figure15: *Estoire del Saint Graal, La Queste del Saint Graal, Morte Artu.* Old French, c. 1315-1325. The British Library. (Cropped from margin of a page.)

Figure 16: *Book of Hours.* MS. Rawl. liturg. f. 8. Dutch (Delft, the Netherlands). Bodleian Libraries, University of Oxford. (Cropped from margin of a page.)

Figure 17: Offices, prayers for private use. MS. Douce 8. Italian (Latin), late 15th century. Bodleian Libraries, University of Oxford. (Cropped from margin of a page.)

Figure 18: *Haarlem Book of Hours.* Dutch, c. 1445-1450. National Library of the Netherlands. (Cropped from margin of a page.)

Figure 19: *Hours of Francis I.* Master of François de Rohan (French, active c. 1525-1546), c. 1539-1540. The Metropolitan Museum of Art.

Whale

This image was discovered while searching for "fantastic beasts."

Figure 20: *Fish Book.* Adriaen Coenen, c. 1580. National Library of the Netherlands. (Cropped most of image, text and edges taken off.)

Note: The image in figure 20 could be divided into two, four, or eight page-sized pieces. Once embroidered, all pieces could be sewn together for a much large fiber piece.

Wrangling the Image

When searching for items to embroider, use simple word searches for the subjects you may be interested in studying. Some common themes within medieval manuscripts include angels, demons, animals, flowers, love, castles, farming, and fantastic beasts. For example, if looking for beetles, one could simply put in a search bar: "beetles" or "beetles AND 12th century England." Looking for these terms on several websites or databases will result in many different manuscripts with different drawings. Be aware that many of these drawings are tiny but well defined and are often drawn as ornamentation around the text.

Well-known images are often found in "Book of Hours" or "Psalter" manuscripts, so using those terms to search for illuminated drawings can be useful. Many amazing drawings will be discovered if the website offers a paging tool, which allows the manuscript to be viewed page by page and enlarged for better study. Page through the entire manuscript carefully to see the small drawings in the margins.

Consider a state archive with books no longer in publication; many of those books were written about certain towns. Drawings of popular buildings, fallen into decay or gone, could be turned into fiber art and displayed. Many images are uploaded to Pinterest for this purpose and are waiting to be discovered. Consider an old drawing of an 18th or 19th century building, printed on iron-on transfer paper, ironed onto fabric, and embroidered. The fiber copy is then put in a display lightbox or a frame and hung in a local restaurant. This new copy of the image could be enjoyed by many. Recently, Adobe came out with the software Fresco which turns any photo into a drawing (Kushins n.d.). With this technology, any modern-day photo may be turned into a line drawing and used to create wonderful patterns for embroidery. This software, provided in a makerspace, will offer more options for creative and personal aspects for pattern design (Kafai et al 2014).

Teaching and learning the simple tools in Paint, such as the snipping tool and select tool, is important. Within some sites, as you right-click on a page of a manuscript, it will open that image into Paint for you. However, to save the part of the image you may want with Paint, it will be necessary to crop the part you want. Use the select tool, outline the image you want, crop it, and save as a JPEG to your computer. The importance of cropping a specific image and documenting where the image is found cannot be overstated. The best method for enhancing the image once in JPEG format is inserting it into a Microsoft Word document and using the ruler function to adjust the size. If a larger image is desired, open the image in Word, then divide image in half, making two iron-on transfer sizes to be joined on the fabric. Always remember to cite where the image came from, even if it is a tiny drawing in the margin of the page.

Once an object is selected and resized, it can be printed out on iron-on transfer paper. When searching on a website for an image, some sites will just allow you to right-click the image and save to your computer, usually in a PNG format, which you will need to open in another software platform to convert to JPEG or GIF. Microsoft Paint seems to be a workable software for this purpose, and it generally comes with personal computers (PCs). Some websites will allow for export, and you can save an image onto your computer, already formatted as a JPEG for easy use and access. The instructions here are based on a PC, but any computer should have programs available to help crop, resize, and save an image. If a person is not familiar with the process, finding a makerspace that offers this service and provides support would be ideal for them. Some websites will use various formats for sharing their images, so be prepared to be versatile.

The Medieval Screen would not have been created if it were not for the efforts of Greg Lindahl who, in the early 1990s, scanned and digitized the images from various resources of "Cantigas"[iii] found in *Las Cantigas de Santa Maria*.[iv] He put them into GIF, JPEG, and PDF formats, and uploaded them to the Society for Creative Anachronism's (SCA)[v] website (Lindahl n.d.). He made these images open access, allowing for free use. Lindahl created an amazing resource for SCA members by designing simple lists of images from 13th century manuscripts and allowing use of his

images. He also informed SCA members that the images are considered public domain and were excellent references for historic study. If more special collections were to make simple lists in GIF, JPEG, and/or PDF formats of a few drawings from their collections and make them open access, the digital images may be widely used and draw more attention to the collections (Willey 2017; Shulman 2014; Kelly 2013; Tanner 2004).

Recycling Effort

One of the benefits of creating fiber art is that the ways the art is made and displayed give ample opportunity to use repurposed materials: donated drapes or tablecloths on which to embroider the images, recycled wood to create frames or repurpose old frames, or even used bi-fold doors to create movable screens. One convenient way to learn a new creative outlet and improve one's research skills is within makerspaces, which provide the equipment, technology support, and upcycled[vi] fabric needed (Davies 2020; Halbinger 2020; Barniskis 2014). Makerspaces can pre-cut the needed materials to specific sizes for various patterns as users come in to design their own patterns for embroidery. Makerspaces can offer handouts of display options, and even explain that the fabrics they provide are from upcycled materials. The focus on reducing the number of throw-away objects within landfills may appeal to some people. Teaching acceptance of repurposed materials is a functional trait of the program.

The Medieval Screen was created by connecting ten used bi-fold doors to build a moveable screen, making it handy to sew completed embroidery works onto the panels (Carmen 2021). The fabric used for the embroidery patches are from donated house drapes that have proven to be sturdy, durable, cost effective, and pleasant to work with. The fabric turned out to be quite appropriate for embroidery, being 75% rayon and 25% acetate; the fabric absorbs the ink from the iron-on transfer paper quite well and is perfect for the embroidery needle.

Why Laid Work?

Applying a documented historical stitch technique such as laid work to a historical image will connect the artist with the image they are working on. Understanding the historic stitches by studying the *Bayeux Tapestry* (Bloch 2006; Grape 1994) and applying those same stitches over other historical images provides an association with the time, place, and art. The laid work technique is repetitive, even, and hypnotic. Users who learn handcraft skills such as crochet, embroidery, or knitting describe the new skillset as "hypnotic and calming," offering a repetitive motion in simple projects and producing a "zen-like" or "meditative" experience (Fontichiaro 2018). The process of creating amazing patterns for embroidery is transformative. Reactions from academics, community members, and children, reached via conference presentations, community presentations, and talking to various people, indicates that many are inspired by and enjoy the embroidered copies of these illuminated and hidden images (Carmen 2015; Carmen 2016; Carmen 2019a).

Laid work offers a rippling effect and looks as if it were woven but is made with needle and thread. Getting this woven result without using a loom makes laid work an easy project to travel with. The simple stitches used with laid work include basics such as the stem stitch, satin stitch, and couching stitch. For more detail, such as in hands and faces, use the split stitch. These basic stitches have no set rules for length of stitches, counting stiches, or challenging techniques. The reason laid work performs so well for covering over simple drawings is because it is designed for many hands to work on one project when needed, and the stitches save floss as they are mainly over the top of fabric. As the *Bayeux Tapestry* shows, using laid work is constructively great at covering large areas (James 2021).

Image Resources and Image Reuse

Open access images are accessible via the internet in digital form and are free of charge or copyright and licensing restrictions (Hoster 2020). The mission of most museums is to educate and serve their audiences, including making images of works in their collections accessible. This open access generates goodwill and recognition among museum users (Willey 2017; Kelly 2013; Hoster 2020; Shulman 2014). The ability to discover a variety of geographic origins from original material, moving beyond the well-known illuminated manuscripts from Western Europe, enhances connections with artists working with other cultural traditions and manuscripts. Researchers working on cross-disciplinary discourse with heritage materials will increase their understanding by studying original manuscripts and experiment with cross-cultural communication by interpreting and translating the materials (Ricciardi 2019). Each time an image is seen by a person, that image becomes more familiar. Images displayed as fiber art in a home or public place are likely to be stored in one's memory and may also pique a person's curiosity. As most of the medieval illuminated manuscripts are written in dead languages, it is exposure to the images that can increase curiosity and spur investigation. Simply seeing subjects in fiber art, whether displayed on a wall, a pillow, or perhaps a movable screen, is enough to subtly imprint that image to more people.

Museums realize they need to change their opinion and treatment of digital images of their collections and invest in the technology to manage the digital images (Willey 2017; Shulman 2013). When users realize the simplicity of creating their own patterns from digital images, demand for more accessible images will likely increase, based on ease of access, less worry, and less steps to create their patterns. Those GLAMs who continue to restrict use of their digital images will be less used and thus less cited (Hoster 2020; Willey 2017). Allowing free use of digital images not only reduces staff time and expense to the institution but also encourages an increase in citations, making this a type of marketing strategy to increase exposure of the collection the image is from (Hoster 2020; Van Lit 2019; Willey 2017). Great resources for finding digital collections include Artstor, the British Library, the Digital Bodleian, Digitized Medieval Manuscripts App (DMMapp), Digital Scriptorium, and the Metropolitan Museum of Art.

In 2019, at various presentations, this author surveyed attendees to ascertain if they would consider a program within their makerspaces to create patterns for embroidery utilizing digital images or try the technique themselves. At an August 9, 2019 presentation by the author entitled "Digital Humanities Reawakens an Ancient Embroidery Technique" at the Pacific Northwest Library Association (PNLA) 2019 Conference in Spokane, Washington, approximately 50% of an audience of about 20 responded via show of hands that they could see using this technique as a potential program (Carmen 2019b). Through an online webinar for The Association for Information Science and Technology (ASIST) Special Interest Group for the Arts & Humanities on August 29, over 50% of the nine attendees stated they would like to try this type of program in their makerspaces (Carmen 2019a). On August 31 and September 1, at the Kittitas County Fair in Ellensburg, Washington (Daily Record 2019), discussions with 70 persons revealed that no one had heard of laid work and only one person knew about *The Bayeux Tapestry* and had seen it in person. Out of these 70 people, about 25 wanted to know more or were interested in trying this technique themselves. The author is also scheduled to teach embroidery creation online early next year, for the Embroiders' Guild of America (EGA)[vii] (EGA 2021).

Creating patterns for embroidery from images that impact a local geographic area can be quite appealing. Brilliant embroidery combined with iconic images are just some of the products that could be realized with a makerspace embroidery pattern-creation program. Would you not like to find lists of open access, local iconic images available from your local GLAMs? Would a program that offered safe images to use for artistic derivatives and provided necessary equipment, technology support, and programs be a great resource?

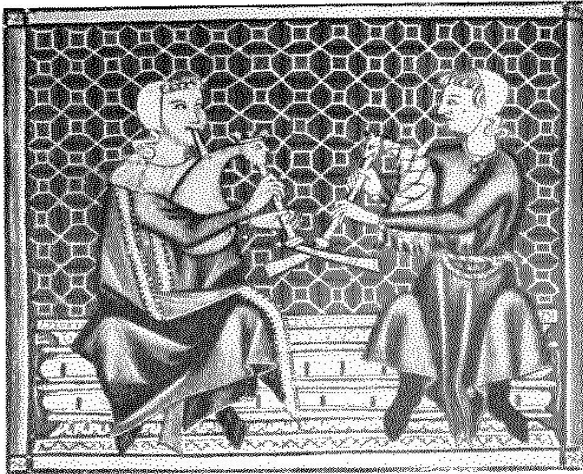Comparison Cantigas images from digital image to completed fiber art:

Figure 21: Image from *Cantiga 260*, from manuscript *Las Cantigas de Santa Maria,* housed at Real Biblioteca de San Lorenzo de El Escorial outside Madrid, Spain. Digital image by Greg Lindahl.

Figure 22: Laid work embroidery of *Cantiga 260* by Julie Carmen. Photo by Marc Wiley.

Figure 23: Image from *Cantiga 350*, from manuscript *Las Cantigas de Santa Maria*, housed at Real Biblioteca de San Lorenzo de El Escorial outside Madrid, Spain. Digital image by Greg Lindahl.

Figure 24: Laid work embroidery of *Cantiga 350* by Julie Carmen. Photo by Marc Wiley.

Conclusion

Multiple embroidered pieces can advantageously be displayed on a moveable screen, explained in an autoethnography about the creation of a moveable screen using digital images and laid work (Carmen 2021). Building on this concept, makerspaces offering needed materials, technical support, and basics of information literacy will bolster a user's digital literacy skills and research methods as they build their own patterns for embroidery (Halbinger 2020; Olasina 2020). Not only is the makerspace providing needed supplies, but it also gives users a way to develop research skills

while introducing basic copyright law and providing multiple resources for the study of art, history, science, and technology (Davies 2018).

       The opportunity to teach the user is an important factor, but some community members are not students and may need assistance to search for and locate a desired image. Once they have their image, the makerspace can create the pattern for them for a fee. Once any user leaves the makerspace, they may be given handouts for more information about laid work, or perhaps the makerspace could offer a night class teaching laid work or a workshop about history; it will be different for each makerspace. The pattern creation program is multi-disciplinary, giving ample ways to coordinate with educators in many subjects (Willey 2017).

       Will this concept be tried in makerspaces? It is hoped so, given that the author's fiber copies attract much attention and show the popularity of such a program. Some makerspaces have offered sewing classes and machine embroidery classes in the past (Lane Community College 2021; Green County Public Library 2021; Arlington Public Library 2021). Digital images are continually being discovered, shared, and talked about (Hoster 2020; Buchholz et al 2014; Van Lit 2019). What if more rare images are applied to a specific type of artwork such as laid work? Would there be a spike in downloads and views of digital collections? What about citations of the institutions maintaining the special collections? Once they have embroidered and displayed their embroidered copies, these fiber art pieces may inspire other artistic concepts in addition to discovery of various cultures, languages, science, and science-fiction/fantasy over the ages (Olasina 2020).

Bibliography

Arlington Public Library. *Makerspace.* 2021. https://www.arlingtonlibrary.org/makerspace.

Artstor. "About Artstor." 2021. https://www.artstor.org/about/.

Barniskis, Shannon Crawford. "Makerspaces and Teaching Artists." *Teaching Artist Journal* 12, no. 1 (2014): 6-14.

Bloch, R. Howard. *A Needle in the Right Hand of God: the Norman Conquest of 1066 and the Making of the Bayeux Tapestry.* (Random House, 2006).

Bodleian Libraries, University of Oxford. *Digital Bodleian: Western Medieval Manuscripts.* Dutch, Delft, Netherlands. https://digital.bodleian.ox.ac.uk/collections/western-medieval-manuscripts/.

British Library. *Digitized Manuscripts.* https://www.bl.uk/manuscripts/.

Buchholz, Beth, Kate Shively, Kylie Peppler, and Karen Wohlwend. "Hands On, Hands Off: Gendered Access in Crafting and Electronics Practices." *Mind, Culture and Activity* 21, no. 4 (2014): 278-297.

Carmen, Julie. "Makerspaces: Combining Information Literacy with Pattern Design for Fiber Art through Digital Images." *Library Trends*, 69, no. 3 (2021).

Carmen, Julie. "The Medieval Screen: How Digital Humanities Reawaken an Ancient Embroidery Technique." Presented for ASIST SIG AH Webinar, on August 29, 2019. https://sway.office.com/7MCA5TjyGlIdvTNh?ref=Link.

Carmen, Julie. "Digital Humanities Reawakened an Ancient Embroidery Technique." Presented at PNLA 2019 Conference, Spokane, WA, August 9, 2019. https://sway.office.com/cgtmb70pvdobvRe3?ref=Link.

Carmen, Julie. "Introduction to Laid Work." 2019. https://sway.office.com/lLBdJmT2xvDearZw?ref=Link.

Carmen, Julie. "The Medieval Screen: Reuse, Digital Humanities, Art, and Sound." Presented at "Inertia: Momentum, a Conference on Sound, Media, and the Digital Humanities." Online conference, April 28-30, 2016. http://www.echo.ucla.edu/cfp-inertiaconference/.

Carmen, Julie. "The Medieval Screen: A Work in Progress." Presented at The Symposium of University Research and Creative Expression (SOURCE), May 21, 2015. https://digitalcommons.cwu.edu/source/2015/posters/135/.

Carnegie Mellon University Libraries Libguide. *Visual Resources: List of Image Collections.* 2021. https://guides.library.cmu.edu/vr/image_collections_list.

Czamanski-Cohen, Johanna, and Karen L. Weihs. "The Bodymind Model: A Platform for Studying the Mechanisms of Change Induced by Art Therapy." *The Arts in Psychotherapy* 51 (2014): 63-71.

Daily Record. *2019 Ellensburg Rodeo and Kittitas County Fair.* https://www.dailyrecordnews.com/ellensburg/2019-ellensburg-rodeo-and-kittitas-county-fair/collection_598579b9-b81f-5c22-9031-b59e1a09ff75.html.

Davies, Sarah R. "Characterizing Hacking." *Science, Technology, & Human Values* 43, no. 2 (2018): 171-197.

Digital Bodleian. 2020. https://digital.bodleian.ox.ac.uk/

Digital Scriptorium. "Using the Images." 2020. https://digital-scriptorium.org/about/

Digitized Medieval Manuscripts App. Sexy Codicology. https://digitizedmedievalmanuscripts.org/.

ELON University Libguide. *Open Access.* 2019. https://elon.libguides.com/openaccess/images.

Fontichiaro, Kristin. "Making as Self-Soothing: The Power of Stitches. (LIBRARY MAKERSPACES)." *Teacher Librarian (Vancouver)*, 45, no. 5 (2018): 53-63.

Frazer, Amy. *Art Makers: Empowered Embroidery.* (Lake Forest, California: Walter Foster Publishing, 2021).

Grape, Wolfgang. *The Bayeux Tapestry: Monument to a Norman Triumph.* (Munich, New York: Prestel, 1994).

Green County Public Library. *Embroidery Machine*, 2021. https://greenelibrary.info/makerspace/embroidery/.

Hackerspaces.org. *List of Hackerspaces.* 2021. https://wiki.hackerspaces.org/List_of_Hacker_Spaces

Halbinger, Maria. "The Relevance of Makerspaces for University-based Venture Development Organizations." *Entrepreneurship Research Journal*, vol. 10, no. 2 (2020).

Hielscher, Sabine, and Adrian G. Smith. "Community-Based Digital Fabrication Workshops: A Review of the Research Literature." *SSRN Electronic Journal* (2014).

Hoster, Rachel. "Art Museums and the Public Domain: A Movement Towards Open Access Collections." *VRA Bulletin.* 47, no. 2, article 4 (2020).

Hughes, Janette, and Laura Morrison. "The Use of E-Textiles in Ontario Education." *Canadian Journal of Education* 41, no. 1 (2018): 356.

J. Paul Getty Museum. *Manuscripts.* https://www.getty.edu/art/manuscripts/

James, Chantel. Bayeux Broderie: Embroidered Kits. 2021.

https://www.bayeux-broderie.com/gb/12-embroidered-kits

Kafai, Yasmin B., Eunkyoung Lee, Kristin Searle, Deborah Fields, Eliot Kaplan, and Debora Lui. "A Crafts-Oriented Approach to Computing in High School." *ACM Transactions on Computing Education* 14, no. 1 (2014): 1-20.

Karlsson, Áki Guðni. "Copyrighting the Copies." *The Library Quarterly (Chicago)*, 89, no. 4 (2019): 333-347. https://doi.org/10.1086/704961.

Kelly, Kristin. "Images of Works of Art in Museum Collections: The Experience of Open Access: A Study of 11 Museums." *Council on Library and Information Resources (CLIR)*. Prepared for the Andrew W. Mellon Foundation. 2013. https://www.clir.org/pubs/reports/pub157/.

Kim, Eun-mee, and Soeun Yang. "Internet literacy and digital natives' civic engagement: Internet skill literacy or Internet information literacy?" *Journal of Youth Studies,* vol. 19, no. 4 (2016), 438-456. http://dx.doi.org/10.1080/13676261.2015.1083961.

Kushins, Jordan. *Turn Photos into Line Drawings with a Difference.* https://creativecloud.adobe.com/discover/article/turn-photos-into-line-drawings-with-a-difference.

Lane Community College. 2021. https://libraryguides.lanecc.edu/makerspace/Sewing

Lindahl, Greg. *The Cantigas de Santa Maria: Illuminations.* http://www.pbm.com/~lindahl/cantigas/images/

National Library of the Netherlands. *Medieval Manuscripts.* https://www.kb.nl/en/themes/medieval-manuscripts

O'Callaghan, Joseph F. *The Cortes of Castile-León 1188-1350.* (Philadelphia: University of Pennsylvania: 1989).

Olasina, Gbolahan. "Cultural Expression Using Digital Media by Students." *Journal of African Media Studies,* 12, no. 3 (2020): 351-364. doi: https://doi.org/10.1386/jams_00029_1.

Ricciardi, Paola. "Manuscripts in the Making: Art and Science." *Heritage Science*, 7, no. 60 (2019). https://doi.org/10.1186/s40494-019-0302-x.

Sheridan, Kimberly, Erica Rosenfeld Halverson, Breanne Litts, Lisa Brahms, Lynette Jacobs-Priebe, and Trevor Owens. "Learning in the Making: A Comparative Case Study of Three Makerspaces." *Harvard Educational Review* 84, no. 4 (2014): 505-531.

Tanner, Simon. "Reproduction Charging Models & Rights Policy for Digital Images in American Art Museums: A Mellon Foundation Study." *KDCS Digital Consultancy* (2004): 33-40.

The Metropolitan Museum of Art. *Illuminated Manuscripts.* 2021. https://www.metmuseum.org/search-results#!/search?q=Illuminated%20manuscripts

The Morgan Library & Museum. *Medieval and Renaissance Manuscripts.* https://www.themorgan.org/digital-facsimiles.

The Walters Art Museum. *Manuscripts and Rare Books.* https://art.thewalters.org/browse/medium/manuscripts--rare-books/.

Salvador-González, José María. "The Bed in Images of the Annunciation (14th-15th Centuries): An Iconographic Interpretation According to Latin Patristics." *De Medio Aevo* 15, no. 1 (2021): 77-93.

Shulman, James. "Sustainable Free: Lessons Learned from the Launch of a Free Service Supporting Publishing in Art History." *LIBER Quarterly* 24, no. 2 (2014): 84-111.

University of Chicago Library Libguide. *Guide to Medieval Manuscript Research: Locating and using manuscripts and the digital middle ages.* 2021. https://guides.lib.uchicago.edu/c.php?g=813534&p=5805556#s-lg-box-wrapper-23113317.

Van Lit, L.W.C. *Among Digitized Manuscripts. Philology, Codicology, Paleography in a Digital World.* (Brill, 2019).

Whitman College Penrose Library Libguide. *Finding and Using Images: Image Collections Online.* 2019. https://libguides.whitman.edu/images.

Willey, Eric. "An Examination of the Convergence of Theory in Libraries and Archives." *Archival Issues.* 38, no. 2 (2017): 42-62.

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[i] Ancient stitches based on the Bayeux Tapestry, an artifact from the 11th century, from Normandy, France.

[ii] Creative Commons is a nonprofit organization that helps users to understand the sharing of knowledge and creativity: https://creativecommons.org/licenses/.

[iii] Cantiga is a loose translation of "song" in Spanish.

[iv] The rare manuscript, made up of four known surviving codices, depicts written music and many illuminations about the daily lives in the castles of Castille and León.

[v] The Society for Creative Anachronism is an international non-profit, volunteer educational organization: https://www.sca.org/about/.

[vi] Upcycling is taking a used or incomplete item and turning it into something more useful or better.

[vii] Embroiders' Guild of America is a non-profit organization, offering online, local, regional, and national memberships focused on teaching the art of embroidery. Membership is open to anyone, with many resources offered including classes, workshops, and shared tips for free or for fee: https://egausa.org/about-us/.