German Art History Students' Use of Digital Repositories: An Insight

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Abstract. The paper describes a study on art history students' research behavior and needs connected to digital resources and repositories. It tries to identify aspects of and approaches to improving and developing these repositories. These students make up a large proportion of the users of digital libraries and their content; their supposedly distinct attitude and skill level concerning technology renders them an important group to observe. Qualitative data derives from three focus groups with 25 students from two German universities. Thematic analysis is based on questions concerning research approaches, curriculum, and the students' connected desires as avid users of technology in everyday life.

Keywords: Digital libraries · Art history · Human information behavior · Qualitative research · User study

1 Introduction

Innovation occurs in research support structures like archives, libraries, and museums [1]. Recent developments have forced many libraries and facilities to close down and only operate online, making the need to offer users digital access more obvious. While digitization is still very much on the minds of most libraries and repositories, they are aware that needs are changing. Wanting to update their interfaces and make their digital supply more accessible and usable, they are turning their attention toward the users. This paper examines the idea that digital libraries and especially digital image repositories can support and improve art history research in many ways, particularly for its students. On another note, it might uncover ways for repositories to reach students and therefore grow their user group.

Previous research concerning developments and improvements in libraries and repositories has focused on evaluation and reviews [2–8], looked at technological advancements in general and their potential for development in repositories [9–11] and the discipline of art history itself [12–17], or examined the behavior and needs of advanced scholars in art history and the humanities [18–27]. Findings are always very similar regarding improvements (metadata, usability of interfaces and functions, information on digitization, amount and quality of data available) but seeking and handling images poses additional challenges that have received less attention.

Art historians are hesitant to adopt new technologies [28], so art history students as a user group with similar information and especially image needs [29] seems a promising line of enquiry. To date, art history students have only been included in studies providing instructions for their online research [30–32] or for advice on how to deal with teaching in the digital age [33]. Studies on visual [34] and information literacy [35] provide interesting insights into student skills but do not consider art historians. Students are more comfortable with using social media. So far, social media has only been considered as a means of communication and exchange with peers [1] but it is thought to have greater potential and impact on art history that needs to be exposed [3].

Many studies comprise international views and findings and do not pay specific attention to the situation and issues in Germany. The German art history community is still concerned with debating pros and cons of digital art history [36]. This paper focuses primarily on art history students as users of digital image repositories. It is expected that the German situation differs from the international one because of the way students are taught at university and their use of local solutions for research.

Regarding differences between students and established scholars of art history, experts are able to define their information needs and suitable search approaches well due to their prior knowledge of the subject and sources [26, 37]. Students have not gained a thorough insight into possible research areas and all the available sources. But their experience and attitude toward digital content and new technologies make them an interesting group to investigate.

To gain insight into how art history students use digital repositories, their investigative practices within the research setting need to be explored. Information and image seeking is the active and intentional behavior to satisfy the information need connected to the research for assignments [38] and includes planning, executing and evaluating a search [39]. Browsing is another way to satisfy a very loosely defined information need [40]. Information seeking has changed somewhat with the development of digital content and online solutions. Before digitization, finding an image involved just three tasks: describe, search, and interact [41]. Now, it requires understanding digitization, online search features, presentation software, and manipulation software [1].

2 Intention and Research Questions

This is a study of students who are connected to the academic environment and obliged to meet scientific standards for their seminar assignments, which places them in the position of an apprentice investigator [22, 42]. Their motivations and approaches when seeking information and images differ from those of the general public but they are not as experienced as advanced scholars. Their assignments pose as traditional research interest in art history on a smaller scale. But students might have a different attitude to new technologies and opportunities for research and a higher skill level in this due to their private use of media and technology.

The main intention is to identify aspects and approaches of how digital repositories can be improved to address the needs of art history students. The connected research questions are:

- How do students approach and structure their research for assignments and when do they rely on online resources and digital image repositories during the process?
- Do their private interactions with digital technologies influence their approaches and desires for new resources and features?
- How do general habits of art history and the curriculum impact their research actions?

3 Research Design

The findings presented here are derived from three focus groups held by the author in September 2016, June 2019 and January 2020[1] (see Table 1).

The focus group method was chosen because the topic of students' research is very broad, linking many complex aspects, and a qualitative approach is suitable. It is a way of exploring the students' opinions and experiences; statements can be discussed and clarified on the spot [43]. The use of different image repositories and platforms is very much connected to individual preferences and research routines but students may also agree on certain standards and habits. The sampling was designed to investigate their approaches, perceptions, and thoughts with regard to their different levels of experience. The first focus group helped to get data from students at the very beginning of their academic career. The purpose of the second cohort was to collect data from slightly more advanced students at a different university. The last group provided an insight into changes and ideas related to working on bigger assignments like a thesis, because the participants were further into their studies. During the first two focus groups new behaviors and questions had emerged. With the third focus group, saturation was reached.

Using interview guidelines, focus groups provided a semi-structured way of collecting data. Multiple rounds focused on the same topics but different reactions and discussion arose; direct feedback by peers offered a broader perspective [44]. Having groups with the same level of experience ensured that participants could discuss experiences and challenges without being intimidated by more advanced students. The small group size helped every participant to engage.

An initial survey with the first focus group in 2016 focused on the step-by-step process of research for a traditional art history assignment [3]. This was done so the process could be classified based on information behavior models and helped to identify stages when new approaches and features become relevant. The focus here is on the use and perception of online platforms and repositories for information and image seeking.

3.1 Focus Groups and Participants

The first focus group was carried out in September 2016 at the University of Würzburg, Germany and involved 15 students from the art and architectural history program. The majority of them were just a few semesters into their bachelor's program. The students were recruited during a seminar on certain architecture and buildings of the city of Dresden. The main aim was to investigate how students deal with seeking images for

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[1] The two-and-a-half year gap between the 1st and 2nd cohort was due to the author's extended parental leave.

Table 1. Overview of focus groups

Number of participants	Length of focus group	University	Details of participants
1st cohort in September of 2016			
15	1 h 20 min	University of Würzburg, Germany	Sex: 4 males, 11 females Age: 20s to 70s Experience: 2nd and 4th semester of bachelor's program, 2x third age learning program
2nd cohort in June of 2019			
5	3 groups: 30 min, 23 min, 15 min	Technische Universität (TU) Dresden, Germany	Sex: 5 females Age: 20s Experience: 6th semester of bachelor's program and 2nd semester of master's program
3rd cohort in January of 2020			
5	30 min	University of Würzburg, Germany	Sex: 4 females, 1 male Age: 20s and 60s Experience: 1st semester of master's program; 1x third age learning program

a seminar assignment. The moderator prepared a guideline with questions in advance, which was slightly altered or extended for the following focus groups (see Table 2).

The second focus group was carried out in June 2019 at the TU Dresden, Germany. At the beginning of different lectures on the art history program, students were recruited. Five students agreed to take part. The participants named art history as their major and either English studies, Romance studies, or philosophy as their minor. Due to timetabling, the group was split up for the focus group. Three consecutive rounds (2 participants, 2 participants, 1 participant) were carried out which lasted 30 min, 23 min, and 15 min.

The third round in January 2020 was a focus group with five students from the University of Würzburg. Again, the participants were recruited during a seminar on architectural structures and developments in Dresden. Four students had completed their bachelor's degree (including a thesis) at three different German universities and just started the master's program in Würzburg. One had chosen two majors, art history and English studies, the other three had abandoned their minors. All participants took part in the same 30-min focus group.

Table 2. Overview of questions in the interview guideline for each of the three focus groups

Focus group 2016	Focus group 2019	Focus group 2020
How did you approach your research work?		
x	x	x
What type of source material do you search for?		
x	x	x
What criteria are important to you when selecting pictures?		
x	x	x
Where and how do you search? Which databases, repositories, and sources do you know and use?		
x	x	x
How do you know the repositories you mentioned?		
x	x	x
What are your alternative sources when the results that the repositories provide are not satisfactory? Would you turn to social media platforms for images?		
	x	x
Does your university offer a seminar or any material on scholarly practices within art history?		
	x	x
Do you miss any functionalities for repositories or software solutions for data analysis during your research process?		
	x	x
How do you come up with and develop search terms for the (digital) repositories and platforms you use?		
		x
Are you aware of any current trends in the research landscape or any advances concerning digital art history? Does this topic come up in any of your lectures or seminars?		
	x	

3.2 Data Preparation and Analysis

Thematic analysis was applied to identify, analyze and report themes within the data [45]. The focus groups were recorded using handwritten and audio recordings with the consent of the participants. The audio was transcribed using AmberScript.[2] The automatically generated transcripts relied on speech recognition and needed some editing to ensure correct, clean transcripts of the focus groups. The transcripts were analyzed through coding using the software MaxQDA.[3] Coding helped to identify patterns in the students'

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[2] AmberScript is a software that automatically transcribes audio into text using speech recognition. See https://www.amberscript.com.

[3] MaxQDA is a software program for computer-assisted qualitative data analysis. See https://www.maxqda.com.

responses [46–48]. The open and inductive coding allowed for multiple codes [49] which led to the themes discussed here.

The study has several limitations: 1) the small number of participants from just two German universities, and 2) the presence of the lecturer (during the focus group in 2016) and of fellow students may induce social desirability bias. The focus group styles were slightly different each time, which of course affects the outcome and to some extent the comparability. However, the mentioned topics and responses were of interest and not necessarily directly comparable between the three groups.

4   Findings

All students stated clearly that they strictly distinguish between a) phases and b) sources dedicated to gathering textual information in the beginning and visual data later on. The findings which will be discussed in this paper are related to 1) information seeking, 2) image seeking and 3) curriculum.

4.1   Information Seeking

Prior to picking a topic for an assignment, the students usually make use of a preliminary search and evaluation of authoritative writing on the designated object or subject. To explore the topic first, they often turn to an online library catalog, and some also use Google to identify new keywords.

Seeking profound textual information is part of the very beginning of research work even before students may come up with a hypothesis and arguments. Hence, their further actions are very much influenced by what they come across. Before browsing the library shelves, students use the online library website to identify and locate suitable sources. During the focus groups, the students named ways of gathering additional information mainly through references in books and other people's work, citations, and indexes, as well as looking at nearby shelves.

Although all students named the library as their first choice for textual information, they did turn to other online resources when they were desperate for material.

It is important to point out that they are not at all inexperienced with the use of online platforms for more recent articles due to assignments for their minor subjects:

As I said, essays online, there is just not much available for art history. In English studies I often do research digitally at home and can download the essays directly as PDF documents. [Question by moderator: So there are other solutions you use for your minor?] JSTOR most of the time. They don't have everything, but you can find a lot more. And most importantly, a lot more recent articles from the last few years. It is hard to get those through other ways than digital platforms.[4] (January 2020, 1ˢᵗ semester of master's)

JSTOR, a digital library for academic journals, was named as a solution for minor subjects a few times.

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[4] Any quotes from the focus groups are the author's direct translations from the German transcript.

4.2   Image Seeking

When searching for images, the students usually look for either digital or digitized photographs or digital images of art pieces such as paintings or sculptures. The only visualizations potentially enriched with additional information that were mentioned were maps:

The only other thing I have used for art history is actually Google Maps. When it comes to architecture, for example, to show geographical distances. This building is far away from the city center or any other building. (June 2019, 6th semester of bachelor's)

All participants preferred to use digital images instead of digitizing images themselves. The resolution was the main quality criteria for a 'good image.' Quantifiable resolution was not important, only the need to be 'not blurry.' Correct color display was also mentioned:

[Question: How do you cope with possible color deviations?] Compare [many images] to estimate the average colors. But it is almost standard for a good reproduction to have this color strip included. If I find an image with it, then this is my preferred choice. (January 2020, 1st semester of master's)

The students are very aware of time-consuming tasks—e.g., digitizing images and creating visualizations—and many only consider making this much effort when they are in desperate need or the assignment is of greater significance, like a thesis. They are aware that it is accepted in art history to use one's own camera for digitization.

If you want to put more effort into it, for example for a bachelor's thesis, you can also photograph it [the object] yourself. (January 2020, 1st semester of master's)

Students prefer to get as many search results as possible and are frequently afraid that relevant images are left out due to restricting search terms.

I think I always approach it relatively inconveniently, because often, if your search terms are too specific, many images are not included in the results. Therefore you tend to enter less and then have to search through more. (January 2020, 1st semester of master's)

It seems metadata are in general less important for students then they are for advanced scholars.

This is also the question of how many pictures to choose from? If the [additional] information is not there and I have only a few images I don't care. But if I have information, then I would rather choose an image where I know there is more available. Because it comes across as more scientific or certified. Whether this is true, I don't know. (June 2019, 6th semester of bachelor's)

Repositories and Sources for Images.   Table 3 provides an overview of all sources for images mentioned by the students.

Table 3. Overview of mentioned repositories and sources used for image access

Repository/Source	Comment
The Prometheus Bildarchiv[a]	Known to all participants and almost always mentioned instantaneously; recommended by university staff during early semesters; usually university staff assists with setting up access
Image database of the university's art history department[b]	Usually set up with easyDB,[c] and referred to by many students as easyDB of [university]
Website of a museum	Digitized images the museum provides
Foto Marburg[d]	Mentioned several times
Artstor[e]	Mentioned once
Deutsche Fotothek[f]	Mentioned once
(Google Images)	Students are aware that Google redirects to the actual resource
Wikipedia	Mentioned several times, especially by younger students
Instagram	Mentioned several times and for different scenarios
Flickr[g]	Mentioned several times during the 2016 focus group as a way to get images with transparent copyright handling; never mentioned during the later focus groups
Travel-related sites and blogs	Typical vacation pictures and selfies are not desired

[a]The Prometheus Bildarchiv is a distributed digital image archive for research and education mainly focused on art and cultural sciences. It belongs to the department of art history of the University of Cologne, Germany. See https://www.prometheus-bildarchiv.de

[b]Before the rise of digital images, art history departments had their own slide collections for students and staff to use for lectures and research work. Now, many departments have digitized their stock and make it available to their associates through their own online solutions.

[c]easyDB is a Digital Asset Management System developed in Germany. See https://www.programmfabrik.de

[d]The Deutsche Dokumentationszentrum für Kunstgeschichte – Bildarchiv Foto Marburg (German documentation center for art history) is an image archive with a focus on art and architecture belonging to the Philipps University of Marburg, Germany. Their online portal for search is called Bildindex der Kunst & Architektur. Foto Marburg and Bildindex are used interchangeably. See https://www.bildindex.de

[e]The Artstor Digital Library provides access to curated images from reliable sources for education and research. See https://www.artstor.org

[f]The Deutsche Fotothek is a picture library and universal archive dedicated to art and cultural history. See https://www.slub-dresden.de/sammlungen/deutsche-fotothek

[g]Flickr is an American image hosting service that was especially popular while it was owned by Yahoo! (2005–2017). In the past years its popularity has significantly decreased.

Most students were completely satisfied with their small selection and did not see the need for many other resources. Apparently, there is a lack of awareness concerning resources. However, it does not seem to pose an issue for the students:

[Access to Prometheus] was actually set up at the beginning. I didn't even look at Google anymore to see if there were any pictures. I only searched there for images for my essays. (June 2019, 6th semester of bachelor's)

Several students stated that they have always found what they needed:

[Question: What if you don't find it on Prometheus?] This has never happened before. Sometimes it was my fault that I didn't enter the search term correctly or it was too specific and the website was a bit overwhelmed. But actually it has never happened that something was not there. (June 2019, 2nd semester of master's)

Now, as far as architecture is concerned, there may not be one photograph from every angle or view. When you are looking for a specific display, or you need a color photograph and there are only black and white ones or something. But apart from that, I have actually always found everything. (June 2019, 6th semester of bachelor's)

Furthermore, students stick to familiar approaches and sources and do not change their ways as long as they do not encounter difficulties.

[Question: Why don't more students use e.g., the Deutsche Fotothek?] Because nobody ever talks about it. That's also the case during the seminar in the first semester, there's never a word about the Deutsche Fotothek. And then it doesn't get picked up later, when you have developed a routine, because you have never heard about it. And you don't start looking for new resources in the fifth semester. Usually. Well, not for pictures. You take the five or six you have or know, and you don't start looking for new databases. Not for an ordinary essay. (June 2019, 2nd semester of master's)

Once the students encounter difficulties in seeking digital visual content and connected information, they do turn to Google.

Well, I think it has happened to me quite often, that you search for an image on Google, because you don't know where the object is hung [at which museum it can be found] or if it is privately owned. (January 2020, 1st semester of master's)

The students are very aware of which resources are good and which are not; they pay attention to stating the source, since this is essential to maintain a good scientific standard.

[Question: Pinterest offers many images. Would it be an alternative for images?] [It is possible] that you find a good image on Pinterest. But most of the time you have to provide the image credits […] and then you would probably get your head torn off for that [using Pinterest]. That's why you don't use them. Only for a quick look maybe. (January 2020, 1st semester of master's)

Instagram was named several times during the focus groups with regard to different scenarios.

- For providing images:

  [… I] follow accounts of art galleries [on Instagram] […]. And I actually find it quite exciting when this is offered. They also post images you could use. They write texts for it, too. […] but also the background, who took it, and so on. You can actually use that quite well. I like it. (June 2019, 6ᵗʰ semester of bachelor's)

- To build on knowledge in art history which can be beneficial in the long run:

  I think it's cool that so many public institutions go online, and I always think it's a really good way to incorporate your studies into everyday life without having to sit down and read a scholarly text for three hours. Instead, it's just a very relaxed way of getting further information. [*Certain museum] has a kind of small series: Mythology Wednesday or something. Every Wednesday they post a picture from [*a certain collection], which represents a mythological story from Greek or Roman antiquity and then provide the story briefly. I think this is a great way to learn something. (June 2019, 6ᵗʰ semester of bachelor's)

- As a research topic:

  A fellow student, for example, has done a piece on Instagram as a showroom. […] It's the platform where the artists can present themselves and we as art historians can look at it and analyze it. (June 2019, 6ᵗʰ semester of bachelor's)

- As a research tool during an internship:

  […] to compile a catalog for an artist's work. Just to collect material on him and try to trace where his works are located today. And it was all about the collection of material, and in some cases, simply for documentation purposes, Instagram images and posts were screenshotted and documented. To simply trace back who owns it today. Where and in which exhibition was it displayed when. (June 2019, 6ᵗʰ semester of bachelor's)

4.3   Curriculum

Most art history programs include some kind of training, either in form of a seminar or as handouts for self-study. Topics included in these training materials were: Citations, references and bibliographies, image captions, repositories and resources, use of the online library catalog and search on the spot, approaching and structuring essays and PowerPoint presentations. The students were mostly satisfied with the content and found it helpful. Some said that the issue of developing research questions was neglected:

[Question: What was missing from the seminar?] Maybe developing research questions. But it was just at the beginning of the studies, and it wasn't so important to ask research questions back then. In the beginning it was more about describing images. (June 2019, 6ᵗʰ semester of bachelor's)

Another comment raises the question of how much the assignments help to prepare undergraduates for an active research routine.

[…] it's noticeable that the focus of the work is really not so much on research itself. In art history it's more like, look and read what he and she said and somehow summarize it. So that one's own research part is neglected. (June 2019, 6ᵗʰ semester of bachelor's)

Information on current trends and developments in art history was not part of the curriculum. However, one student noted that it is possible to get a glimpse into advances in the field through guest lecturers. Currently, assignments fit the established ways that university staff has been working for possibly the last decade. The courses and tasks have not changed much and do not rely on the use of new technologies.

The way I have experienced the [university's art] department over the last five years, 'old school' is quite appropriate. They have their common research techniques and their procedures and methods, how it is done, and also their areas of expertise. And that's perfectly fine. But it does not go beyond that. They won't give a lecture on a topic they haven't really dealt with for 20 years. (June 2019, 2ⁿᵈ semester of master's)

5   Discussion

The students' initial approach to research shows that online libraries should consider that users in the early stages of their research need a broad overview of relevant information, more guidance discovering connections, and help recognizing additional keywords. It might be possible to use technological advancements to provide suggestions based on approaches and selections of other users.

Bibliographies, footnotes, citations, and indexes from books have been recommended to find additional literature [18, 31]. Unfortunately, those options are not available as easily accessible links online. When books have been scanned or are available as PDF documents, their citations and indexes are usually not included for keyword search. With all necessary data available, digital libraries could improve by interconnecting texts or at least allowing users to tag and link certain resources.

The lack of access to more recent resources for art history has been mentioned various times by Beaudoin [26], stating that material might be overlooked or outdated [50]. This will only change once the field of art history turns away from 'only print counts' [1] to fully embrace digital and open access publications. However, older materials not available in digital form do not lose relevance [51] and still provide necessary information and ideas for comparison [22]. Currently, digitization of older material is an ongoing process and the selection will certainly grow.

The value of the library shelves as discovery source is undiminished; the readability and browsability of books and their tables of contents is not easily achieved through online search [40]. The issue of finding sources when semantically related material is shelved at distant locations, so important 30 years ago [52], was not specifically mentioned. It is not clear if this problem was not revealed because students do not strive to find every possible source and accept a decent number of sources as sufficient. Several statements indicate that they are willing to put in more effort for assignments with greater significance, like a thesis. Nevertheless, the use of online library websites has made it significantly easier to locate material. This experience can be further enhanced by ensuring usability standards for the library websites.

Art history lives on images and they are needed to comprehend, visualize, and verify arguments, and to emphasize findings in essays. However, students do not actively look for visualizations and do not expect to find them in an image repository. Rather, they create them themselves using resources like Google Maps and image editing tools.

A color strip to estimate color rendition and suitable resolution were the mentioned criteria for selecting a digital image. Any influence by screens or actual analysis of the colors was not addressed. However, this emphasizes the need for image repositories to provide high-resolution images including an indicator for the color rendition and for universities to raise awareness how digitization and display alter images.

Licensing and copyright for images was not part of the study and the topic was only briefly addressed during the 2016 focus group, when the students praised Flickr for its transparent copyright labeling.

The students' answers about which repository or sources they turn to for images were not as diverse or numerous as expected after reviewing previously published articles [3, 50]. It is also very interesting that local or German solutions were so commonly used; bigger, internationally known repositories like the ones suggested by Chen were hardly used at all [31].

The fortunate lack of problems finding images might be because the students' assignments are very well-aligned with the recommended sources, like Prometheus.

All participants that had switched university for their master's program agreed that they still preferred the familiar database of the old university and had not bothered to look at the new one, confirming Beaudoin's findings [25]. Problems may occur later on in the academic career when students have to develop their own research projects or during a thesis where they are suddenly confronted with more rare or 'exotic' pieces of art.

The students' mention of Instagram and its many connected possibilities for use in art history research are very interesting. Advanced scholars in art history do occasionally turn to social media when material is otherwise difficult to access [3]. A shift toward recognizing or trusting social media channels of well-known institutions is not unlikely. This may point institutions and digital libraries in the direction of considering social media to raise awareness of stock and foster serendipitous findings for followers.

Art historians usually look for objects of art, their reproductions, related objects, and any written accounts on them [18]. These categories are not sufficient for today's online image search. The following three use cases are helpful when seeking images:

1. Looking for a specific, well-defined image,
2. Looking for a loosely defined image,
3. Looking for items that can be grouped by characteristics.

When looking for a specific image, a clear name or description (usually by the object's title and artist) is needed for a keyword search [53] and the goal and criteria are well-defined. Even for comparing several items, the literature usually provides objects that help to clarify the description.

Finding a loosely defined image is much harder, because while the goal is clear, the description might not be. Sometimes an idea of what is depicted needs to be put into words [25]. The description needs to correspond with the metadata of the desired image; the user needs to be proficient in describing the image and repositories must maintain metadata well.

The students very much struggle with or avoid constructing search terms. It is not clear if they are not confident enough with their own abilities to construct search terms or if they do not trust the search features or metadata of the repositories. What is clear is that they prefer to look through more irrelevant images during their search. As McKay et al. [40] have put it, the needs are better met by recognition than specification.

Most online search algorithms rely on possibly flawed metadata [25, 54–56] which might make it harder to find images. Crowdsourcing is an option to improve metadata quality [57], which some repositories are embracing [58]. Advances in the field of artificial intelligence, particularly automatic object and context recognition,[5] can be used to improve and standardize metadata entries. Several more recent approaches try to overcome possible flaws in metadata using artificial intelligence by providing advanced keyword tags,[6] object recognition, and georeferencing images [59]. Students appreciate metadata, but clearly value quantity over quality.

Looking for images for e.g., inspiration can be grouped by characteristics and is even more loosely defined. Users prefer to browse through a longer list and see what comes up [40]. Different repositories offer faceted search to tackle this issue which might help students to identify new relevant keywords.

For this study it was assumed that students have similar requirements to scholars because their assignments function as traditional research interest in art history, although on a smaller scale. Students stated that their work was more about summarizing and describing than developing their own research questions; thus, especially when starting their studies, their work differs significantly from that of advanced scholars. Therefore, students need to be discussed as an independent user group within academia.

Many articles highlight the need to prepare art history students for a future that relies more on technology [1, 60]. Higher education should certainly prepare students to use up-to-date concepts and methodology, considering technological advances. Some have argued that it would be better to train postgraduates than undergraduates because training is endless and technology changes rapidly. But including innovations in student training

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[5] See Artificial intelligence as a bridge for art and reality, by J. H. Dobrzynski, in The New York Times, October 25, 2016.

[6] Exploring art with open access and AI: What's next? in The Met Museum. See: https://www.metmuseum.org/blogs/now-at-the-met/2019/met-microsoft-mit-exploring-art-open-access-ai-whats-next September 9, 2019.

will help the whole discipline to move forward. The push for innovation already comes from younger scholars who are more adept in the digital realm [1]. Increasing awareness of technological advances needs to be complemented by training in source criticism, however, concerning the digital or digitized nature of images and data, as well as the reliability of sources.

6 Conclusion

The study provided several clues on topics both familiar (e.g., metadata) and lesser-known (e.g., social media) to archivists and librarians to improve digital repositories based on art history students' approaches to research and their discipline-specific habits.

The potential students saw in Instagram is noteworthy, and sets them apart from many career researchers. Students felt their experience with research was limited; hence, their assignments might not pose as traditional research in art history and their needs might differ significantly from those of advanced scholars. These aspects emphasize that art history students are a user group with distinct requirements which image repositories should consider more closely.

Not all issues raised by the study can be tackled by the repositories. The opportunities presented by new technologies and approaches need to be better communicated to the art history community. Universities should introduce more recent topics, approaches and technologies into their curricula to equip the younger generation and broaden the scope for changes and advances in the field.

The focus groups were among the first efforts to observe art historians' information behavior. In combination with expert interviews, this may supply more details on improvements for digital repositories to meet the needs of art history scholars. A quantitative study could follow, to show the significance of the derived implications. The academic landscape is changing and more art history students are venturing into newly established digital humanities programs, which may have an impact on their future research topics and methodologies.

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