Georeferencing Old Maps by First Year Students

Elger Heere*, Marco van Egmond**

* Utrecht University of Applied Science – Geodesy / Geo-Informatics, The Netherlands
** Utrecht University Library – Special Collections, The Netherlands

Abstract.

The Utrecht University Library manages a large amount of maps. An effective way to enclose this collection is to georeference the maps and show them on Google Earth. One librarian will never be able to georeference some 200.000 cartographic documents, so the help of the crowd is necessary. The experience some georeferencing, the Library and the University of Applied Sciences joined together in a small project, where in two sessions 120 water management maps and 100 fortification plans were georeferenced.

The maps and plans were georeferenced with the online tool Georeferencer. With this tool it is possible to georefence digitized maps as a crowdsourcing project. The Utrecht University Library is the first library in The Netherlands which uses this tool.

The georeferencing was performed by first year students, who study Geodesy/Geo-Informatics. For them it was a first introduction to work with old material, which gave specific problems. The experiences with these students can be used to design a large crowdsourcing project.

Keywords: Education, Historical Cartography, Crowdsourcing

1. Introduction

The Utrecht University Library is constantly looking for new, innovative, ways to enclose its collection. The map collection is part of the library's Special Collections and contains around 170,000 post-1850 maps and atlases and around 6,000 older cartographic documents.

Last two years 120 water management maps, from the period 1600 – 1825, and 100 fortification plans, from the period 1600 – 1835, has been digit-

ized. These scans can be viewed in two web exhibitions on the subjects *water management maps* and *fortification plans*. The maps are not only presented just as pictures, they are also georeferenced with the online tool *Georeferencer*. The result is that the maps can be viewed in Google Maps and in Google Earth.

The georeferencing was performed by Geodesy / Geo-Informatics students of the Utecht University of Applied Sciences. There are plans to georeference more maps, with a larger crowd.

This paper presents both web exhibitions and the role of the students within the georeferencing process.

2. University of Applied Sciences, study Geodesy

The study program of *Geodesy /Geo-Informatics* is a bachelor program at the *Building and Environment Department* at the *Utrecht University of Applied Sciences*. Other fields of study within this department are Civil Engineering, Construction Management, Engineering, Environmental Studies and Urban and regional Planning.

There are ca. 125 students, with some 20 new students each year. Some 75% of the student graduate in the field of geo-informatics, while 25% graduate in Geodesy. One or two students each year graduate in Cartography.

As part of the curriculum of the study Geodesy/Geo-Informatics are some courses in Cartography. In the first year, the students learn about the cartographic basics, like map use, the graphical grammar of Bertin, different kinds of (thematic) maps, the use of texts, colours and symbols on maps, atlases, how to lie with maps and the history of mapmaking in The Netherlands. In the second year they learn how to make maps for urban planning. In the fourth and final year they learn how to deal with the modern visualisation techniques, like maps for mobile applications, web mapping, cartographic animations, multimedia cartography and virtual and augmented reality.

As mentioned above, in the first year, attention is paid to the history of mapmaking in The Netherlands. Problem is that most of the students are mainly interested in technics and geo-informatics and not that much in history. The question that had to be answered was how to make the history of mapmaking attractive to this group of students.

The answer lies in two activities:

1. to visit the University Library of Leiden, which has a large collection of old maps. The map curator had the instruction to give a lecture without the

use of Powerpoint or Prezi. He just had to illustrate his story with the original material, like a 16th century atlas, a Leo Belgicus and so on. *Figure 1* show the group during the lecture of the map curator in Leiden.

Figure 1: Lecture in the history of Dutch map making at Leiden the University Library (photo by E. Heere).

2. the second activity is to let the students work with the old material. The opportunity to work with old maps came from the Utrecht University Library, who wanted some of its old maps been georeferenced with the online tool *Georeferencer*. By using the students, lots of maps could be georeferenced in a short time, while the students learned how to handle unexpected problems with working with old maps.

Learning outcomes of this project were:

Students had to

- experience the difficulties of working with old maps
- learn about the accuracy of old maps
- learn about working with a cloud application
- learn about crowdsourcing

3. Web Exhibition Special Collections from the Utrecht University Library

Presenting digital documents together in context gives them added value. The digital exhibitions of the Special Collections of the Utrecht University Library offer a considered and well-reasoned selection of items from the different collections.

Most of the exhibitions are themed. Among the themes are astronomy (*400 years of the telescope*), maps of Holland, 100 thematic maps, fortification plans and water management maps. They include images of complete documents relating to a specific subject as well as more information on certain aspects and details of documents. The various items on display are accompanied by – often detailed – scholarly explanations. Most of the subcollections have an introduction including the reasons for choosing the items. The exhibitions can be found on *URL1*.

The last two themes mentioned, Fortress Europe and water management maps, are the themes the students worked with.

3.1. Water Management Maps

In 1812 Gerrit Moll was appointed professor in physics and mathematics. For the purpose of teaching and research he created a large collection of documents that was bequeathed to the university library. The collection contains about 1,500 maps and a dozen atlases. It is a very versatile collection with an important place for large-scale water district maps of mainly Dutch regions. This subject is covered by over 150 maps consisting of approximately 300 leaves of water board districts, river diversions, plans, whether executed or not, for canals and dikes etc.

The water management maps within the Moll collection are detailed and accurate and sometimes richly decorated. In this respect they are not only an important source for landscape research but also attractive to look at for a more general public. Moreover, they fit in with a current Dutch climate theme: giving water storage and rivers more room in the landscape. *Figure 2* shows an example. It's a map dated 1611, from the so called *Wieringer Waard*, one of the oldest polders in the Netherlands.
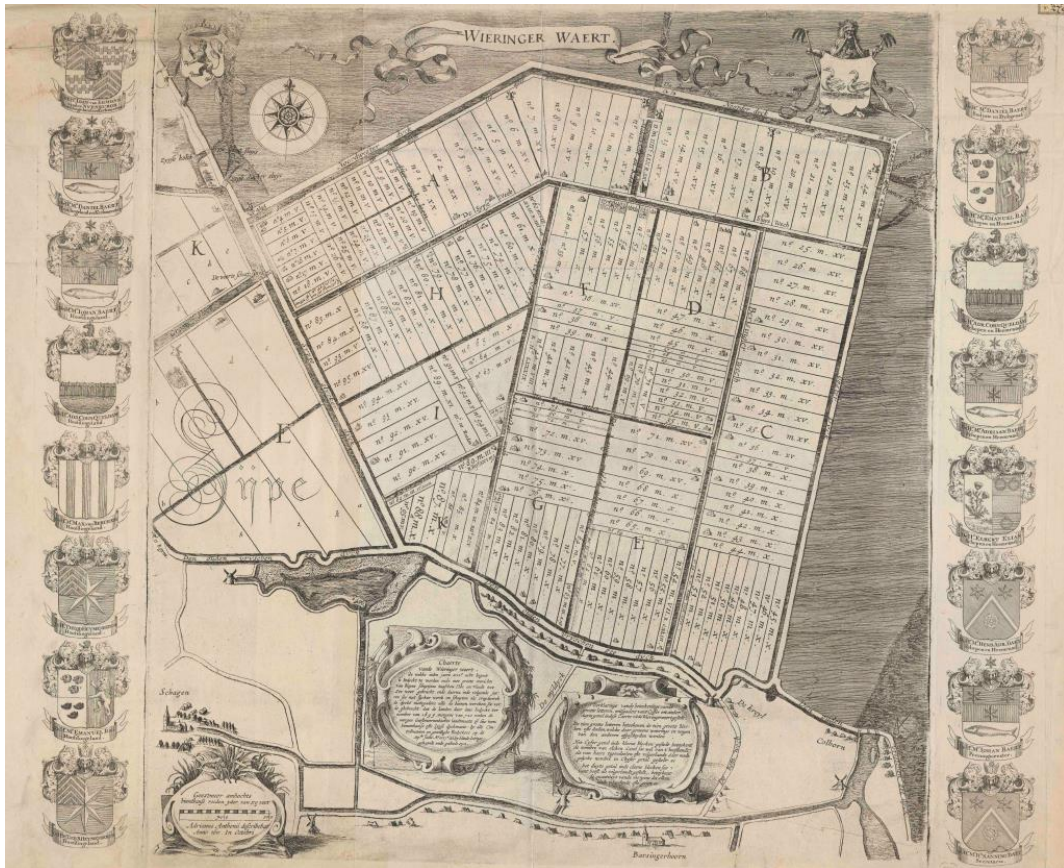
Figure 2: Map of the Wieringer Waard, 1611, by the surveyor Adriaan Anthonisz. (Utrecht University Library, KAART: Moll 223).

Nowadays water is a hot item. Especially in the Netherlands where problems with water storage are expected, due to climate change and the sea level rise. Every day sea and river dikes are being rebuilt and strengthened, and in certain areas all kinds of plans are being made to enlarge the water storage capacity. Yet in the past the authorities also took active measures where water management was concerned. Old maps often testify to this fact. The collection of water management maps in the Utrecht University Library, puts a strong emphasis on hydrography.

3.2. Fortification Plans

During the War of the Spanish Succession (1702-1713) the general public liked to be informed of the war acts taking place all over Europe.

Booksellers met this demand by printing and publishing pamphlets and leaflets. These short texts gave an overview of the actual situation. Also the newspapers reported about the war, but they were mainly distributed locally or regionally. *Figure 3* shows a newspaper map, dated 1708 from the battle near Oudenaarde, nowadays in Belgium. The publishers reached a larger audience by publishing siege maps or news maps: printed maps with clear images of the siege or battle, with or without explanatory notes. Furthermore, printed fortification plans showed the strength of the fortified European cities. Besides the siege maps and fortification plans another kind of map became a success during the War of the Spanish Succession: maps by engineers. These were mainly fortification maps which were drawn by hand by military engineers. These maps were intended to improve the local fortifications. The work done by the military engineers was very important in the warfare of those days. Famous fortification architects such as Menno van Coehoorn (1641-1704) and Sébastien Le Prestre de Vauban (1633-1707) even owed their reputations to their designs of fortifications considered to be unconquerable.

Figure 3: Map of the battle near Oudenaarde, 1708, published by Pieter Husson, bookseller (Utrecht University Library, KAART: Moll 691).

Utrecht University Library houses a large collection of these kinds of siege maps, fortification plans and engineers' maps. They offer a splendid visual image of the events during the War of the Spanish Succession. Also of many other succession wars in the turbulent 18th century the library has often unique cartographic material in its vaults. In addition, there are smaller numbers of maps bearing witness to military operations and situations from the 17th and 19th century.

4. Georeferencing

4.1 The Application

Digitizing and putting old maps online is a good thing in itself. However, the documents get an extra dimension by linking them to a geographical medium such as Google Earth. For the purpose of georeferencing the old maps the application *Georeferencer* was used (see *URL2*).

Georeferencer is a cloud application or a SaaS (Software as a Service) and for this purpose it was incorporated in a, for public domain, closed part of the Library's website. This means that nothing had to be installed on the client side, which is an important condition in a school environment.

4.2 The Process

The Library had prepared a set of maps which they wanted to be georeferenced. The maps appear randomly on the screen, each time a user wants to georeference a new map. The screen is split in two parts: left is the old, to be georeferenced, map and right a modern reference map, in this case Google Maps (see *figure 4*)
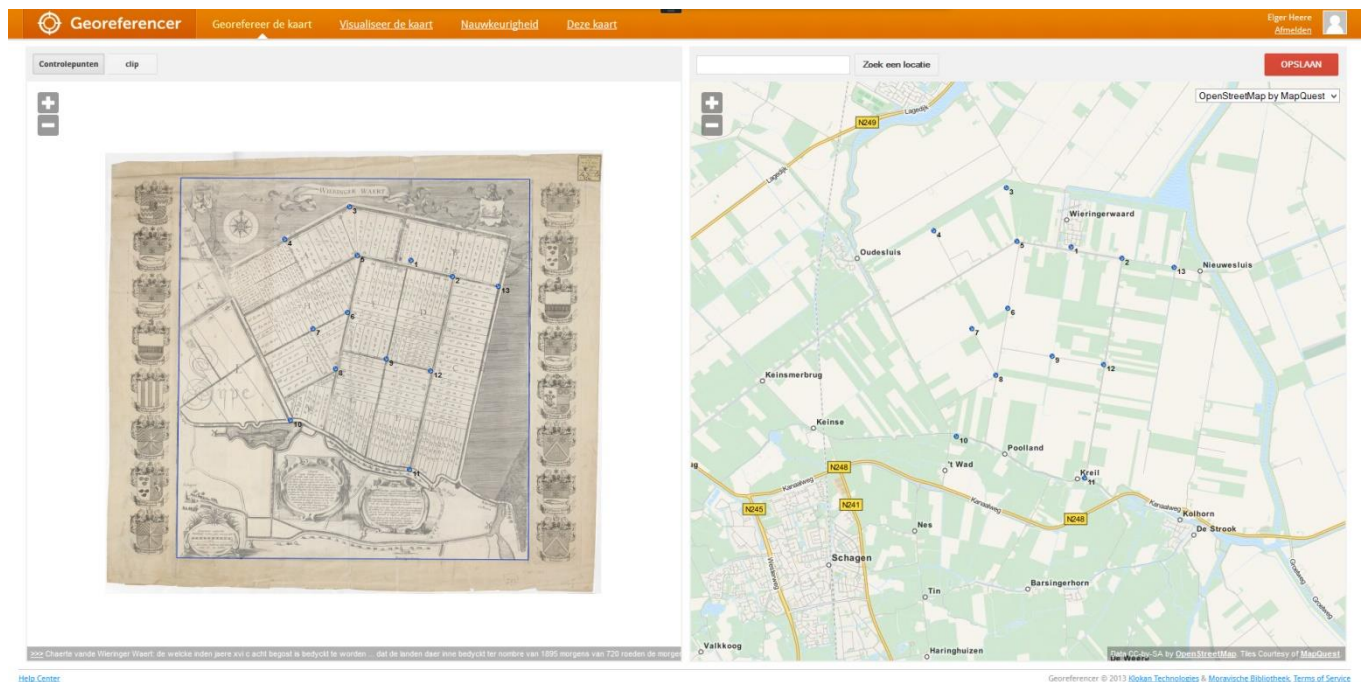

Figure 4: Start screen *Georeferencer*

The user looks for common points on the old and the reference map and connects these point. *Georeferencer* now connects geographical coordinates to the old map and when the user saves his work, the old map is georeferenced. Next the georeferenced maps can be consulted by means of a KML link in Google Earth or in *Georeferencers* own viewer. It is also possible to judge the accuracy of the georeferenced map in *Georeferencer*. *Figure 5* shows the map of the battle near Oudenaarde (see *figure 3*) in Google Earth and *figure 6* shows the map of the Wieringer Waard (see *figure 2*) in the *Georeferencer* application. Figure 7 shows an example of an accuracy analysis of an old map.

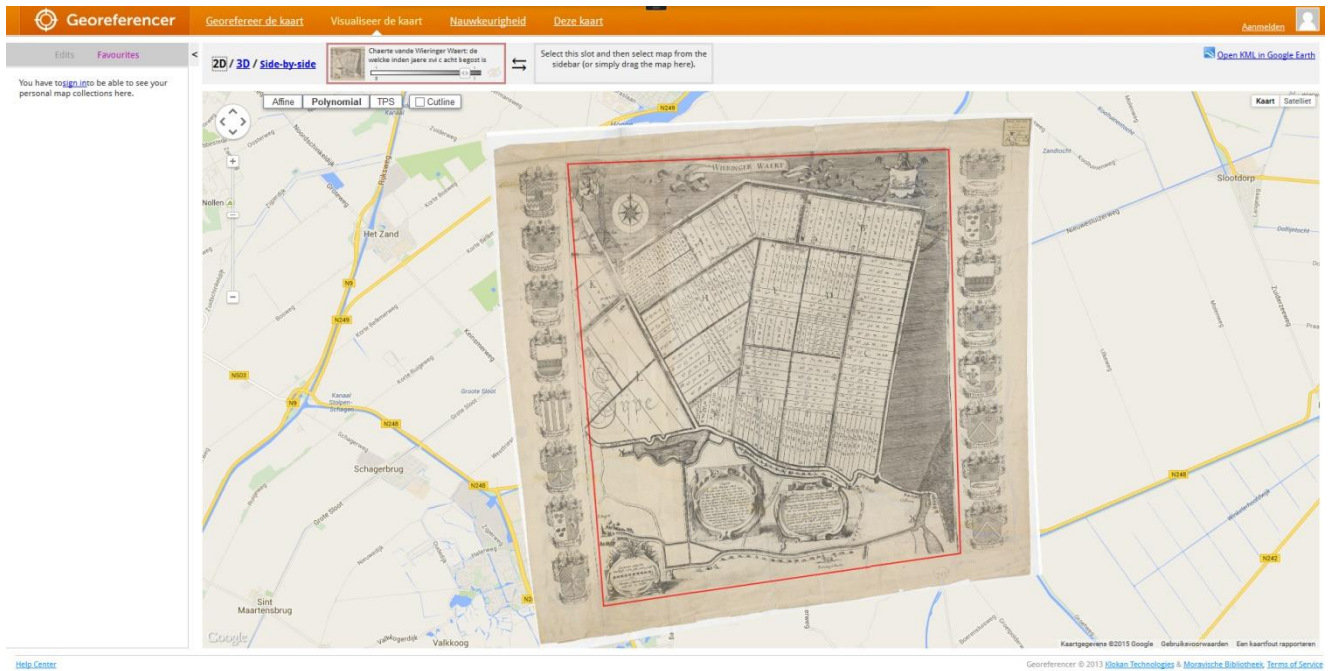**Figure 5** The map of the battle near Oudenaarde on Google Earth

Figure 6: The map of the Wieringer Waard in the *Georeferencer* application
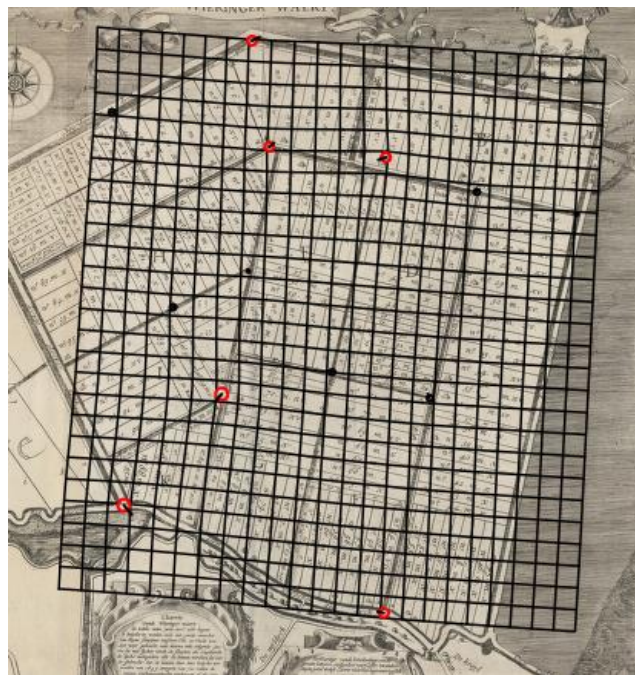

Figure 7: Accuracy analysis

4.3 The Possibilities

Per map the university library gives access to the scan in both Google Earth and *Georeferencer*. By clicking on a map in the digital exhibition it will be shown in the viewer of the library. In the left menu you will then find links to the scan in Google Earth (Document in Google Earth) and to *Georeferencer* (Georeferences). Both applications make it possible to zoom in sharply on the map. The map can also be made transparant (in Google Earth: use the transparancy tab left middle after selecting the map; in *Georeferencer*: tab top left) which makes a comparison with the current situation possible.

Apart from the fact that georeferenced maps are shown in modern and advanced interfaces such as Google Earth, there are other advantages. It is for instance also possible, by opening more map layers, to pile several old maps on top of the others, thus comparing them. Moreover, new ways to analyze old maps or to link them to other spatial information are created. Last but not least georeferenced maps offer improved accessibility.

4.4 The Project

The georeferencing was performed by first year students Geodesy / Geo-Informatics. For them it was a first introduction to work with old material, which gave specific problems.

At first, the students were invited to come to the Utrecht University Library for an introduction to the subject and to become acquainted with the old maps. Although working with digital scans of old maps is practical, nothing beats the thrill of seeing and holding the original material.

Then, the georeference work is done at school, under the supervision of the map curator, a technical specialist of the Library and the teacher (see *figure 8a* and *8b*). After ca. 120 water management maps and ca. 100 military maps were georeferenced, the students had to give an oral presentation about their findings.

Figure 8a and b: Hard work, and a lot of consultation, during the georeference process (photo by E. Heere).

A couple of things, the students noticed on working with old maps, what they didn't expect.

At first, sometimes they had great difficulties with localizing the old map. Especially the fortification plans were sometimes extremely difficult to localize. As an aid with the localization, students could use some atlases with modern and 19th century topographical maps, but in some cases the landscape had radically changed. *Figure 9* shows such an example.

Figure 9: Radically changed landscape: nowadays nothing remains of the old city walls in Arnhem.
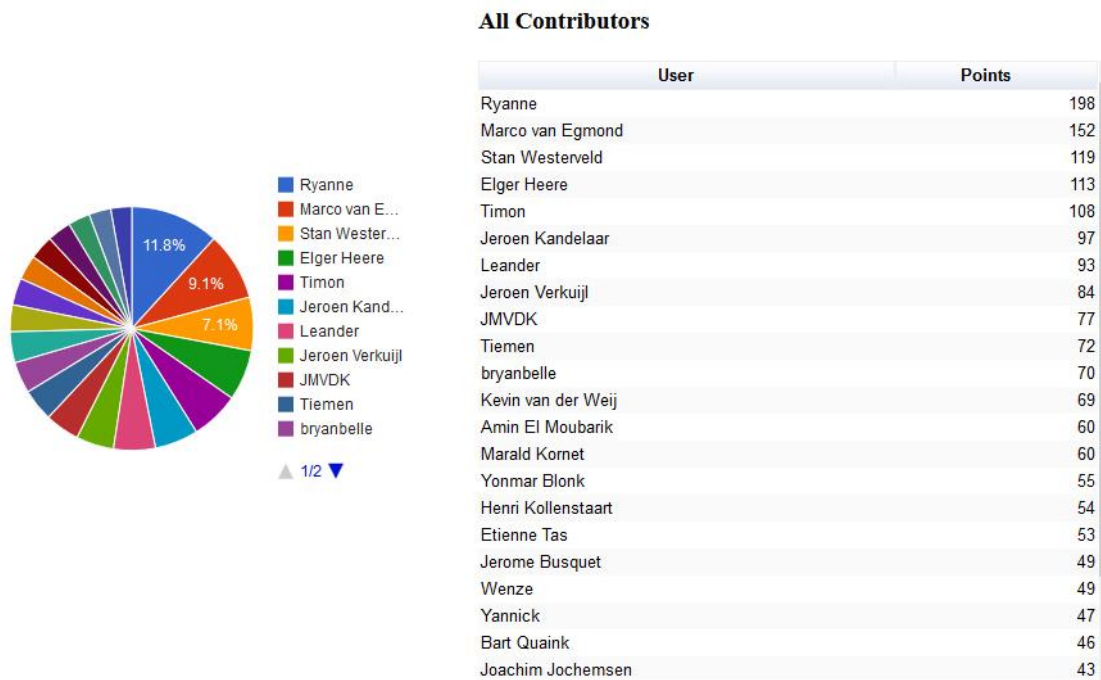
Second, sometimes placenames has changed, something students didn't realize at all.

Third, the students are accustomed with the fact that the north is always on top of the map. With old maps, this is seldom the case. The direction of the north is rather at random. It took some time before students were used to this.

Fourth, the accuracy application, within *Georeferencer*, was used frequently. Students got a better notion of the nature of the old maps and they were able to judge their own and others work.

No special comments were made on working with cloud based software. This was not new to them.

At last, student had fun in doing this project. Although they find difficulties, mentioned above, they considered it as a challenge to get the old maps georeferenced. Not in the last place, because of the competitive element. *Georeferencer* keeps rankings about how many points each participant had set. Figures 10a and 10b shows these rankings.

All Contributors

User	Points
Ryanne	198
Marco van Egmond	152
Stan Westerveld	119
Elger Heere	113
Timon	108
Jeroen Kandelaar	97
Leander	93
Jeroen Verkuijl	84
JMVDK	77
Tiemen	72
bryanbelle	70
Kevin van der Weij	69
Amin El Moubarik	60
Marald Kornet	60
Yonmar Blonk	55
Henri Kollenstaart	54
Etienne Tas	53
Jerome Busquet	49
Wenze	49
Yannick	47
Bart Quaink	46
Joachim Jochemsen	43

Figures 10a and 10b: Ranking of the georeferencers.

5. Conclusion

Was this project successful? The answer is *yes* for the teacher and *not entirely* for the map curator.

For the teacher it was successful because the learning outcomes that was hoped for, were fulfilled. The students experienced working with old maps and found out that this is completely different than working with modern maps. Beside this, they learned about map accuracy, technical aspects of working with cloud applications and they learned about the fundamentals of crowdsourcing.

For the map curator, it was not entirely a successful project. The work by the students was not always accurate and with some maps they made a lot of errors. Sometimes, the students were not able to georeference the map at all. So there was some editing to be done by the map curator.

With the experience of this project a few recommendations on didactical and technical issues and from the librarians point of view can be made.

From a didactical point of view, students are very motivated to work on a project like this. They like to get out of the classroom and they had the impression that they were working on a unique project, which was never done before in The Netherlands (which was the case). Also the competitive element works very well with students. But their ability to work concentrated is not that long. So you have to do the project in a couple of hours maximum. After the project, students had to give an oral. This showed that they had fulfilled the learning outcomes.

First year students are an extremely difficult group to do such a project. They have hardly knowledge about historical geography or history in general and they have never seen an old map before. So it is hard to generate recommendations for a large crowdsourcing project, where you can expect that the crowd has at least some knowledge about history and old maps.

The results of the georeferencing project increases when there is knowledge of the area on the map and its history. But you can make it the user easier when rotation tools are added to the georeferencing application. Also important is the addition of old topographical maps to the application, which can be used as reference maps.

For the librarian, it is important to realise that editing is an important part of the project. Of course you can let the crowd do the editing, like in Wikipedia, but some ways to ensure the accuracy of the georeferencing have to be found and are an essential part of the workflow.

References

URL1: Digital exhibitions Utrecht University Library:
http://bc.library.uu.nl/digital-exhibitions

URL2: Georeferencer: http://www.georeferencer.com/