

# Digital Makerspace – a Tool with Multipurpose Use and Potential for Teaching and Others

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**Abstract**— A multipurpose software tool for building web apps and software-based Open Education Resources, called “Digital Makerspace” (DMS), was developed in the last 8 years at the applied university and is now ready for use. The tool is useful for creating and designing almost all thinkable material and tools for online usage by web users, for example providing digital learning material and digital interactive exercises. The tool is free for use for everyone and is supposed to be self-explaining. In this paper, the DMS is introduced and as an example multi-purpose learning material for students are shown which were designed via the DMS.

**Keywords** - web-based tool, web components, learning material, digital makerspace, quiz, online exercise, eLearning

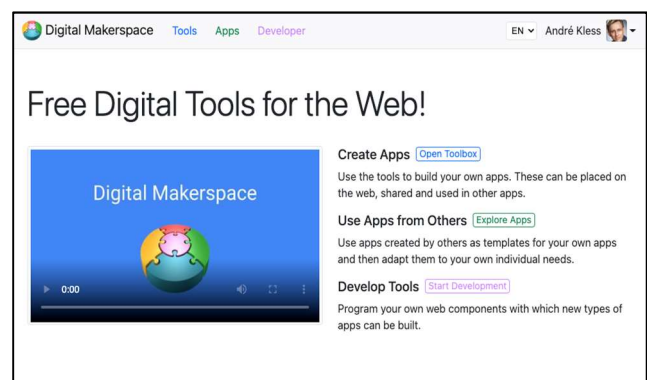


Figure 1: Start screen of the DMS

## I. INTRODUCTION

A makerspace is a workshop with open access to materials and tools that are otherwise not readily available to everyone. It's a place where everyone can co-creatively create things and implement ideas. A makerspace leads to a democratization of high-tech access, such as an open machine hall with 3D printers. In the Digital Makerspace, which was developed over the last 8 years at the Bonn-Rhein-Sieg University of Applied Sciences, this concept is transferred to the digital world.

## II. DIGITAL MAKERSPACE (DMS)

The DMS offers free digital tools, with each tool being able to build a specific type of app without any programming knowledge using simple web forms. The apps are then available in the public domain and can be used flexibly anywhere on the web and as a template for your own apps, [1].

If you have programming knowledge, you can contribute additional tools to the DMS, which in turn can be used to build new types of apps. So there is not one central authority offering a certain selection of tools or apps, but it is a decentralized approach where everyone can contribute, expand the possibilities for everyone and freely use the contributions of others.

You find the DMS online at <https://ccmjs.github.io/digital-makerspace/> or shorter at [dms.ccmjs.eu](https://dms.ccmjs.eu).

## III. INTERACTIVE OPEN EDUCATION RESOURCES (iOER)

When it comes to Open Education Resources (OER), many only think of the reuse of text, images, audio and video. But there can also be small web applications such as quizzes, gap texts and other trainer apps in which learners solve a task, receive direct feedback and/or, depending on the app, also interact collaboratively with each other. The term iOER focuses on OER's that are not only content but also software. From this point of view, the DMS is a platform specialized in iOER, with which iOER's can be created and shared.

## IV. CUSTOMIZATION AND INTEGRABILITY

In Germany, more and more platforms for the distribution of OER are emerging, also thanks to increasing government funding. OERs can be published via web portals such as orca.nrw and reused by others. The problem, however, is that such platforms only address the findability of OER. However, in order for the OER idea to gain acceptance in practice, adaptability and integrability must also be considered. Especially for iOERs, the adaptability is very limited, if at all, and last but not least usually requires programming knowledge, which a teacher rarely has.

The DMS solves these problems and allows teachers without programming knowledge to use iOERs created by others as templates via simple web forms and to adapt them to their own individual teaching situation and didactics.

Too often, eLearning is still thought of as learning platforms and iOERs in particular are often integrated there via plug-ins or standards such as SCORM (Sharable Content Object Reference Model). However, this is increasingly outdated, since learning takes place on the web and not isolated in learning platforms. On the other hand, iOERs based on web standards such as HTML, CSS and JavaScript can be used anywhere on the web. In the Digital Makerspace, iOERs are technically realized exclusively via web standards in the form of web components and their configuration. This makes it very easy to combine iOERs with each other and use them in other web applications.

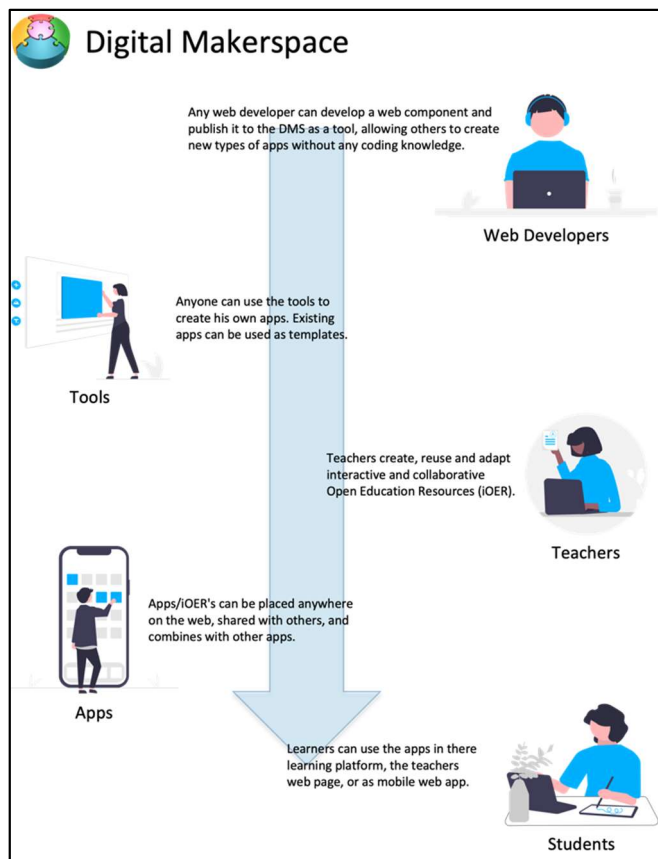


Figure 2: Roles and Artifacts in the DMS

For example in the DMS, a teacher can implement his lectures as a slidecast and his exercises using quizzes and fill in the blanks and then combine these as an single app collection into an iOER. The whole thing can then be made available to the learners, e.g. via the school's own learning platform, the teacher's website or as a mobile web app. Some teachers have already build their entire course with the DMS, [1],[2],[3].

## V. WEB COMPONENTS

Technically, a digital tool in the DMS is a web component published as free software and implemented exclusively based on web standards. A certain type of app is implemented via the web component, which can then be used and configured freely on the web. In order to create a specific app, you only need a configuration in addition to the web component, which is done in the DMS using simple web forms without any programming knowledge.

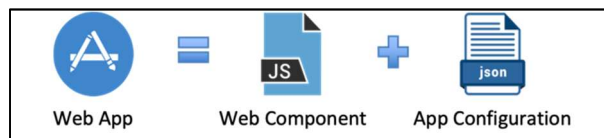


Figure 3: Technical composition of an app in the DMS

For example, to create a multiple-choice test, you use the digital tool for quizzes (= web component) in the DMS, then enter the questions and answers that the quiz should contain, and which answers are correct (= configuration) in a web form.

## VI. DIGITAL TOOLS AVAILABLE

The following tools/web components for building apps/iOER's are already available in the DMS:

- Quiz: Single/Multiple choice tests
- Cloze text: Fill in missing words in a text.
- Live Poll: Make spontaneous live polls.
- PDF Viewer: View PDF online.
- Slidecast: Commentable slide presentation with audio.
- App Collection: Combine apps into one app.
- Image Map: Place apps on an image.

Many other tools are already in development and will be added.

## VII. PROCESS OF APP CREATION

The DMS is divided into three areas: tools, apps and developers. Under Tools you will find the digital tools with which you can build your own apps without programming knowledge. All apps that have already been created (including those of others) can be found in the apps area. Those who have the necessary knowledge can contribute new tools in the developer area by publishing self-implemented web components in the DMS.

There are two ways to create an app: Either you select a tool in the tools area and then fill out the web form again in the app editor, or you look for a similar app in the apps area and use it as a template. Then you also end up in the app editor of the corresponding tool, except that the web form is already pre-filled with the data that was entered by the app creator in the app used as a template.

If you have configured your app according to your own wishes via the web form and are satisfied with the app preview, the app can be created specifically. At this point at the latest, you have to register with a free DMS account so that the app can be assigned to the app creator and found more easily by him, edited later if necessary and deleted. Finally, the app creator can store meta data about his app (e.g. title, description and categories) so that others can find and understand the app more easily.

Once everything is done, everyone can find the app in the apps area and can try it out there and share it with others. For an app, you get a public app URL, an HTML embedding code and a bookmarklet in the DMS. In addition, the app can be downloaded as an HTML file and as a SCORM package. By calling up the app URL, the app can be opened as a website. With a mobile device, it can be placed on the home screen as a mobile web app and can be accessed there like a native app with just one click, regardless of the operating system. The app URL is also offered as QR code. With the HTML embed code, the app can be embedded in web pages, similar to a YouTube video. If you drag the bookmarklet into the bookmark bar of the web browser, the app can then be brought into a currently open website at any time via the bookmark. The app URL, the HTML file or the SCORM module can be used for integration into a learning platform.

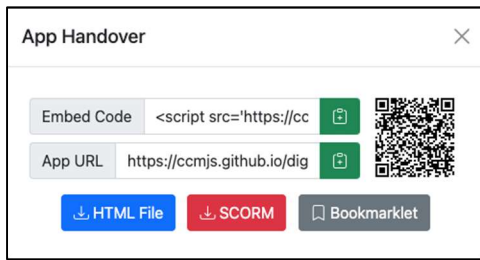


Figure 4: Handover of an app in the DMS

### VIII. AN (GERMAN) EXAMPLE FOR USAGE OF THE DMS

In the duration of one and a half year the usage of the DMS was improved while a lecturer prepared all in all learning materials for a Computer Science course for Technical Journalist students and Visual Communication students in their second year.

The App Collection was used to construct the following listing of all learning material for the course:

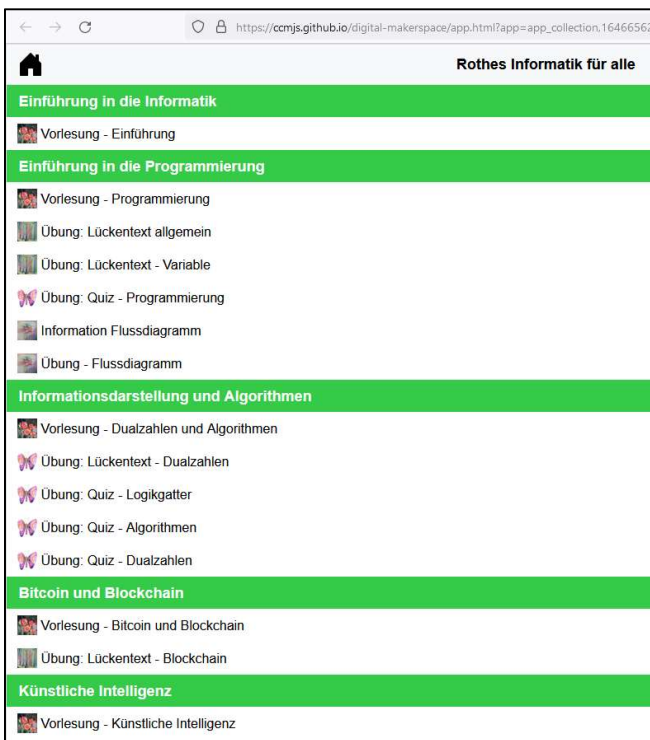


Figure 5: App collection for the course Computer Science

In this App Collection the following pre-created Apps were used:

- Quiz App
- PDF Viewer App
- Image Map App
- “Fill in the Blanks” App
- Content App

The app is available in the DMS at [https://ccmjs.github.io/digital-makerspace/?show=app\\_collection,1646656274722X8296866847017588](https://ccmjs.github.io/digital-makerspace/?show=app_collection,1646656274722X8296866847017588).

The following picture shows the look of the “Fill in the Blanks” app offered in the DMS:

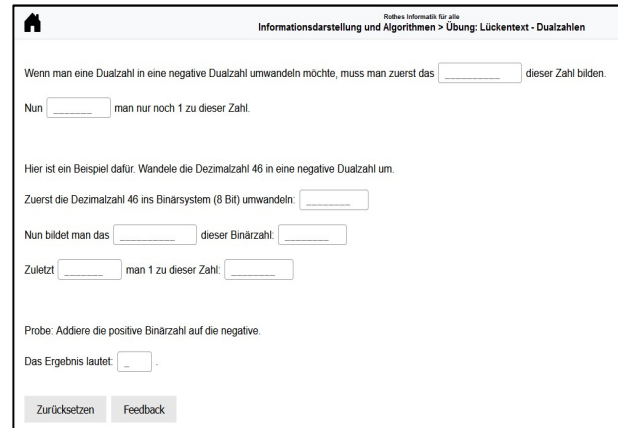


Figure 6: Screenshot of a “Fill in the Blanks” App

The next picture shows the Quiz App offered in the DMS:

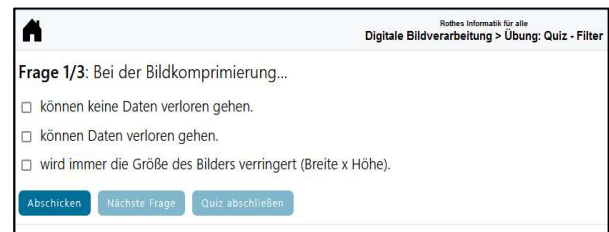


Figure 7: Screenshot of a Quiz App

The following picture shows the PDF Viewer App:

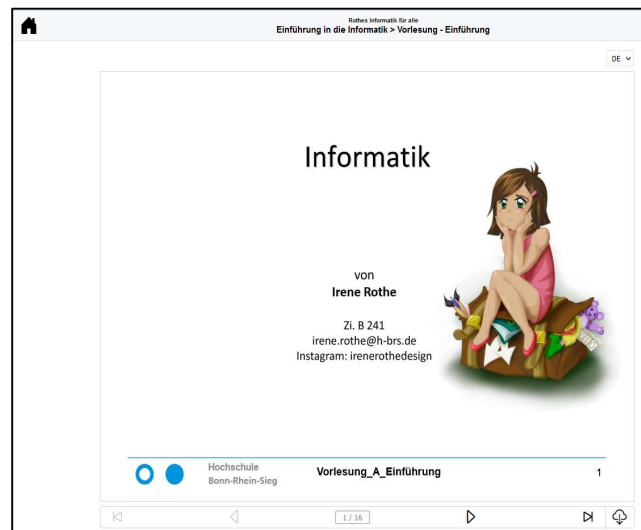


Figure 8: Screenshot of a PDF Viewer App

Here, a picture of an Image Map App:



Figure 9: Screenshot of an Image Map App

The arrow in Figure 9 show one of the small images behind which a riddle is hidden to be solved after clicking on the small butterfly.

Besides the thinking and creation of all the exercises itself it took only a bit more than an hour to put this course material all together in such a beautiful outfit and ready to be used by the students.

#### IX. CONCLUSIONS

The DMS is a new approach to software-based OER (iOER) with an unprecedented level of customization and integrability. It's also a collaborative, decentralized approach where everyone can contribute and reuse, regardless of their technical skill level.

#### X. REFERENCES

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