The End of Digital Humanities and the Future of Manuscript Studies

Eyal Poleg, Queen Mary University of London (e.poleg@qmul.ac.uk)

We are standing at the edge of a major transformation in manuscript studies. The proliferation of digital surrogates, Digital Humanities analyses and the rise of new scientific analytical technologies, all provide hitherto unknown, and unknowable, information. This article looks at how the field can best integrate these transformations. It argues that any separation between Digital Humanities, heritage science, and manuscript studies is becoming artificial. Concentrating on training programmes for advanced students as a way of reimagining the field, it provides concrete advice for the future of manuscript studies.

The future of manuscript studies is already here. Digital images of manuscripts are proliferating online, becoming a bedrock of research and teaching, as well as inspiring creative memes and social media engagement. New technologies are irreversibly changing the way we consult, study, and communicate about manuscripts - ancient, medieval and modern alike. The outbreaks of Covid has made this even more pronounced, with the need to conduct teaching and research remotely. The rise of non-invasive analytic technologies, big-data tools and the availability of enhanced computing and imaging facilities, combine to transform the technological study of manuscripts. The field, however, seems to be adjusting quite reluctantly to this new reality. In many universities, the training of the next generation of scholars seems to put aside many of the major transformations of the past decades. The possibility of enmeshing digital tools for studying, communicating, and teaching manuscripts has emerged and recently explored in the conference On the Way to the Future of Digital Manuscript Studies (Nijmegen, 2021), which served as the impetus for the current work.1

Manuscript studies is a complex and interdisciplinary field. Students are inducted to become inter- and multi-disciplinary, in a field that builds upon a variety of linguistic skills, as well as auxiliary sciences necessary for analyzing the manuscript’s creation and use. Paleography and codicology explore script and the physical construction of the book, while philology and linguistic analysis address the textual data encoded in its leaves. Manuscript studies have been forward-looking from their onset. Recently, scholars have embraced a more holistic approach, emerging in tandem with the rise of book history, which joins these different facets to look at manuscripts as complex objects, created, used, read and modified over long periods of time.

Digital surrogates have become synonymous with new ways of accessing manuscripts. They have introduced an unprecedented ease into viewing, comparing and analyzing manuscript pages. Rather than relying on inferior reproductions, or, in the best case, huddling around a manuscript, scholars can now view and engage with the smallest details of script and iconography on their own devices. This has been done to such an extent that innovations in manuscript studies and the concept of the ‘digital manuscripts’ has become synonymous with digital images of manuscript pages.

The recent Covid pandemic has accelerated the way we embed digital elements in manuscript research and teaching. As manuscript collections were closed and classes moved to virtual learning environments, teachers, students and researchers grew to rely on digital surrogates. Even tutors attached to well-endowed manuscript collections, who had had the fortune to employ physical manuscripts in their teaching, have begun embracing digital technologies. This has followed already

1 I wish to thank the organisers and participants of the conference for allowing me to present parts of the following paper and receive important feedback. Key ideas were also presented in the workshop: The Digital Medieval Manuscript (St Andrews 2021). I am in debt to Lucie Doležalová and Suzanne Paul for reading and commenting on earlier drafts of this paper.
well established trajectories, evident in the creation and dissemination of paleography modules such as the *album interactif de paléographie médiévale* and Public Record Office palaeography course. Such modules have been used to train generations of students in addition to, and at times instead of, classroom teaching.

The greater reliance on digital surrogates has often been accepted at face value, uncritically. Some greater reflections on the new technology and its impact were made in a recent volume following a conference marking the launch of Parker 2.0, which provides some critical reflections on the digitization of manuscripts and the use of digital surrogates. It advocates not only a critical awareness to ‘the gaps and fissures between material object and print or digital realization open a productive space where we can think through how we relate to these objects’, but also the need of greater transparency in the process of digitization, a claim recently made also in a PhD dissertation by Suzette van Haaren.

The centrality of digital images has sideloaded other innovations in the field. Some of the most exciting developments in the study of manuscripts come from scientific collaborations. The information retrieved by new technologies breaks new grounds in our analysis of the manuscript page. Whereas past technologies often confirmed and quantified what is evident to the naked eye or the trained scholar (e.g. the type of animal whose skin was used as parchment or the density of dirt left by readers and users), new technologies are providing unknown, and hitherto unknowable, information altogether. They supply manuscript scholars with a range of data which would have otherwise been left completely invisible. Technologies are becoming more widespread and affordable, and are gradually embraced by libraries and heritage institutions. Their proliferation is further enhanced by the development of non-invasive procedures (with a few, such as Proteomics and DNA analysis discussed below, being micro-invasive) which do not require physical contact or sampling. This simplifies use and eases gaining the curatorial approval necessary before deploying any new technology to a manuscript. It irreversibly transforms the way we conduct research, and we can no longer ignore, or consider them as an optional addenda to the traditional field.

For more than a decade I have been collaborating with scientists, curators, imaging specialists and developers on new ways of researching manuscripts and early printed books. I have also been involved in a variety of initiatives for teaching advanced students how to work with manuscripts in a digital environment. This short paper provides me with the opportunity to present some of these initiatives, the journey they have entailed, and – importantly – to reflect about moving beyond such ad-hoc solutions to scalable and replicable models.

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2 [https://paleographie.huma-num.fr](https://paleographie.huma-num.fr); [https://www.nationalarchives.gov.uk/palaeography/where_to_start.htm](https://www.nationalarchives.gov.uk/palaeography/where_to_start.htm)
3 Benjamin Albritton, Georgia Henley, and Elaine Treherne, eds. *Medieval manuscripts in the digital age*, Digital research in the arts and humanities (London and New York: Routledge, 2021), and especially especially: Astrid J. Smith, ‘What it is to be a Digitization Specialist: Chasing Medieval Materials in a Sea of Pixels’, pp. 17-24; Siân Echard, ‘Rolling with It: Navigating Absence in the Digital Realm’, pp. 82-90; Catherine E. Karkov, ‘Severed Heads and Sutured Skins’, pp. 190-204.
4 Echard, ‘Rolling with It’, p. 88.
5 Suzette van Haaren, ‘The Digital Medieval Manuscript: Approaches to Digital Codicology’, PhD Dissertation, University of Groningen, 2022.
6 An discussion of the variety of technologies available for scientific analysis of manuscripts took place in a workshop convened by Matthew Collins, Alexandra Franklin and Peter Stallybrass, Oxford, 2017, and summarized in [https://www.science.org/content/article/goats-bookworms-monk-s-kiss-biologists-reveal-hidden-history-ancient-gospels](https://www.science.org/content/article/goats-bookworms-monk-s-kiss-biologists-reveal-hidden-history-ancient-gospels).
I was first introduced to the potential and mechanisms of collaborative technological research through the analysis of an early modern Bible. Working on subsequent uses and transformations of the book, I was intrigued to discover that the margins and empty spaces of the book had been heavily annotated, and later pasted over by thick paper. Unfortunately it proved nearly impossible to decipher these annotations. Invisible to the naked eye, they merge with the other side of the page when using a backlight. Six months of attempts with different types of image manipulation had ended in vain, given the similarity between the ink of both strata. Finally, Graham Davis, Professor of 3D X-ray Imaging in the School of Dentistry at Queen Mary University of London, provided the solution. Working together for a few days, we took fresh images with and without backlight and discussed possible solutions. This has led Graham to write an algorithm subtracting one image from the other, completely cleaning the image and fully retrieving the annotations (Figure 1-3 depict the three stages of analysis: normal light, backlight, and following digital subtraction). We were now able to read the annotations, which contain important information on the subsequent uses of the book, and, crucially, the hesitant course of religious reform in sixteenth-century England.

Collaboration was key. This was done using only a standard DSLR and an inexpensive light sheet, commonly available in reading rooms. Cross-disciplinary communication relied on framing the problem in terms of image analysis, rather than historical context. It was supported by joint work both in examining the book and subsequent photo shoots.

A wider range of technologies, and a more blue-sky approach, characterized a subsequent collaboration with Paola Ricciardi, Senior Research Scientist at the Fitzwilliam Museum, Cambridge. Rather than coming up with a specific problem to be solved, I have identified historically significant objects with possible layers of transformations: Henry VIII’s and Thomas Cromwell’s presentation copies of the Great Bible (Paris/London 1538/9). We were able to secure one book, currently at St John’s College Cambridge, for 3 days’ analysis in the analytical labs at the Fitzwilliam Museum, applying a range of non-invasive technologies and framing new research questions as the analysis progressed.

The title page of the book proved especially receptive to complex analysis. An important starting point has been a modification identified prior to the collaboration: an image of a woman which was transformed to resemble a prominent figure from Henry VIII’s court (figure 4). Raman spectroscopy and X-Ray Fluorescence spectroscopy (XRF) provide clear insight into the chemical compilation of pigments. This has enabled the identification of pigments, which joins more traditional art historical analysis in ascertaining artists and workshops working on the book (and, indirectly, assists in establishing date and provenance). Better appreciation of pigments, assisted also by near-IR imaging, also enabled the reconstruction of the image as it would have been seen in the past, before subsequent modifications by generations of readers and the transformations of materials. This analysis has revealed, for example, that the woman’s dress, which is currently drab grey, was originally dazzling silver. The oxidized silver has modified the appearance of the image nowadays, and its reconstruction changes the balance of the page, revealing the centrality of this person in the original composition (supported also by its use of gold leaf, rather than the shell gold employed elsewhere on the page).

New technologies can support further analysis of elements initially identified by the naked eye. They can also provide information and reveal elements which cannot be detected in other means.

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7 Eyal Poleg, ‘The First Bible Printed in England: A Little Known Witness from Late Henrician England’, Journal of Ecclesiastical History 67:4 (October 2016), 760-80.
8 See Eyal Poleg, A Material History of the Bible, England 1200-1553 (Oxford:Oxford University Press, 2020), pp. 125-7
9 For initial analysis see: Eyal Poleg and Paola Ricciardi, ‘How Thomas Cromwell Used Cut and Paste to Insert Himself into Henry VIII’s Great Bible’, The Conversation 13 Aug. 2020, https://theconversation.com/how-thomas-cromwell-used-cut-and-paste-to-insert-himself-into-henry-viis-great-bible-143765.
The use of microscopes on the same page has revealed hitherto unknown elements within that celebrated Tudor Bible. Microscopy, often employed by conservators, can assist in identifying minute details in the style of scribes or artists. When combined with varying light sources it revealed (as could other, more complex, surface-mapping technologies) modifications to the page. Figure 4, the title page of the presentation copy of Henry VIII’s Great Bible, has commonly been used by scholars of the English Reformation. However, deploying a microscope with raking light (a light source at an oblique angle) has revealed that two of the faces had been painted on a separate piece of parchment and pasted into the book at a later date (figure 5). This modification has been skillfully masked by the Tudor artist, and can only be revealed by the new technology. Pigment analysis has revealed that this transformation was not carried by any of the artists originally working on the book, and most likely took place in a different location. It adds a new dimension to our understanding of the manipulation of the page, and the court politics behind it. These modifications, and others identified in the Bible, shed important light on its creation and use, about which little external information survives.

Following these initial discoveries, and with the support of the Centre for Visual Cultures, Cambridge, we were able to transport the sibling-Bible from the National Library of Wales to the lab. The unique problems posed by this complex object required new means of analysis. The book has pages which appear to imitate its original compilation, possibly a later interpolation. However, pigment analysis suggests this might have been contemporaneous to the creation of the book. Codicological analysis has identified specific bifolia (two connected pages), which were not part of the printed book. However, as they imitate the original campaign, assessing their relation to the original book proves challenging. Here, additional technologies may offer a clue. Proteomics and DNA analysis are becoming some of the most powerful, and under-utilised, codicological tools. Manuscripts are often written on parchment, processed skin which still retains information about the animal from which it was made. For bio-archaeologists the parchment pages of manuscripts and documents are vast depositories of biological information about ancient breeds. This has been spearheaded by the Beasts2Craft project (York/Cambridge/Copenhagen) and was aided by two recent developments. The exponential growth in the commercial and academic use of proteomics and DNA analysis has led to a significant reduction in the size of sample required, and importantly for scholars in the humanities - a decrease in price, making this more and more available for scholars lacking the funding associated with research in medicine or the sciences. New sampling technique introduced by Sarah Fiddyment employs the electrostatic qualities of a common rubber (eraser) to lift protein and DNA samples from a manuscript page. This micro-invasive technology replaced the need to physically remove a piece of parchment, and eases approval by libraries and archives.

The link between proteomics and in-depth codicological analysis has been practiced in a study of a twelfth-century glossed Bible. Unambiguous evidence for the different animals used for its parchment was linked with scribal practices and textual units to present a nuanced view of the book’s creation and codicology. Proteomics has also been used to assess stains in manuscripts and rolls, inferring, for example, on possible uses of birthing scrolls. The technology is not without its limitations. Not every parchment supports full analysis, which could be hindered, for example, by its means of production. More data on ancient breeds and parchment commerce is needed to support the use of these technologies to date and localise manuscripts. However, much like pigment analysis, a more comparative approach can provide important insights. In the National Library of Wales’ Bible, for example, we are currently employing DNA analysis to question whether leaves

10 Sarah Fiddyment, Bruce Holsinger, Chiara Ruzzier, Alexander Devine, et al. ‘Animal origin of 13th-century uterine vellum revealed using noninvasive peptide fingerprinting’, Proceedings of the National Academy of Sciences 112:49 (2015), 15066-71.
11 B. C. Barker-Benfield with Andrew Honey and William Zachs, The Glossed Luke with the Letter A: A Manuscript from St Augustine’s Abbey, Canterbury (Edinburgh: Blackie House, 2020).
were inserted at a later date, or were part of the original compilation of a book. Swabbing adjacent leaves and looking whether these share a DNA profile can help in supporting this codicological inquiry in new ways. This is a prolonged process, and sequencing is currently taking place, with results forecasted in the coming months.

Reflecting upon these projects, informed and honest communication has been key in ensuring their success (and an important shortfall when recalling failed collaborations). It necessitated me to move away from seeing technical analysis as a service provided to scholars. Rather, it is a joint endeavour, done as collaborative work – the historian needs to be present throughout the analysis, and engage in ongoing dialogue with scientists, curators and technicians. There is an important learning curve, and a need to understand key facets of analytical technologies, and especially their potential and limitations. Appreciating the limitations of these technologies has enabled moving away from ascertaining absolute information on date and provenance into the wide possibilities of a more comparative approach, rewriting research questions and developing further methodologies.

These collaborations have opened new directions for employing analytical technologies in the historical study of ancient books, and revealed hitherto unknown facets of their creation and use. I would not, however, hurry to adopt a triumphalist tone. These were ad-hoc collaborations. With nearly zero-budget they relied on the good will of colleagues, research teams, libraries and labs. They originated not within institutional hubs, but rather in random meetings which grew to fuller collaborations. In many ways, they were not part of institutional culture, but rather required us to break away from it, taking time off to achieve this analysis. They were made possible by being in a privileged position, on open-ended contracts and embedded in some of the world’s leading heritage institutions. Junior colleagues, those on precarious contracts, or outside leading research and heritage centres, would have found that creating and running similar projects would verge on the impossible.

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An obvious place for such collaborations should have been centres of Digital Humanities, a natural hub for collaborations which have innovated the field of manuscripts studies. Since its inception Digital Humanities has led in the development of tools and research strategies, and, more widely, in embedding novel technologies into the heart of humanities research. Its origins within Humanities Computing, often linked to corpus linguistics, relational databases and textual analysis, have led to major advances in the analysis of textual corpora. Closer to our field, digital philology has utilised novel means of textual comparison to infer on the relationship between historical texts and their manuscript witnesses. Important work has also been done in image recognition and Handwritten Text Recognition (HTR) of manuscripts.\(^\text{12}\)

Digital Humanities and new technologies are intrinsically intertwined with major methodological shifts within manuscript studies. The rise of the New Philology, for example, was contemporaneous with, and facilitated by, the proliferation of digital surrogates. At the centre of traditional philology is the critical edition, the informed scholarly reconstruction of a text, disseminated through printed editions in books and journals. New Philology, on the other hand, concentrates on the individuality of each manuscript. This requires a greater ability for scholars and students to consult each, either in person or through a surrogate. It cannot be facilitated by a plethora of facsimiles (often expensive and complex to produce) and would not have been possible before the dissemination of digital surrogates. A greater awareness to the materiality of manuscripts was manifested before the mass-dissemination of digital surrogates. Its reception, however, was facilitated by this technological leap and flourished in the same academic environment. The side-by-side growth of technology and

\(^{12}\) As, for example, Transkribus (https://readcoop.eu/transkribus/).
methodology is evident, for example, in the Roman de la Rose Digital Library (https://dlmm.library.jhu.edu/en/romandelarose/, commencing in 1996) which aims to provide digitised surrogates of all manuscripts of the Roman de la Rose, without giving clear preference for one over the other, or highlighting specific textual qualities. It is therefore not a surprise that Stephen G. Nichols, the project’s director and instigator, was also the editor of the 1990 edition of Speculum which was instrumental in ushering in the New Philology (although digital technologies did not feature prominently in that issue). 13

Innovations in Digital Humanities and digitization of manuscripts are presenting a parallel way of revolutionizing manuscript studies. The proliferation of high-quality digital surrogates of manuscripts is embraced by scholars and students, saving the need to travel to collections far and wide, or invest one’s life savings in procuring high quality colour images. The adoption of IIIF protocols by libraries and heritage institutions encourages interoperability and opens up new directions for scholarly engagement. IIIF tools such as Mirador (https://projectmirador.org), were created to facilitate the comparison between different manuscripts, an extremely complex endeavor only a few decades ago. Such new technologies have had immense impact on manuscript studies, and ushered unprecedented ease into palaeographical and art-historical comparative analysis.

Centres for Digital Humanities are loci of research and teaching, attracting funding and offering specialised teaching and support for scholars across faculties. As funding bodies expect, and at times require, digital facets of research projects, these centres also assist in facilitating this facet of humanities research. However, one may ask whether the discipline of Digital Humanities has reached a point it risks damaging, rather than developing, the discipline of manuscript studies. Digital Humanities has taken a specific trajectory, which should now be reconsidered. The origins of the field within information technologies and linguistic analysis have shaped it ever since, centering on the analysis of text and image. Databases, mass-analysis of text and textual variants, or image analysis are all hallmarks of Digital Humanities. Heritage science, on the other hand, has rarely been incorporated into the field of Digital Humanities. 14

Manuscripts - ancient, medieval and modern alike - are not only depositories of texts. As highlighted by manuscript scholars and book historians alike, they are also complex objects containing information which extends far beyond the text retrievable from their pages. Viewing manuscripts as complex objects quickly moves us away from the primarily textual and image-based tools traditionally used by scholars of Digital Humanities. Rather, it leads us to deploy tools which are often the reserve of archaeologists and conservators. These are practiced by imaging technicians and heritage scientists, who traditionally tend to be affiliated with museums and conservation departments.

Innovative technologies both within and without Digital Humanities are transforming the study of manuscripts by providing new information, unattainable in more traditional means. In this new environment, the disciplinary separation between manuscript studies and Digital Humanities seems more and more artificial. Can manuscript studies as a field of studies exist as separate from digital imaging or technological analysis? What is the place of the traditional skill-set employed to study manuscripts, and how can we imagine working on manuscripts in the new reality?

The rapid advanced in technological analyses of the page do not replace the manuscript scholar. New technologies cannot substitute traditional disciplinary training in palaeography, codicology, art history etc. Rather, they add new information to support further, more complex and better informed, scholarly analysis. A useful litmus test for assessing the place of new technologies within

13 Speculum 65:1, ‘The New Philology’ (January 1990).
14 The exception is the use of multi- and hyper-spectral imaging, commonly used to retrieve erasures and analyse palimpsests.
manuscript studies is the training offered to advanced students in manuscript studies. Such training (primarily on graduate and postgraduate levels) reveals not only the current state of the field, but also the ways by which we think about the next generation of scholars. It can also serve as a way of reimagining the future of the field, and its complexities.

In many universities the separation between manuscript studies and Digital Humanities is manifested in teaching provisions. There, training in manuscript studies is commonly reserved to the ‘traditional’ disciplines (e.g. palaeography, codicology, art history or philology), with digital components being an add-on or optional modules. Digital modules likewise rarely include more traditional means of manuscript study, and often focus primarily on the digital perspective of manuscript analysis and presentation.

The need to integrate Digital Humanities and scientific analysis into manuscript studies is evident. Training the next generation of scholars and defining the field of manuscript studies requires another key consideration. Current training in manuscript studies is aimed at providing tools for active engagement with the manuscript. Palaeography, codicology, philology or art history supply advanced students with the practical skill-set necessary to actively study manuscripts. They enable students to critically reflect on the work of past scholars, while also, importantly, conducting independent research. The move to greater use of digital surrogates should follow a similar trajectory. Students should not be designated solely as recipients of new technologies. While courses do allude to the existence of new technologies, only a handful extend to train students in these technologies. We should support students in becoming both informed end-users of the new technologies, as well as design ways of integrating them into their own research. This should apply to the entire gamut of the new technologies, from working in imaging suites, through using commercial and custom-made tools, to the creation of new digital resources. Unlike other skillsets, however, they cannot be expected to manage this all on their own. Rather, by experimenting with these technologies in their own projects, students would develop a better and more informed appreciation of their potentials and limitations as active users.

The rise of new technologies leads to an inevitable conclusion. There is a greater need, if not a necessity, to reimagine manuscript studies as embedded within new forms of analysis. The traditional tools of manuscripts scholars — palaeography, codicology, stemmatology, or art-historical analysis — should be joined by coding, imaging technologies, spectroscopy and proteomics. This would support not only a more informed study of manuscripts in their fullest extent, but also the ability to develop and conduct truly interdisciplinary research projects.

Filling this lacuna is far from straightforward. Changes to graduate teaching and diminishing prospects of academic careers mean that many of our students would not be, nor should be solely taught to become, the academics of tomorrow. Shortening of MA programmes and working within a highly competitive market further complicates the place of manuscript studies. Even without this additional plethora of training requirements, students in intensive manuscript courses are subjected to a training-overload. Unlike other degree programmes in the humanities, in which training requirements are often minimal, students undertaking a manuscript-centred degree are often required to master ancient and modern languages, as well as manuscript-specific skill-sets, from deciphering historical scripts to reconstructing the compilation of a codex. Some of this training is complex and cannot be taught en masse. In an academic environment in which manuscript-centred degrees are already in a precarious position, increasing the demand on students would make them completely untenable. Furthermore, fully embracing the new technologies would move students, who have been training within the humanities, completely out of their comfort zone. It would
require them to adjust to the natural sciences, with methods and discourse for which they have not been training.

For more than a decade now I have been running digitally oriented training programmes for advanced students in manuscript studies. These have provided me with an opportunity to develop and reflect on methodological needs, potential and limitations, while receiving important feedback from generations of students. Some of the programmes were embedded into universities’ curriculum, while others were multi-national training opportunities; some catered for a specific skill-set while others were more reactive and versatile. As a whole, they gradually moved beyond traditional teaching provision to begin reimagining our training offering. The majority of our modules are still taught in weekly sessions. There, teachers aim to provide an entire class with a mostly uniform skill-set necessary for consulting and researching manuscripts. Experimenting with a range of teaching programmes has led me to see the possibility, if not the necessity, of moving beyond this paradigm to embed the use of new technologies within our curriculum. This moves us away from thinking of manuscript studies, Digital Humanities and new technologies as separate disciplines.

My first brush with teaching new technologies in manuscript studies was an optional module offered to MST students in Oxford (2012/13). Digital Manuscripts introduced graduate students to the theory and practice of digital editions in the first term. In the second, funding by the Oxford’s Teaching Project Award was aimed at providing a developer to work alongside the students on their editions. This, I regret to say, has never materialised. Despite some students preparing fascinating editions, the work with the developer stalled and then retracted altogether. Change of personnel, the two-stage plan, and the lack of allocated time to liaise and supervise this work, has led to its failure. Together with other complications arising from working alongside developers in past projects, this had demonstrated to me that collaborations with developers cannot be taken for granted. Such work should not be seen as an ad-on component, additional to the core of teaching programmes or research projects. Rather, there is a clear need for students (and faculty) to be gradually initiated into collaboration with IT specialists in a supportive environment, a key part of training in the digitisation of manuscripts.

This collaborative approach was further developed in a three-year training programme generously funded by the EU’s Erasmus+ scheme: Digital Editing of Medieval Manuscripts (DEMM, 2014-17). Each year, students from participating universities across Europe came together for three one-week training schools, each week introducing an area less commonly studied in manuscript classes. The first week provided training in philology, initiating students into critical editions, and supporting their own research on medieval texts. The second week was an intensive immersion in TEI. Students then went back to their home institutions and were supported in encoding part of an edition they were working on. In the last week the students brought their encoded text and liaised with developers to prepare it as an online edition (which were subsequently published on https://www.digitalmanuscripts.eu).

The rationale of the training programme – short bursts of teaching and workshops interspersed with independent work of students – proved a meaningful learning experience, not inferior to that achieved in a more traditional classroom. Running the programme was complex, not the least due to its nebulous admin and finance (whose brunt was selflessly bore by Lucie Dolzalova, Charles University Prague). However, it was the third week which proved most challenging. Initial attempts to work alongside professional developers or advanced Computer Science students proved too challenging for all those involved. Communication problems and managing expectations became paramount. To assist in achieving a meaningful collaboration within a short span of time, we resorted to working alongside developers with some background in the humanities, which significantly eased communications with students. The funding of the project uniquely enabled
students to travel across Europe, providing accommodations, and – importantly – paid for developers and admin support. It also added a significant burden for the organisers, and limited the scope of the programme to three years, preventing fully embedding it in each university’s curriculum.

When funding ran out, the convenors wished to continue providing similar training, leading to two separate training projects: *Digital Scholarly Editions: Manuscripts, Texts, and TEI Encoding*, a week-long school for students from Lyon, London, Prague, Budapest, Bratislava and Tokyo, was convened by Marjorie Burghart and ran as a ‘flipped classroom’ - online course followed by in-site practical sessions. Yearly one-week immersion classes on TEI were funded by the French Regional Government, and brought students and staff together in a combination of practical workshops and project presentations. Its funding ended in 2021.

*Hands:on* is an annual teaching collaboration between Queen Mary University of London and Cambridge University Library.15 Students from the UK, Europe and beyond join for a week-long hackathon, working with curators and developers to produce digital prototypes for consulting manuscripts online. Each year’s hackathon has a different theme, linked to current or forthcoming exhibitions or research projects (which we term ‘client’). Thus, for example, the 2019 hackathon supported the Palimpsest exhibition at Cambridge University Library, the 2022 hackathon (following two-year Covid hiatus) linked to a forthcoming Silk Roads exhibition at the British Museum, and in 2023 we will be part of a project on medieval medical recipes. Students receive light-touch online training in soft-skills such as product design and project management prior to the hackathon. The programme does not aim to produce fully functional products, but rather proofs of concept – innovative prototypes which present novel means of engaging with manuscripts online. Students break into groups, ensuring each group has members with and without coding experience. Each group chooses a user persona (such as a retired schoolteacher, a bored teenager, or an academic researcher) and create a prototype for them. The groups then work to first create a mockup and then digital prototypes, which are user-tested before finalised and presented to a wide audience of academics and curators. The ‘client’ is then supported in utilising the prototypes and transforming them into fully functional web resources. The funding structure of the programme breaks away from past initiatives, as it does not rely on external funding, nor on students paying their own expenses. Each participating university funds its own students, and additional costs are kept at a minimum (and mostly covered by the project’s ‘client’). This has enabled us to avoid short-term funding cycles. As the programme is cost-neutral, we can keep it open-ended, enhancing the possibility of incorporating it into universities’ curriculum.

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Some of the abovementioned collaborations started in running clubs or playground talks; they were ad-hoc initiatives based on past acquaintanceship or luck. How to transition these disparate research and training programmes into scalable and replicable programmes? Training here is key – teaching how to efficiently collaborate with non-academics both equips the next generation of scholars with key tools, while intrinsically being linked to current research and dissemination. Universities celebrate research-led teaching. Here is an opportunity to engage in teaching-led research, in which collaborations created in teaching programmes would support research of advanced students and faculty alike. The combined experience of these training programmes has led me to identify key traits, which could assist in rethinking how to integrate innovative training within manuscript studies:

15 The programme is convened by Mary Chester-Kadwell and Suzanne Paul (Cambridge University Library), Chris Sparks and Eyal Poleg (Queen Mary University of London).
1. **Agile.** To avoid a training overload, there is a need to reimagine our teaching provision. Rather than providing a blanket training to entire classes, training should be agile, on-demand, and, inevitably, partial. Most students, for example, do not need to learn the entire gamut of Western scripts 500-1500, nor full knowledge of XRF spectra analysis. Both traditional manuscript skills and implementation of new technologies should be tailored to students’ projects, and would, when brought together, provide students with a unique and bespoke learning experience. Being responsive to students’ educational needs would lead to tuition that is more relevant, and better suited, for emerging projects and career development. Such training would focus on teaching students how to conduct interdisciplinary research projects, which would better serve them both within their degree programmes and hereafter.

2. **Flexible.** Some topics, especially those requiring repetition and long gestation time, are perfectly suited for weekly classes. Others, however, are not. Past training programmes have surprised us in showing that intensive weeks provide an equally significant learning experience to weekly seminars and lectures, as does the combination of online and on-site training. This type of immersion experience assists in initiating students to new types of work. This is hardly a novelty, as such models have been used by students and practitioners in computing and the sciences, where the model of the hackathon was developed. Such flexibility also enables bringing together a wide range of expertise for a limited period of time. Joining together of developers, curators, conservators and advanced students is more likely to occur in a condensed week training, than in a term-long weekly sessions.

3. **Cross-Institutional.** These are complex, bespoke and often niche training programmes. One would often struggle to recruit enough students from a single institution to justify the investment of staff time and additional resources necessary for an immersive training programme. National and international collaboration ensures full attendance by keen and suitable students. They require an additional level of administration and support, while going against some universities’ managerial imperatives and financial structures. They lead to networking opportunities and to establishing future scholarly communities and collaborations, and are supporting on-demand and bespoke learning. Only by stopping to think about each university as an isolated bastion of learning can we truly embed the multitude of disciplines necessary for manuscript studies in the new era.

4. **Practical.** Embracing the Hackathon model assists in rethinking goals and assignments. Universities often employ imagined assignments, in which students’ work is viewed only by, and relevant only to, the module’s tutor. Some manuscript modules have moved away from this, harnessing their students’ work to further knowledge and support cataloguing of manuscripts. New technologies lend themselves more easily to practical implementations, which is a model we have embraced in different training programmes. This could be either students’ individual projects, which they then publish online to further academic knowledge, provide them with early scholarly engagement, and serve as a significant boost for their CVs. It could also be harnessing an entire training programme to support a research project or an exhibition, in which students gain practical experience and a significant output. The commissioning institution is offered a unique way of improving their digital environment and the necessary time to engage with aspects such as product design or user testing, often sidelined in academic projects.

5. **Collaborative.** Moving to a truly cross-disciplinary training programme necessitates relying on a wide array of skills which are beyond the remit of a single individual, and often not found even within the same department or institution. Training should be delivered by, and with, historians, palaeographers, philologists, scientists, curators and developers. It should bring together universities and non-higher education institutions, such as libraries, archives and museums. Past experience has revealed this to be a challenging endeavour, and one which requires careful planning and execution. One cannot take for granted efficient cross-disciplinary work and collaboration; it must be managed and maintained. Such collaborative experience, however, has an immense value in itself and serves as an important learning opportunity for students, preparing them for work both within and without academia.
6. **Soft Skills.** This topic is often sidelined within university training, which tends to prioritise hard disciplinary skills such as palaeography, codicology, or languages. However, reflecting on past training programmes and their long-term benefit for students, it is evident that soft skills take a central role, and serve students’ future endeavours. Crucial for collaborative work, as well as future research, are project- and time-management, communication skills and product design. This are fully transferable, and invaluable for managing research projects. They are rarely supported in humanities studies, but cannot be taken for granted. In past training programmes we taught these through a combination of online modules and on-site hands-on training, which also provided an opportunity to experiment with this in a supportive and reflexive environment.

Embracing new teaching initiatives and integrating new technologies into manuscript studies is a necessity. While often seen as a stronghold of traditional teaching, manuscript studies is one of the most innovative and forward-looking areas of academic pursuit. It also has the potential to transform the field, making it a model for humanities teaching in the twenty-first century. Other disciplines such as history, literature, geography or material culture would likewise benefit from similar approaches. This transformation needs to start with the teachers. It aligns with the EU’s educational strategies of *Teaching the Future* and *Pedagogics to the Max* (https://knowledge4policy.ec.europa.eu/diversification-education-learning_en#megatrend), reflecting much of the abovementioned changes necessary to manuscript studies. They also highlight the high expectations this sets on educators, moving them beyond their comfort zone and into new pedagogical realities. Any transformation of the field would first come from the teachers.

Transforming the field would provide an immense service to our students, their academic capacities and future employability. It would also serve to change the way we study, teach and research. In this new reality, Digital Humanities can no longer exist as a separate entity, nor can manuscript studies as a discipline devoid of technological advances. Only by a complete disciplinary merger could we truly embrace the future - and present - of manuscript studies.

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Figure 1 Hidden annotations under normal light. To the naked eye this appears to be a blank page. The verso of the title page in Berthelet’s Bible (Lambeth Library copy SR2 E75 [1535]). © Lambeth Palace Library, London.

Figure 2 Hidden annotations with backlight. With a light source behind the page, annotations and printed text are mixed together. The verso of the title page in Berthelet’s Bible (Lambeth Library copy SR2 E75 [1535]). © Lambeth Palace Library, London.

Figure 3 Hidden annotations following digital subtraction. An algorithm, developed by Prof. Graham Davis, QMUL, allows us to virtually ‘peel’ the layers, revealing an English table of lections. The verso of the title page in Berthelet’s Bible (Lambeth Library copy SR2 E75 [1535]). © Lambeth Palace Library, London.

Figure 4 Hand-coloured title page of the Great Bible. This lavish image contains significant modifications of the original printed title page (Cambridge, St John’s College, copy Bb.8.30). By permission of the Master and Fellows of St John’s College, Cambridge.
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