# Worksheet Creator 2: Blended geometry for the class room

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#### Abstract

There are a lot of tools available to create dynamic mathematical content at the computer, e.g. GeoGebra, Cinderella, GEONExT, and many more. But to use this dynamic content in the class room, it takes more than just handing out a GeoGebra or GEONExT construction file to the students. A predestined way for the preparation of dynamic mathematical content for the use in the class room is to use html web pages in which the content is embedded together with explanations and exercising instructions. To support the teacher and ease the process of creating such dynamic worksheets, we created a web application called Worksheet Creator 2.

#### 1 Introduction

To visualize geometry and calculus in class room, dynamic geoemetry systems (DGS) are used more and more, because DGS's enable students to learn interactively by experimenting with geometric constructions provided by their teacher. In most cases a DGS offers a wide variety of features and a graphical user interface which makes it easy to create geometric constructions. That is important to ease the creation of such teaching resources. While those graphical user interfaces usually are great for the creation of dynamic resources, they are not that good for presenting such content: You can hardly display longer, formatted, and structured texts like a description or explanation of the given construction or like exercise instructions without interfering with the construction, and students easily get distracted by all those buttons making them do a lot of things but those the teacher wants them to.

Hence, most DGS's offer an export into HTML format. Most are rather simple like in GEONExT or Cinderella, where a simple HTML file containing just a Java-Applet displaying the construction is generated. At least in GEONExT you can choose which menubars and toolbars you want to be shown by the applet. A little more options can be set in GeoGebra's HTML export. There you can even enter some descriptive texts which are shown above and below the exported construction.

In 2007, Peter Baptist and Carsten Miller released a tool called "GEONExT Worksheet Creator". With this tool dynamic worksheets consisting of several geometric constructions could be created. The teacher first provides a worksheet title and description. Then he creates one or more slides by providing a GEONExT construction, a description of the construction and a set of tasks per slide. Finally, the Worksheet Creator generates a set of web pages including a table of contents and a navigation bar. The teacher can give those files to his pupils who can view the worksheet in any Java enabled web browser. In theory, those dynamic worksheets sure could be done by hand, but using the Worksheet Creator the creator can focus on the didactical aspects of his worksheet rather than being obstructed by technical issues.

Unfortunately, Windows is the only operating system officially supported. Also, GEONExT Worksheet Creator is commercial software and it requires Java, both for creating and viewing dynamic worksheets. This is bad because the importance of Java on the web in general is decreasing more and more. Other technologies, like JavaScript and the upcoming HTML5 standard, are able to supersede Java and Flash.





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Fig. 2 The worksheet creation page is kept as simple as possible

## 2 Worksheet Creator 2

This is why we began with a successor of the GEONExT Worksheet Creator code named "Worksheet Creator 2" (XWC2) this year. XWC2 is a web application easing the creation of HTML/JavaScript based dynamic worksheets. It is completely free to access, just a registration is required. Though this application is still under development, it is already accessible<sup>1</sup> and usable by anyone who wants to. All you need is a JavaScript capable browser. Officially supported are recent versions of Firefox, Internet Explorer, Opera, Safari, and Google Chrome.

The interface for guests, i.e. not registered visitors, is pretty simple. There is a home page which shows latest updates and news about the site and its development. An overview of all published worksheets is given by the browse page (see Fig. 1). The login page is for registered users to authenticate themselves and the sign up page is used to create a new user account.

Registered users by now have three additional menu items: "Create worksheet", "Import" and "Edit settings". Additionally to all worksheets published by other users, the user's own worksheets are shown on the browse page. Soon, registered users will be able to change their personal data and choose a language the application will be in on the edit settings page. It is even possible to import dynamic learning environments from the original GEONExT Worksheet Creator. All you need to do is to upload the xwc file on the import page.

The main page of the application is the create worksheet page (see Fig. 2). It is subdivided into 3 parts. First the title part, where the user gives a title and a description what the whole dynamic worksheet is about. This title and this description will be shown on the worksheet's entry page, together with an automatically generated table of contents. The table of contents is simply a list of all slides, the user can describe in part two of the create worksheet page. Every slide consists of a title, a construction, a description of the construction and some exercise instructions for the students. The construction can be given in a file created with GEONExT, GeoGebra, Cinderella or any DGS with export to the Intergeo file format, or can be given in JessieScript construction code. The third part of the create worksheet page is used to save, download, and publish the dynamic worksheet.

After finishing a worksheet, XWC2 generates a single HTML file which contains the whole worksheet. To render the given constructions, JSXGraph is used. This enables us to render GEONExT, GeoGebra and Cinderella not just by their intergeo output, which often is like a "light version" of the original construction, but by their original description of the construction.

# 3 Technical Background

XWC2 is a PHP based web application and uses a MySQL database to store the user profiles, worksheets and uploaded files. Most of the pages are simple html pages with

<sup>&</sup>lt;sup>1</sup> http://jsxgraph.uni-bayreuth.de/xwc2

forms, but the create worksheet page is slightly more sophisticated: Already the first part uses a rich text editor to make well structured and formatted texts possible even for users without any knowledge about html. Part 2 of the creator page makes heavy use of a technology called AJAX (Asynchronous JavaScript and XML). This technology is based on the ActiveX (in Internet Explorer) resp. JavaScript (in all other browsers) object XMLHttpRequest. With this object it is possible to load data asynchronously from a web server without (re)loading the current or any other page. So, whenever the user chooses a slide from the list of slides on the left, two AJAX requests are sent to the server: First, a request to save the current slide. As soon as this slide is saved, another AJAX request is sent requesting the selected slide's data which is loaded into the form using JavaScript. This approach has several advantages.

It saves bandwidth: only that data is sent between server and browser which is actually required. No unnessecary data, like the menu, the header, or the footer has to be transmitted.

For the user it looks like a desktop application: Choosing or creating another slide doesn't cause complete reload of the worksheet creator.

Data integrity: As soon as a new slide has been loaded, the old slide is saved on the server. If the user's browser crashes, worst case scenario is the loss of the current slide.



Fig. 3 The worksheet after it has been generated by the worksheet creator

Another part of the XWC2 that uses a lot of JavaScript is the XWC2 file format. As a learning environment can consist of more than one page, JavaScript is used to store all the slides metadata and select which slide to display. All the slides and the worksheet's title and description are stored in this html file in JSON format. JSON is a very simple data format derived from the JavaScript programming language. It can store JavaScript objects, arrays, numbers and strings in a human readable way. To determine which page the user wants to see and thus has to be rendered, all links in a worksheet have a question

mark followed by the page index attached to the worksheet's url. The url is read and parsed by a JavaScript and the according slide is chosen and rendered.

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