

Primer: Digital Collaboration

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What is digital collaboration?

The term *digital collaboration* refers to the process of working with others using digital tools. While up to a few years ago, most digital collaboration involved sending emails with attachments back and forth, modern digital collaboration tools have much more to offer. Here, we summarize some useful tools for students and researchers from the University of Zurich (UZH). We will show how modern tools can greatly increase productivity by simplifying time-consuming or error-prone tasks in daily scientific work.

What tools are available?

Table 1 provides an overview of popular digital collaboration tools. It is important to distinguish between tools that are free and open source software (FOSS) and those that are proprietary (non-free/closed-source). FOSS tools respect the users' privacy and liberty rights, and their source code can be inspected and modified. For these reasons, FOSS tools should be used for research and teaching purposes whenever possible. We will discuss the different categories in more detail below.

Cloud storage and file sharing

Cloud-based file sharing platforms such as *SWITCHdrive*, *OneDrive*, *Google Drive*, or *Dropbox* offer a simple way to share any type of files with others over the internet. The documents are hosted on a server controlled by the service provider. Users must therefore be careful if their files contain sensitive information, and file storage in institution affiliated platforms such as OneDrive (for Business) or institutional servers are recommended over those owned by commercial companies. Furthermore, open repositories, such as *OSF*, *Zenodo*, *Dryad*, or *Figshare* can be used to share research-related files according to the FAIR principles (Wilkinson et al., 2016), a practice that is increasingly adopted by journals and funders. These repositories, however, are more for sharing finalized products rather than work-in-progress.

Text, spreadsheet, slide editing

Many file sharing platforms integrate text, slide, and spreadsheet editing tools, such as *ONLYOFFICE*, *Google Workspace*, *Microsoft 365*, or *Overleaf*. These tools allow multiple people to work on the same document simultaneously, see Figure 1 for an illustration. This eliminates the need to compare different versions of a document written by different people, possibly at the same time. There are two other advantages to such cloud-based solutions. First, they all have built-in auto-saving, a feature that automatically saves an open file at regular intervals. This means that no work is lost due to a crash of the user's computer or because they forgot to save the file before quitting the editor. Second, all of these services have built-in version control, which allows users to view previous versions of the document, see who made what changes at what time, and revert to a previous version if necessary. As scientific writing is an iterative process, this feature is particularly useful when specific parts of the document have been removed at a certain point but later on still turn out to be useful.

Reference sharing and management

Another way to increase productivity is the use of reference managers such as *Zotero*, *Mendeley*, *Citavi*, or *EndNote*. These tools come with browser and text editor plug-ins which allow users to automate

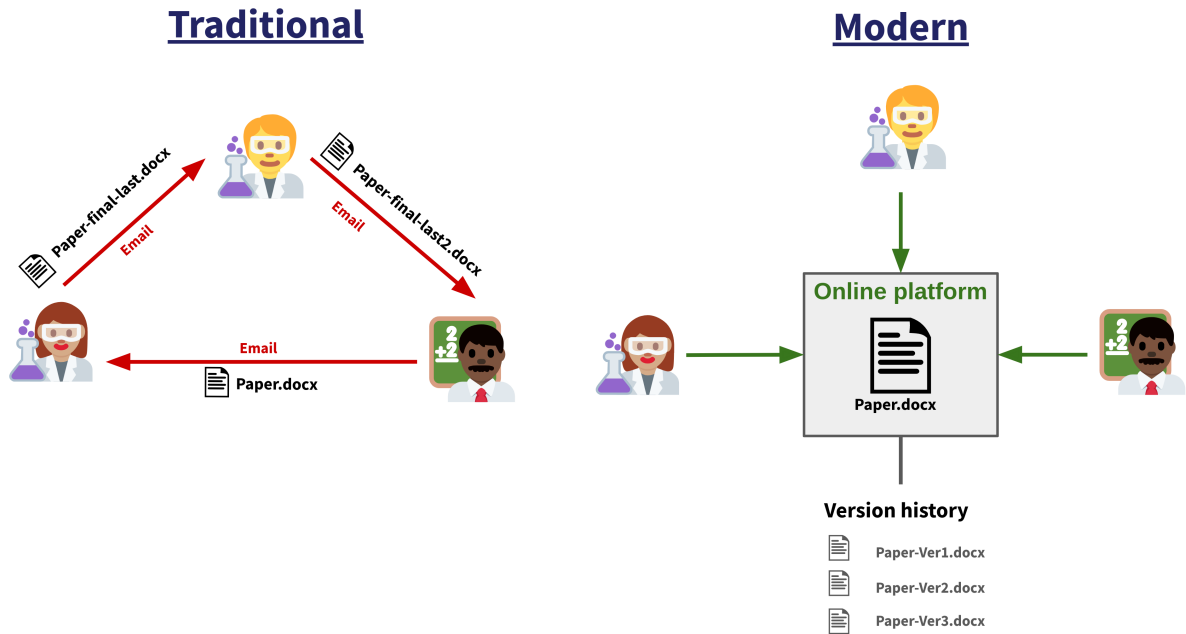


Figure 1: Schematic illustration of traditional versus modern digital collaboration.

the process of downloading a reference and writing its information into a bibliography list. Reference managers can also export bibliographies in a variety of output formats so that they can be used with most modern typesetting software.

Code editing and sharing

Collaboration on projects involving source code, i.e. machine-readable instructions, can be greatly facilitated by specialized version control systems such as *git* or *SVN*. Since such projects usually consist of multiple files that interact with each other, implementing a single idea might require changing multiple files. Therefore, the logical model of these tools differs from the basic version control in, for example, cloud-based office applications where documents are simply auto-saved periodically. The main difference is that the individual users work on local copies of the project files and when a specific idea has been implemented in the copy, all of the changes belonging to that idea are committed and pushed to a remote server. This server usually runs a specialised software such as *GitLab* or *GitHub* that merges the new changes into the existing files.

Team communication

Other software packages such as *Microsoft Teams*, *Zoom*, or *Google Meet* enable effective communication with collaborators through video calls with additional features such as screen sharing, recording of meetings, or chat functionality. This allows meeting participants to quickly present their work to others, discuss issues, or distribute tasks, even when the team members are not in the same location. *Zulip*, *Slack*, and *Mattermost* also target team communication. However, their use case is not primarily video calling, but rather the organisation of text based communication threads within a group of collaborators. Their main advantage is that messages are sorted by topic instead of just by date or sender. Especially in large groups, this makes it easier for each member to quickly see what has been discussed regarding a given topic. In contrast, doing the same thing with e-mail is much more time consuming and more likely to miss important information.

Recommendations for UZH members

SWITCHdrive

For non-personal/non-sensitive data storage and office applications we recommend SWITCHdrive with its ONLYOFFICE integration because most Swiss research institutions are subscribed to the service so that it is free to use for their members. A complete list of subscribed institutions can be found [here](#). Another prerequisite to use SWITCHdrive is a [SWITCH edu-ID](#) which serves as a user account. Most students and researchers at Swiss research institutions already have an edu-ID as it is often used as a login to other services at the subscribed institutions. However, edu-IDs can also be created by following [this guide](#). Once these conditions are fulfilled, the only thing left to do is registering the edu-ID for SWITCHdrive on the [login page](#). Optionally, users can furthermore install the desktop application from the [the SWITCH website](#) which sets up a local directory that synchronizes with the cloud server. After the setup is completed, the user can navigate to <https://cloud-id.switch.ch/> to access their directory on SWITCHdrive.

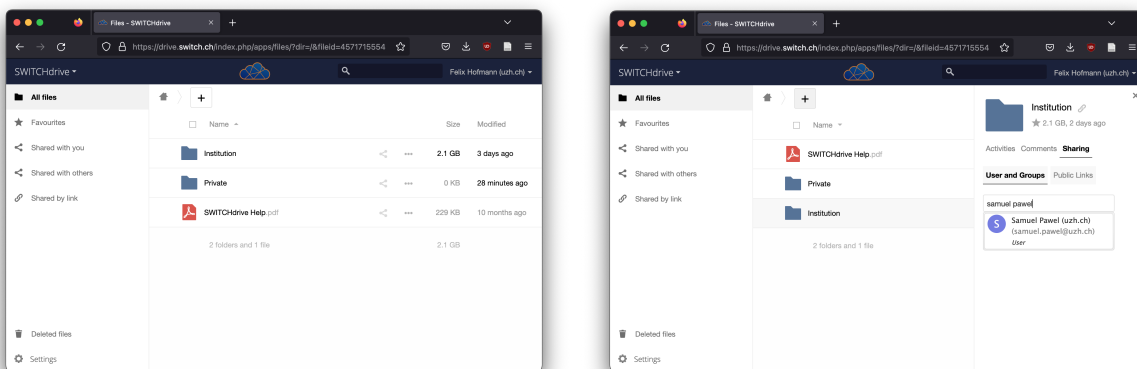




Figure 2: User interface of SWITCHdrive in the browser.

The user interface of SWITCHdrive is intuitive. As shown in Figure 2, files and directories can be created or uploaded from the local system by clicking the “+”-button and selecting the appropriate action. Once created, any file or directory can be shared with collaborators by clicking on the -button on the right side next to the file or directory name. This opens the dialog shown in the right panel of Figure 2. Collaborators with SWITCHdrive accounts can be searched by typing their names or e-mail addresses into the search bar. If some of the collaborators do not have an account for SWITCHdrive, documents can be shared by sending them a link created by clicking the “Public Links”-button.

Files can be edited by simply clicking on them and then selecting “Open in ONLYOFFICE”. All of the editors - text, spreadsheet and slides - are fairly simple to use and the layout and functionality are very similar to Microsoft Office applications. As an example, Figure 3 shows this primer opened in the ONLYOFFICE text editor while two people are contributing at the same time with the green highlighted text being written by the remote collaborator. The document is saved automatically on the SWITCH server such that work progress cannot be lost due to sudden crashes of any collaborator’s computer or a failure to save the document. In order to facilitate collaboration further, the ONLYOFFICE editors also have an integrated chat feature which can be used to discuss the content of the document with co-workers.

Earlier versions of a specific document can be visited by clicking the -button next to the document name and then selecting “Versions” in the pop-up menu (see the right panel of Figure 2).

Zotero

For managing bibliographies and citations, we recommend Zotero. This free and open-source software can be downloaded from the download section of the [Zotero website](#). On the same page, you

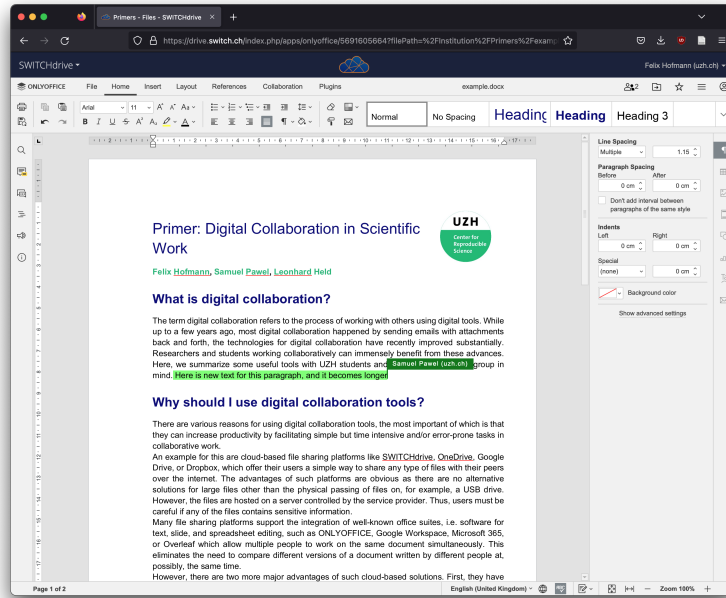


Figure 3: Simultaneous editing of a text document in ONLYOFFICE on SWITCHdrive.

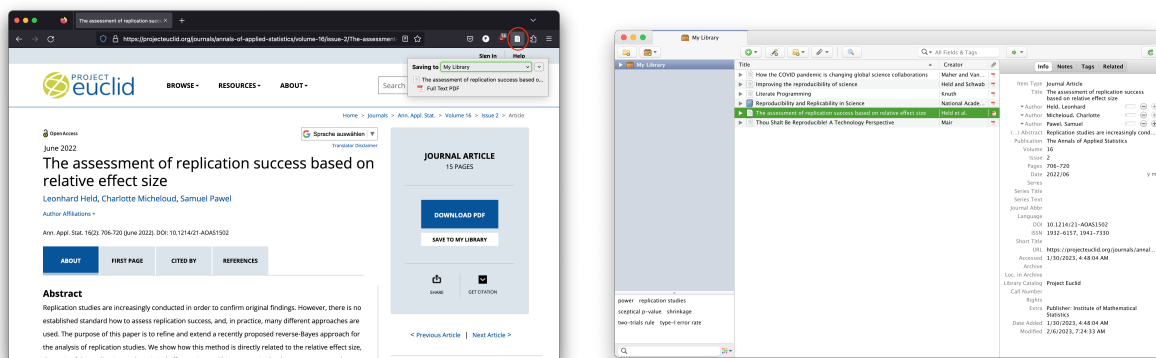


Figure 4: Left: Downloading a publication and its bibliographic information with Zotero. Right: The downloaded publication after the import into the Zotero client. The bibliographic information in the right column was added automatically.

can also find the Zotero Connector browser plugin which allows users to download PDF documents together with their bibliographical information from the browser. The downloaded PDFs are directly imported into the Zotero client which comes with an integrated PDF reader that allows users to highlight parts of the text as well as taking notes either on the PDF itself or in a separate file attached to it. Moreover, the Zotero client allows the users to organise literature in different libraries which can then be exported into most common file formats. Figure 4 illustrates this process on an example publication.

While these features are already quite useful on their own, the functionality of the Zotero reference manager can be extended further by opening an account on the [Zotero login site](#). This account has several advantages. First, it allows users to synchronise the library on their local computer with a Zotero server, which prevents data loss when the local machine becomes suddenly unavailable. Second, libraries can be shared via the cloud such that all collaborators have the same and most recent version of the project's literature. Finally, the account enables usage of Zotero plugins in remote editors such as the previously presented ONLYOFFICE instance on SWITCHdrive. In order to use the Zotero integra-

tion in ONLYOFFICE, however, it is necessary to link the Zotero account to the ONLYOFFICE account. This can be achieved by navigating to the [settings section](#) on the Zotero website and clicking on "Create new private key", selecting the desired access rights, and then clicking on "Save key". At this point, the website will show a sequence of characters which needs to be copied into the text input field under "Plugins > Zotero" in the ONLYOFFICE editor. Detailed instructions on how to open an account and how to use these features can be found in the extensive [documentation](#) for the Zotero software. Documentation on the Zotero plugin for ONLYOFFICE can be found in [this guide](#). Zotero also offers an add-in for Microsoft Word that allows references to be added to the running text and automatically creates the reference list at the end of the document.

UZH GitLab

As described in Section [Code editing and sharing](#), there are dedicated tools available for working with source code such as GitLab or GitHub. If your research relies on code, we recommend the use of the [UZH GitLab instance](#) which is hosted on servers owned by SWITCH, a non-profit foundation that has been established by the Swiss Federal Government as well as the cantons hosting universities ([SWITCH, 2023](#)). In comparison to GitHub, which is owned by Microsoft, and Google Collab, this ownership structure has the advantage, that data and code are not stored on servers owned by foreign corporate enterprises which might not respect licenses or use your code and data in other ways without your consent.

Other than that, GitLab offers a wide variety of features related to version control, continuous integration, and project management. However, going into the details of how these exactly work goes too far for this primer and thus, we refer to the official [GitLab documentation](#). In order to use this service, an edu-ID is necessary for authentication. If you do not have one yet, Section [SWITCHdrive](#) contains a paragraph describing how it can be created.

Zenodo

Zenodo is a general-purpose and open-access repository that is developed and hosted by CERN since 2013 as part of the Horizon 2020 project OpenAIRE (Open Access Infrastructure for Research in Europe), a project that aims to support open science and facilitate the access and sharing of research data across Europe ([OpenAIRE, 2023](#)). It allows researchers to freely share all types of research output, such as, data sets, images, and software, on a single platform. While Zenodo promotes open access to research outputs, it is also possible to host files with restricted access ([Zenodo, 2023](#)). Each upload is assigned a Digital Object Identifier (DOI) so that the files can be easily found and cited. Another advantage is that files are versioned, meaning that they can be curated and updated over time so that other researchers can reuse them. All of these features facilitate adherence to the FAIR principles for data sharing ([Wilkinson et al., 2016](#)). Finally, Zenodo is well integrated with the git repository hosting service GitHub (unfortunately, not yet with the UZH GitLab), so that code hosted on GitHub can be archived on Zenodo with one click.

More Information

The freely available Turing Way handbook for reproducible research includes an [excellent chapter](#) on modern research collaboration ([Turing Way Community et al., 2019](#)). The central IT service also has a [comprehensive website](#) on digital collaboration with Microsoft 365. A good comparison of open repositories is provided by [Stall et al. \(2022\)](#).

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Appendix

Table 1: Non-exhaustive list of digital collaboration tools for researchers and students from the University of Zurich (UZH). Information are as of September 18, 2023 and may change in the future.

Name	Free/Paid	FOSS	Description
<i>Cloud storage and file sharing</i>			
SWITCHdrive	Free (UZH)	✓	Cloud storage service hosted by SWITCH with 100 GB of free storage. The service is based on the FOSS ownCloud software.
Google Drive	Free (basic)		A popular cloud storage service from Google. The basic version includes 15 GB of free storage.
OneDrive	Free (UZH)		The cloud storage service from Microsoft. The OneDrive UZH instance can be used by UZH members for free.
Dropbox	Free (basic)		A popular cloud storage service. The basic version includes 2 GB of free storage.
OSF	Free	✓	Open repository for research data, files and software operated by Center for Open Science . Digital object identifiers (DOIs) are supported.
Zenodo	Free	✓	Open repository for research data, files and software operated by CERN . DOIs are supported. 50 GB limit per data set.
Dryad	Paid	✓	Open repository for research data operated by the Dryad nonprofit organization. DOIs are supported. The service is free when publishing with associated journals or publishers (most of them in the life sciences), and otherwise \$150 per submission. 300 GB limit per data set.
Figshare	Free (basic)		Open repository for research data. Supports DOIs. 20 GB of free storage.
<i>Text, spreadsheet, slide editing</i>			
ONLYOFFICE	Free (UZH)	✓	A browser-based collaborative office suite which is integrated in SWITCHdrive .
Google Docs, Sheets, Slides	Free (basic)		A popular browser-based collaborative office suite which is well integrated with other Google applications. The basic version is free.
Microsoft 365	Free (UZH)		A collaborative office suite which can be used from the browser or locally, and is well integrated with other Microsoft applications.
Overleaf	Free (UZH)		A browser-based collaborative LaTeX text editor. Well-fitted for mathematical typesetting but steeper learning curve.
<i>Reference sharing and management</i>			
Zotero	Free	✓	A free and community developed reference manager. References can be shared in groups. Available on all operating systems. Good integration with web browsers and text editors. Reference synchronization across devices is possible, can be self-hosted on SWITCHdrive.

Mendeley	Free		A free reference manager developed by Elsevier. Available on all operating systems. Group-sharing of references is possible. Integrated with Microsoft Word and web browsers.
Citavi	Free (UZH)		A paid reference manager. The local version is only available for windows, the web version works on all operating systems. Integrated with Microsoft Word and web browsers. Sharing of references in groups is possible.
EndNote	Paid		A paid reference manager. Not available on Linux support. Integrated in web browsers and Microsoft Word.

Code editing and sharing

GitLab	Free	✓	An open source git repository hosting service. An UZH GitLab instance is provided by SWITCH.
Github	Free		A git repository hosting service which is now owned by Microsoft. It offers paid and free plans, and most features are accessible with the free plan. The service is well integrated with Zenodo.
Google Colab	Free		A Google service where Python notebooks can be executed and shared. It is free of charge but there are not unlimited computational resources and the usage limit fluctuates. It is possible to pay for a premium account with more computational resources.
mybinder	Free	✓	A free platform for building and sharing reproducible and interactive computational environments via Containerization.

Team communication

Slack	Free (basic)		A popular text, audio, video chat and file sharing application. The free version has only limited features.
Zulip	Free	✓	A text chat and file sharing application that can also be self-hosted. The premium version is free for research organizations.
Mattermost	Free	✓	A self-hosted text chat and file sharing application.
Microsoft Teams	Free (UZH)		The text, audio, video chat, and file sharing application from Microsoft.
Zoom	Free (UZH)		One of the most popular video chat applications. Meetings with up to 300 participants are free for UZH members, licenses for meetings with more participants can be requested from the central IT .
Google Meet	Free (basic)		The video chat application from Google.

Version from September 18, 2023.

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