Geo-information Science and Remote Sensing

BSc Thesis Report GRS-80418

The importance and use of GIS-supported participatory spatial planning approaches in higher education

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19-06-2019

WAGENINGEN
UNIVERSITY & RESEARCH

The importance and use of GIS-supported participatory spatial planning approaches in higher education

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A thesis submitted in partial fulfilment of the degree of Bachelor of Science

at Wageningen University and Research Centre,

The Netherlands.

19-06-2019

Wageningen, The Netherlands

Thesis code number: GRS-80418
Thesis Report: GIRS-2019
Wageningen University and Research Centre
Laboratory of Geo-Information Science and Remote Sensing

Preface

This thesis is executed as part of an open bachelor program, specialised in geographic information systems (GIS) at the Wageningen University and Research (WUR). The thesis closes the open program with a research that combines the fields of landscape architecture and spatial planning, and GIS.

As a student who started his bachelor in landscape architecture and spatial planning, but continued more in a GIS direction, I have knowledge of both academic fields. Therefore, this research is a unique opportunity for me to obtain a deeper understanding of participatory planning GIS (PGIS) and to have a contribution to both fields of study. During my first year of the study, the course I enjoyed the most was 'Geo-information science for Planning and Design'. This introduction GIS course awakened my enthusiasm for maps and geographic information I always had. To practice and demonstrate the application of geographical information concepts and methods in planning and design activities, I more and more got convinced of the importance and use of GIS.

However I already knew about participatory planning, I did not know that there was also a development going on about PGIS. The combination of participatory planning approaches and GIS closes my program in an interesting and connecting way.

Abstract

This research investigates GIS-supported participatory spatial planning platforms that can be supportive to higher education courses of landscape architecture and spatial planning. Participatory planning GIS (PGIS) is defined as a merger of participatory learning and action methods with geographic information technologies and systems. Research methods have developed new tools aiming to support and stimulate citizens' participation in planning activity, the so-called PGIS platforms. This research assesses four different types of PGIS platforms to determine which approach can be of importance and use in higher education. Maptionnaire, Mapillary, Map Me and Story Maps are the assessed platforms for this research. A set of requirements is formulated to support the pros and cons of the platforms that are tested.

Based on a review of literature and provided requirements, three tests were developed to explore the functionalities and controls of the platform. A group of second year spatial planning students performed the tests with each of the provided platforms for an evaluation. The platforms were evaluated on the base of the literature review, the test results and different evaluation forms that the participants filled in. PGIS platforms were generally assessed for whether they could contribute to higher education programs. Maptionnaire and Story Maps were indicated as the most preferred platforms on most of the criteria. It is recommended to implement Maptionnaire as a PGIS platform in participatory spatial planning courses of the study program and to implement Story Maps already in an earlier stage of the study program of landscape architecture and spatial planning.

Table of contents

List of Figures

List of Tables

List of Abbreviations

BLP	Bachelor Landscape Architecture and Spatial Planning
CSV	Comma Separated Value
GIS	Geographic Information Systems
GPS	Global Positioning System
LUP	Land Use Planning Group
OSM	Open Street Map
PGIS	Participatory Planning Geographic Information Systems
PPD	Participatory Planning and Design
PSP	Participatory Spatial Planning
PSS	Planning Support Systems
VGI	Volunteered Geographic Information
WUR	Wageningen University and Research

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1. Introduction

This thesis is a research to support Wageningen University and Research (WUR) courses that deal with Geographic-Information Systems (GIS) and participatory planning. Planning will become more complex and increasingly dependent on information and communication technology instruments. The fields of spatial planning and geographical information systems are both developing at their own pace (Geertman, 2002) and are very important in supporting each other. Therefore, this research investigates the importance and use of GIS-supported participatory spatial planning approaches in higher education.

1.1. Context and background

To understand GIS-supported participatory spatial planning approaches, one must first define what is meant with so-called participatory planning GIS (PGIS). PGIS builds on the integrated use of tools, methods, technologies and systems ranging from simple sketch mapping, to participatory 3D modelling, collaborative aerial photo-interpretation, and the use of GPS and GIS applications (Rambaldi, 2005). To examine the use and importance of these PGIS approaches, the definition of PGIS needs to be linked to courses of higher education. This research will be linked to the cluster of BSc courses within the Bachelor Landscape Architecture and Spatial Planning (BLP) programme of the WUR, which intends to educate in a participatory planning and design (PPD) approach.

Geodesign is an important factor herein. Geodesign is design in geographic space (Miller, 2012), and combines GIS and, planning and design. Geodesign can easily be considered as an outflow or evolution of earlier decision support and participatory GIS applications (Slotterback et al., 2016). Geodesign development is in many ways of interest. As the latest evolution of GIS in environmental design, geodesign has attracted multidisciplinary effort from academia, design professions and geospatial industries to define and contribute to its future (Li & Milburn, 2016). The effectiveness of geodesign thus requires contributions to and collaborations from a wide range of disciplines and professions (Steinitz, 2012). For this research, the benefits of geodesign development and the PGIS platforms are needed as well as the drawbacks. A critical barrier is uncertainty about the quality of the spatial data generated (Brown, Weber, & de Bie, 2015) for example. Place-based thoughts and feelings of individuals can limit the effectiveness of many traditional PGIS for data collection (Huck, Whyatt, & Coulton, 2014). Research methods have developed new tools aimed to support and stimulate citizens' participation in planning activity (De Vidovich, 2018). In this research, these tools will be appointed as so-called PGIS platforms. Crowdsourcing or citizen participation has been widely used for applications in environmental monitoring, management and in decision-making processes (Castell et al., 2015; See et al., 2016; Wilkinson et al., 2015). The advantage of the digital approach to geodesign, particularly when using GIS, is that it can handle a wide spectrum of spatial complexity (Miller, 2012). The spatial complexity of PGIS can be an addition to the courses of landscape architecture and planning because participatory spatial planning (PSP) is an important part of the planning studios.

1.2. Problem Definition

This research will examine different kind of PGIS platforms that can be supportive to higher education programs of landscape architecture and spatial planning. It will be a form of consumer research for students and teachers to a product that may support the geodesign idea. The platforms will be compared to the learning objectives of courses that have to do with PSP. Some platforms are discussed in scientific articles and wide user communities, other platforms may need another scientific approach to compare it to course requirements and a story map that is used in education. The connection of participatory planning and GIS is virtually non-existent in higher education. The development of PGIS platforms is booming and can be a great contribution to spatial planning. In the working field this is already sometimes in use. In a higher education setting there are also opportunities. A variety of PGIS platforms will be analysed and discussed.

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1.3. Research objective and research questions

The objective of this research is to assess different kind of participatory spatial planning platforms where GIS is involved and to determine which approach can be implemented in higher education courses given a particular participatory planning approach.

To achieve this objective the following research questions are formulated:

1. What requirements are coming forward regarding the learning outcomes of participatory planning and design courses cluster?
2. Which platforms related to PSP are available and which procedures can be defined to explore the options of these platforms?
3. How will GIS-involved participatory spatial planning platforms support the requirements?
4. What are the pros and cons of each platform regarding the requirements and is there any preferred platform?

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2. Review

For the literature review of this thesis, a theoretical framework will first be set. Participatory planning and PGIS and their development will be discussed. Literature from different experts and different years will support the framework to obtain a clear picture of the development of GIS-supported participatory planning approaches in time. Following the theoretical framework, the first two research questions will be dealt with. The requirements for this research will be set and subsequently different PSP platforms will be explained and researched using literature. This will all lead to a review conclusion.

2.1. Theoretical framework

2.1.1. Participatory planning

Participatory planning is a significant part of some WUR courses of the bachelor; Landscape Architecture and Spatial Planning (BLP). Students that choose the major spatial planning even take the course 'Studio Participative Planning' in their second year of the bachelor. The learning outcomes of this studio and of the Planning and Research Methods course will later be discussed at the requirements. Spatial planners combine their knowledge of the landscape with their knowledge of people and society to achieve a result that satisfies all the involved (WUR, n.d.). To obtain knowledge of people and society, participation is very important. When these kind of stakeholders are involved in spatial planning, participatory planning can be achieved.

Participatory planning involves the systematic effort to envision a community's desired future and planning for that future, while involving and harnessing the specific competencies and input of community residents, leaders, and stakeholders in the process (Beyea, 2009). Spatial planning problems are often complex and require the competency of experts from different fields, involve stakeholders with diverging interests, and may affect a large number of people (Voss et al., 2004).

Arnstein (1969) illustrated eight levels of participation arranged in a ladder pattern with each rung corresponding to the extent of citizens' power in determining the end product (Figure 1). This ladder is still used in higher education on the topic of public participation.

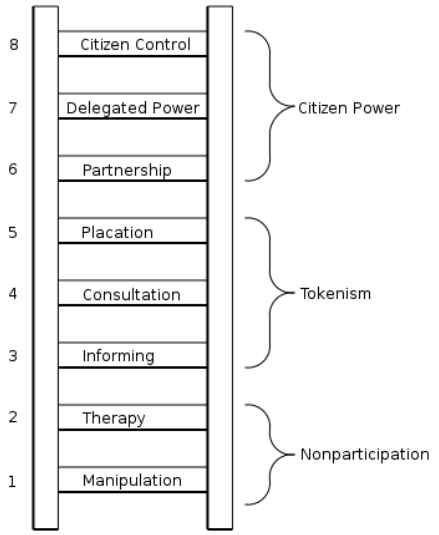

Figure 1 *Ladder of citizen participation, (Arnstein, 1969)*

2.1.2. PGIS

The concepts of participatory planning and geographic-information systems (GIS), people are already familiar with for some time now. Driven by the rise of Web 2.0 (the development of the internet to a communication tool) and the non-stop spread of mobile device sensors, the concept of public participation GIS is knowing a revolutionary era (Brovelli, Minghini, & Zamboni, 2014).

One of the most cited definitions conceives GIS as a combination of hardware, software, data, people, organizations and institutional arrangements for collecting, storing, analysing, and disseminating spatial information (Brovelli et al., 2014). Participatory planning GIS (PGIS, as will be used in this thesis) is a practice resulting from a spontaneous merger of participatory learning and action methods with geographic information technologies and systems. It builds on the integrated use of tools, methods, technologies and systems ranging from simple sketch mapping, to participatory 3D modelling, collaborative aerial photo- interpretation, and the use of GPS and GIS applications. With PGIS applications, indigenous spatial knowledge is composed in the form of virtual or physical, 2- or 3-dimensional maps that are used as interactive vehicles for spatial learning, information exchange, support in decision making, resource use planning and advocacy actions (Rambaldi, 2005). A whole broad spectrum of possibilities and actions.

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PGIS are developed to ease and support experts' work with geographical information or to enhance laypersons' access to geographical information and communication between different stakeholders (Kahila & Kyttä, 2009). Kahila and Kyttä (2009) address in their article also to 'softGIS'. SoftGIS aims to form a bridge between existing traditions in the fields of PGIS and planning support systems (PSS). SoftGIS methods are built on the following principles (Kahila & Kyttä, 2009):

- The operationalization of perceived knowledge is grounded in the theories of humanistic geography and environmental psychology;
- The perceived knowledge is gathered through scientifically valid, reliable and ethical methods;
- SoftGIS methods are developed in cooperation with urban planners, who can use this novel knowledge in their planning practices;
- The database makes systematic GIS and statistical analyses possible; and
- The methods provide a user-friendly internet platform for residents to evaluate their everyday living environment.

In the way that Kahila & Kyttä (2009) describe softGIS in their article, as a bridge-builder between PGIS and PSS, PGIS can build a bridge as well between participatory planning in higher education and new technologies and web-based GIS applications. The evolution over the last decade of web applications dealing with geospatial contents has been burgeoning (Brovelli, Minghini, & Zamboni, 2016). Mobile devices with the latest technologies and applications can utilize up to nine integrated sensors nowadays. Including different transceivers (mobile network, Wi-Fi, Bluetooth), FM and GPS receivers, camera, accelerometer, digital compass and microphone (Haklay, 2013). All these sensors can connect geospatial information to other measured information. Every step you take on social media can be linked to your location. Therefore, mobile applications are a good contribution to PGIS.

The advantage of using GIS in participatory planning activities is that it provides spatial complexity, spatial context, and interactivity and interconnection in the articulation of viewpoints (Talen, 2000). However, PGIS is not perfect either. A significant barrier to the use of PGIS and crowd-sourcing for conservation planning is uncertainty about the quality of the spatial data generated (Brown et al., 2015). Another problem with PGIS is participatory inequality mentioned by Nielsen (2006). Most of the data is contributed only by a small fraction of users. For open contribution systems, the 90:9:1 rule for participation was observed: 90% of the users only consume the information, 9% contribute occasionally, and only 1% is constantly active in contributing information (Nielsen, 2006). GIS can analyse, select and display information for people to think and talk about, but, like a map, they are only as good as those who use them (Chambers et al., 1998). Effective participation is the key to good PGIS practice (Rambaldi, Kyem, McCall, & Weiner, 2006).

2.1.3. PGIS Development

Participatory planning is not a very new concept. The participatory creation of maps started already in the late 1980s (Rambaldi et al., 2006). However, the participatory planning terminology was already introduced earlier: 'The integration of rational and consensual aspects of planning with personal and social aspects leads to a new notion of the planning process. For now this will be called participatory planning' (Smith, 1973). Arnstein published his ladder of citizen participation already in 1969. There is also an example from Kingston, Jamaica, in the 1970s, Frances Madden (pers comm.) asked youths to draw a map to show where waste bins should be located (Chambers, 2006). Eventually nothing was done with the result, but this was also already a form of participatory mapping.

At first, participatory mapping was mostly used with local communities of developing countries. Figure 2 shows an example of a Philippine community working with PGIS. Before the late 1980s and early 1990s some people were so excited at what they were finding local people could do, much indigenous, local and participatory mapping had already taken place in different regions, countries and continents. Mapping and various forms of spatial representation by local people on their own have a long history, and very likely a prehistory as well (Chambers, 2006). The merging of community development with geo-spatial technologies for the empowerment of less privileged communities has come to be known as PGIS (Rambaldi et al., 2006).

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Figure 2 *An example of urban PGIS by residents of the Barangay Commonwealth assisted by Philippine Disaster Resilience Foundation as part of a USAID-funded project about disaster risk reduction (2018). Retrieved from http://wpmu.mah.se/nmict182group2/2018/10/23/the-power-of-maps-participatory-gis-for-disaster-prevention/*

The state of affairs in mapping changed in the '90s, with the diffusion of modern spatial information technologies (including GIS), global positioning systems (GPS), remote sensing image analysis software and open access to spatial data and imagery via the Internet into the industry (Rambaldi et al., 2006). PGIS is traditionally referred to as a system for the collection of geospatial data from the public. The origins of which may be traced back at least as far until the 'original' definition that was attributed to Schroeder (1996, in Sieber, 2006) who describes PGIS as "a variety of approaches to make GIS and other spatial decision-making tools available and accessible to all those with a stake in official decisions" (Huck et al., 2014).

At the end of the 20th century, 1998, a group of 35 researchers and practitioners met at the University of Durham for a workshop to discuss participatory research and the potential for PGIS. The objective of the workshop was to identify the benefits and problems of a PGIS approach (Chambers et al., 1998). Until then PGIS did not currently exist according to a participant of that meeting, but they were at a stage of exploration.

Geertman (2002) discussed that the field of spatial planning has grown at a tremendous pace and in unforeseen directions. It also has become more interactive and participatory in nature. Geodesign can easily be considered as an outflow or evolution of earlier decision support and participatory geographic information system (GIS) applications (Slotterback et al., 2016). Geodesign development is in many ways of interest. As the latest evolution of GIS in environmental design, geodesign has attracted multidisciplinary effort from academia, design professions and geospatial industries to define and contribute to its future (Li & Milburn, 2016). The effectiveness of geodesign thus requires contributions from and collaborations among a wide range of disciplines and professions (Steinitz, 2012). The term Geodesign refers to an approach of planning and design as an integrated process which includes project conceptualizations, knowledge building, design of alternative scenarios, evaluation of impacts, decision-making, collaboration and participation (Campagna, 2014). The participatory approach to geospatial data is therefore an important factor in many fields.

The earlier appointed rapidly increase of web applications dealing with spatial content is also a part of the development of PGIS. This new trend has been traditionally associated with the term Volunteered Geographic Information (VGI) that is explained by comparing humans to ''intelligent, mobile sensors'' able to acquire precious geospatial information (Brovelli et al., 2016). Up to around 2005, almost all participatory application were desktop-based. A second category of participative tools consists of applications running on mobile devices which allow users to gather multimedia data, geo-tag it and directly upload it on the Web (Brovelli et al., 2014). Some examples will be discussed later on. The development of PGIS in higher education is one that has just been mentioned since the last ten to fifteen years.

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The digital revolution continues to create an ever-increasing number of platforms, tools, and methods that have the potential to democratize the production and dissemination of a tremendous variety of place-based knowledge (Eanes, Silbernagel, Hart, Robinson, & Axler, 2018). Increasing ubiquity of smartphones and rapid advancements of the geospatial web combine a host of capabilities in approaches to user engagement that prioritize participation, user empowerment, and the collaborative crowd-sourcing potential of web 2.0 (Sui, 2015). The rise of social media and its related mobile technologies is noted as a high-impact trend with respect to sustainability and environmental learning outcomes (Ardoin, Clark, & Kelsey, 2013). This new development of social media, mobile technologies and applications is sometimes already and will be an important part of PGIS platforms.

2.1.4. PGIS in higher education

About PGIS used in a higher education setting, there is not much to find about in literature. There is an example of participatory action research in undergraduate GIS courses appointed by Elwood (2009). In a park community GIS project, university students, community organization staff members and local residents created an updated version of a neighbourhood strategic plan and developed spatial data for ongoing GIS applications (Elwood, 2009). The project was about the investment of improving the quality of life in the neighbourhood of the research area. Students were embedded in the social and political processes of producing GIS-based data and maps. The notion of involving students in a regular university course has received little attention until this article. For universities a contribution with community organisations can also be an asset, because organisations will see them as a partner instead of only an institution (Elwood et al., 2007).

A drawback is that students are time-limited. Because having students and community partners fully negotiate in the research project would be ideal, it may not leave enough time to fully complete the project. In general, participatory GIS partnerships need all kinds of expertise. Everyone brings something, and everyone gains extraordinary knowledge. When we place the students and a community person together to work with GIS, they learn from each other (Elwood et al., 2007). Students become active in GIS-based spatial data creation and use. Therefore, it can be a contribution to work with individuals and groups that are affected by the results.

According to Sinha et al., (2017) PGIS can help educators meet diverse learning objectives, these learning objectives can help to connect literature on GIS education and PGIS. The learning objectives are:

- Recognizing and appreciating the uniqueness of places, communities, and local knowledge systems.
- Understanding the relationship of people and landscapes through service learning in communities.
- Gaining practical training in field methods of collecting, managing, processing, and visualizing geographic information using geospatial technologies.
- Gaining experiential and practical introduction to mixed-methods research and hybrid qualitative-quantitative methodology.
- Fostering critical reflexivity by explicitly accounting for positionality and identity issues in geographic knowledge production.

“Student involvement extended the scope of PGIS projects far beyond what we had initially envisaged.”(Sinha et al., 2017). This article of Sinha et al. (2017) concludes the combination of higher education and PGIS as a very positive development. One must also realise that there is a great diversity in PGIS projects. Not all types of projects will, however, be equally beneficial to students, or some will be beneficial in some ways, but may also cause problems for students. The time that students can dedicate to a project and how PGIS projects can be transformative educational experiences can be doubtful (Sinha et al., 2017).

The implementation of PGIS in GIS courses is more often appointed then PGIS in spatial planning related courses. The reason for this is probably because a certain level of experience is needed in GIS to implement PGIS in the field of spatial planning or landscape architecture. And most of the current educational tools and participatory approaches are still largely researcher-driven, may or may not involve end-users in their design and development, and do not always allow participants to interact with one another (Eanes et al., 2018). For the implementation of PGIS platforms in higher education, there is still a next step that can be taken.

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2.2. Requirements

What requirements are coming forward regarding the learning outcomes of participatory planning and design courses cluster?

To achieve a decent research for higher education purposes, high standards need to be set. This will be done with a number of requirements. These requirements will be needed to develop the tests for the third research question. From the Land Use Planning (LUP) group of WUR a set of possible requirements is provided. These requirements are updated and improved to connect to this research. A discussed platform does not need to fully connect to each requirement. The requirements will be used as a sort of assessment criteria for each platform. The requirements are factors that will influence the possible addition a platform can be to higher education. If a platform connects well to all, or most of the requirements, the platform will most likely be more suitable as a GIS-supported PSP platform. The used requirements for this research are:

- Integration platform of different knowledge sources, like geodata, CBS (Statistics Netherlands), PBL (Netherlands Environmental Assessment Agency), SCP (The Netherlands Institute for Social Research), literature (journals, books), newspapers, blogs, social media (Instagram, Twitter, Facebook, mobile applications), visual interaction (Skype, virtual reality, visualisations), story's, history, routing, links, networks and emotions (1)
- Easy functionalities and controls, few options overload: consult, select, combine, save, adjust, exchange (2)
- Geo-database support for the purpose of: consult, complement and mark spatial data, open to diverse geographic systems (3)
- Suitable for multiple operating systems (Windows, Apple, Android, etc.), browser/internet systems and for different hardware (pc, laptop, tablet, smartphone etc.) (4)
- Communication via different digital channels and systems (exchange of ideas, thoughts, options, information, discussion, emotions), of WUR students and staff members, governments, NGO's (Non-Governmental Organisation), institutes, individual citizens and other kinds of possible stakeholders (5)
- Open source for possible small adjustments and additions, but not to extended in becoming an own system with maintenance; transparent as possible, accessible for layman's, and easy to be maintained externally (6)
- Privacy security (closed for outsiders) and simultaneously accessible for multiple users, but closed off during individual adjustments (7)
- Open for different materials with own sizes, like documents, pictures, videos, texts, interactive possibilities (8)

For a PGIS platform it is important that many of different data sources are usable and adaptable in the program. It can be useful to import geodata or statistical data in an online environment to make an analysis. To handle the data it is important that the platform is easy in its functionalities and has easy controls to handle. It is also important to know if the platforms or data that comes forward from the platforms are adaptable with which geographic systems. ArcGIS, ArcGIS Online, QGIS are different geographic systems with different manuals. Another difference for the platforms can be the operating system the platform is meant for. Is the platform usable for Windows, Apple or Android or for all of them? And can the data be used for communication with different channels and systems?

When filling in the ladder of citizen participation of Arnstein on a y-axis, together with the stages of a participatory process on an x-axis a table can be created (Table 1). The empty spaces in the table can be filled in with the provided requirements, that regard to that stage and step. The type of data, grey sources or social media sources for example, can be put under 'Data gathering'. The functionalities and controls are important for the data handling, but can also be a part of the data visualisation or interaction stage. The numbers at the end of the requirements are filled in in Table 1 at the place where they can be important.

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Table 1 Combination table of the participation ladder of Arnstein, stages of a participatory progress and the requirements

Ladder of citizen participation		Data gathering	Data handling	Data visualisation	Interaction	Communication
Citizen power	Citizen control Delegated power Partnership	1, 2, 3	2, 3, 4, 6	1, 2, 8	1, 5, 7, 8	1, 5
Tokenism	Placation Consultation Informing	1, 2, 3	2, 3, 4, 6	1, 2, 8	5, 7, 8	1, 5
Nonparticipation	Therapy Manipulation	1	6	8	5, 8	5

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2.3. Platforms

Which platforms related to PSP are available and which procedures can be defined to explore the options of these platforms?

Some platforms were already provided by the supervisor, these four platforms will be assessed. The platforms will be analysed according to literature and own findings. The functionalities will be described and analysed by means of the requirements. Other platforms that came forward out of literature will be discussed afterwards to look into them if they can have a contribution to higher education and for the tests.

2.3.1. Maptionnaire

With Maptionnaire people can make map-based surveys to obtain ideas and insights from residents. It is a survey tool which facilitates simple and effective public participation (Maptionnaire, n.d.). The platform is meant for urban planners, for researchers and technical properties. Surveys of Maptionnaire can be answered with computers, tablets and smartphones. Maptionnaire is developed by a company, Mapita Ltd, to allow cities to use SoftGIS in their urban planning practices more frequently (De Vidovich, 2018) and can be used as a research tool or as a participatory tool (PGIS).

When using the demo, a couple of standard features came forward. For the basis of a survey it is possible to mark your favourite locations, draw lines and mark places with polygon features. A combination map of drawn lines is shown in Figure 3. You can also add regular multiple-choice questions, questions with ranges, priority assessments and open questions. At the end of the Maptionnaire questionnaire, the participant can make it visual with texts, images and colours. Also hand-drawn layers can be visualised on top of the base map. Maptionnaire works with all the major web-based providers like Google Maps and Bing. Own base maps can be used as well in a JPG, PNG or the geo-referenced TIFF format.

Figure 3 *Recreational walks (left) and walking instead of taking some other form of transportation (right) (Maptionnaire, 2019)*

When logged in, it is possible to upload different kind of shape files, images, maps and documents to the platform. Then it is possible to create a questionnaire or to edit one. In the editing mode pages with questions can be created. A start location can be set on the corresponding scale of the topic and the type of available maps can be checked on. When editing pages, draw-buttons can be added for points, lines and polygons to get drawn by participants. Other types of regular questions, documents, videos etc. can be added to these pages as well. When someone is finished with the design and settings of the questionnaire it is needed to have a license to download the results or to analyse them.

The response data of Maptionnaire can be downloaded, analysed and managed. The downloaded file is in an Excel format where it can be saved as a CSV (Comma Separated Value) file. The geographic data of this file can be opened in ArcGIS software. The responses can also be analysed directly. Maptionnaire has a build-in analyse tool by which the separated features, a heat map or a density map can be shown.

López-Aparicio, Vogt, Schneider, Kahila-Tani, & Broberg (2017) used Maptionnaire surveys to improve wood burning emissions from residential heating and urban environmental management in Oslo. The distribution of

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the GIS-survey was carried out using social media, stakeholder groups, municipalities, the construction sector, universities and educational centres, heating associations, groups and associations of senior citizens, NGO's and diverse networks. They collected with the research a total number of 1500 geo-located responses. For the dissemination, they mainly used Twitter as a social media platform and a Q-code on a poster that allows access to the survey for mobile phones and tablets.

Maptionnaire has plenty of partners in their community among which AGEL, a Dutch consultant agency specialised in space, infrastructure and environment. Also ruimteschepper.nl works together with Maptionnaire, this company matches GIS-professionals with governmental organisations. A drawback of Maptionnaire is that you need a paid license to look into the response data, the facet planners actually need to draw conclusions. A positive side is that the platform is already being used in the planning world of field.

Within higher education programs the platform is also in use. The universities of Groningen and Twente and the HAS in Den Bosch are examples of educational institutions that already use the platform in a higher education setting in The Netherlands. The features of Maptionnaire are specifically designed for urban planners and for researchers. So this can be a good connection of the platform and WUR study programs. The program also seems to check a great deal of boxes of the determined requirements. More on this will be tested with the tests that will be discussed later on.

2.3.2. Mapillary

Mapillary is a platform to host, process and publish street-level imagery and map data. It was designed for the crowd sourced collection of street-level photos (Brovelli et al., 2016). Using computer vision, Mapillary combines everything into a connected street-level view and automatically extracts map features (Mapillary, n.d.). The platform allows users to contribute crowd- sourced street level photographs from all over the world due to unique information that can be extracted from street level photographs but not from aerial or satellite imagery, such as the content of road signs, users of other Volunteered Geographic Information (VGI) Web 2.0 applications start to utilize Mapillary for collecting and editing data (Juhász & Hochmair, 2016a). Mapillary can be seen as a contribution network where images are uploaded by contributors, objects are detected, a 3D construction is made and map data are extracted from this input data. All features of Mapillary come eventually back in a contributor network. (Figure 4)

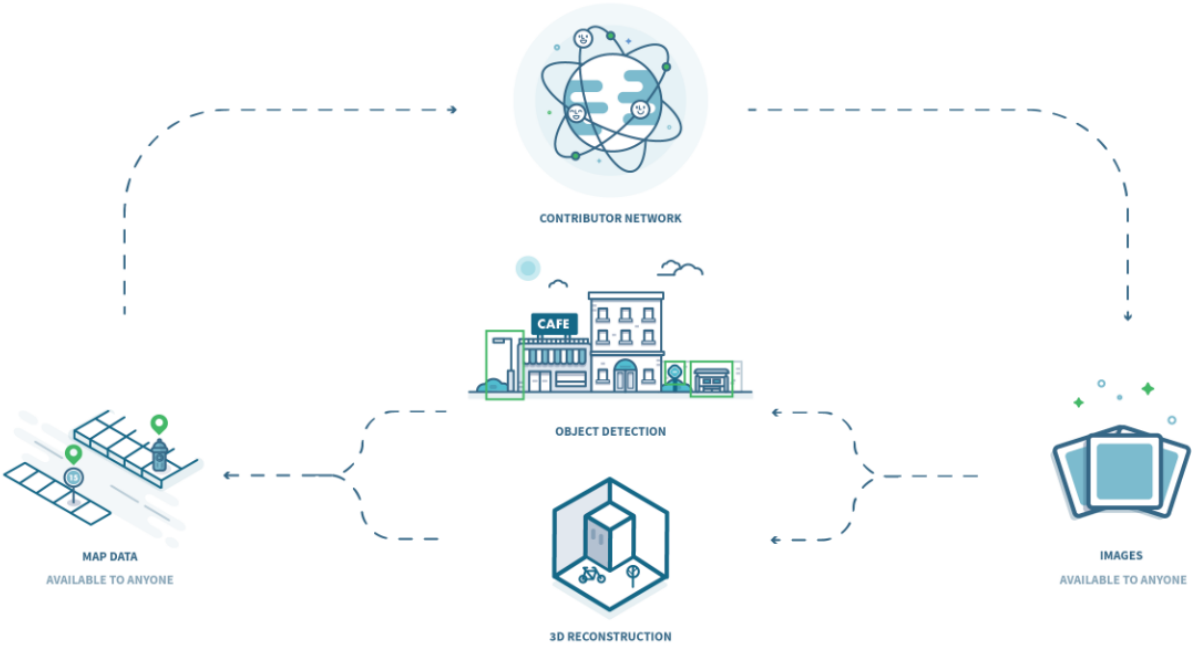

Figure 4 *How Mapillary works (Mapillary, n.d.)*

Mapillary has three key features: the earlier appointed support for simple image collection tools, integrations with GIS and other mapping tools and as developer's resources. It is possible to integrate the imagery and data into any tool, app or website. Also, it connects to some of the most popular GIS and mapping applications like

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ArcGIS and OpenStreetMap (OSM). The integration across ArcGIS is possible with ArcGIS Online, ArcGIS for developers and ArcGIS Pro.

Via the web application of Mapillary people can start to work with the platform. It is possible to see the networks of uploads on the map and functionalities as object detection and map features can be turned on. One can explore traffic signs, point features and line features. If there are multiple uploads on certain roads, one can 'time travel'. The Time Travel function lets you compare images taken at different times. This is useful for observing how places change due to, for example, construction work, wear and tear of infrastructure, or even seasonal change (Mapillary, 2018). It is also possible to switch from an individual account to an organisation account. By adding individual Mapillary accounts to your organisation, you build up a team that works together. If you want to licence Mapillary public imagery or map data (such as traffic signs), you need to set up an organisation and use it to subscribe to an imagery or data plan. This organisation function can be handy when implementing Mapillary in higher education.

Once you have a subscription, you can download map data as GeoJSON or shapefile, and integrate Mapillary public imagery in your own apps, tools, or websites. You do not need a subscription for integrating your own imagery (since it belongs to your organisation) (Mapillary, 2018). When an organisation is made, it is possible to add more people to the organisation. You can make shapes of the areas you want to analyse and look in to the map data of that area. Mapillary imagery, points, traffic signs and objects can be viewed on the map. To extract the map data and imagery to ArcGIS Online or ArcGIS Pro a subscription is needed. With Mapillary for ArcGIS Online, you are able to use the Mapillary application to supplement your own projects with street-level imagery from our community's uploads, as well as to view your own custom imagery (Mapillary, 2018).

Mapillary is a much appointed platform in PGIS literature. It is used for many different purposes like the identifying of sidewalks, to investigate the accessibility for people with mobility impairments (Voigt, Dobner, Ferri, Hahmann, & Gareis, 2016) or just to compare Mapillary to other Street View platforms (Juhász & Hochmair, 2016b). Also the city of Amsterdam used Mapillary to participate on an image-capturing project which captured 800.000 panoramic images of the city for an open data initiative (Beddow, 2017). A demo site is developed where people can analyse the city with the locations of benches, bikes, bridges, curbs and more for all kinds of purposes.

Figure 5 *Semantic segmentation on a Mapillary Vistas image (Peter Kontschieder, 2018)*

Mapillary provides a crowd-sourced alternative of street-level photographs to Google Street View. Mapillary has also the advantage that its users can take photographs with a smartphone and upload them with an app, without the need of professional camera equipment (Juhász & Hochmair, 2016a). Because of this, Mapillary is much more suitable for off-road, pedestrian and bicycle segments. A drawback is that the platform is not as widely known as Google street view and therefore it contains less areas with photos or segments. In the context of user participation it will assess user loyalty in data contribution (Juhász & Hochmair, 2016b) like many participatory platforms. With PGIS there are examples where student knowledge is used to capture geographic features or check features mapped remotely by other students. Some students are contributing to open street-level photo repositories such as Mapillary, using cameras or phones to upload visual data (Solís, McCusker, Menkiti, Cowan,

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& Blevins, 2018). For the research of Voigt et al. (2016) also students were used in combination with Mapillary to identify the sidewalks. Furthermore in a higher education setting where students learn about participatory planning and PGIS there is not much to find about this combination with Mapillary.

When analysing Mapillary with the requirements it is much more difficult in comparison to Maptionnaire or other PGIS platforms. The features of Mapillary do not directly represent the needs of participatory planning problems. The participative part of the platform is mostly the contribution a person can have to the wide network of Mapillary. The integration with data sources is a part that has to be analysed with the tests. Just like the rest of the requirements.

2.3.3. Map Me

The place-based thoughts and feelings of an individual do not, however, always fit well with the space-based points and polygons into which they are typically reduced in such a system, which can limit the effectiveness of many traditional PGIS for data collection. A ‘spray can’ platform allows participants to create spatial representations on a map using a familiar airbrush-style interface, permitting the creation of vague regions and boundaries that better reflect the places to which they refer (Huck et al., 2014). Since 2012 a free spray can platform is available through the Map Me (Mapping Meanings) website. The website refers to Map Me as an online PGIS for the creation of online surveys for the collection of vague spatial data based upon a "spray and say" approach (Map Me, 2019).

The Map Me product is a collaboration of four different institutes in the United Kingdom and the USA. The people of Map Me have experience in the field of GIS and higher education. The product can collect ‘fuzzy’ spatial data from the public with opinions on questions such as “where is good for…?, “where do you feel…?” or “where do you find…?” (Huck, 2012). After creating a free account, it is possible to generate easily a website that contains your questions and maps. It is possible to include a KML (Keyhole Markup Language) data file to link your ArcGIS data to a Google Map for example. Titles, ‘welcome’ and ‘thank you’ pages, logos and an URL can also be added to the website. The blob and spray diameter for the spray can method are adjustable. The output data of the results are exported to CSV files. In the CSV files the blobs are coordinates of individual point features. Map Me uses a custom "Multi-Point-and-Attribute" data format, whereby each individual dot of paint is stored independently in the database, and is linked to several attributes (Map Me, n.d.). These files can be imported into ArcGIS or QGIS for example. It is also possible to immediately open the CSV files in ArcGIS Online without extra handling of the data.

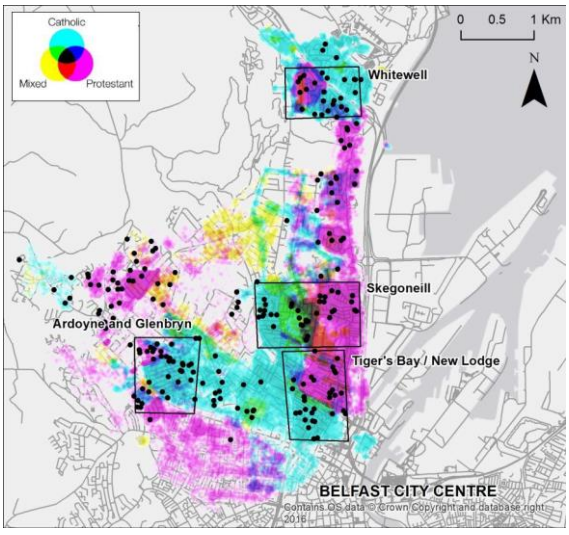

Figure 6 *Visualisation of the Belfast Mobility Project. The coloured background represents community affiliation, as defined by 32 of the participants using the Spraycan (PGIS) tool (Whyatt et al., 2017)*

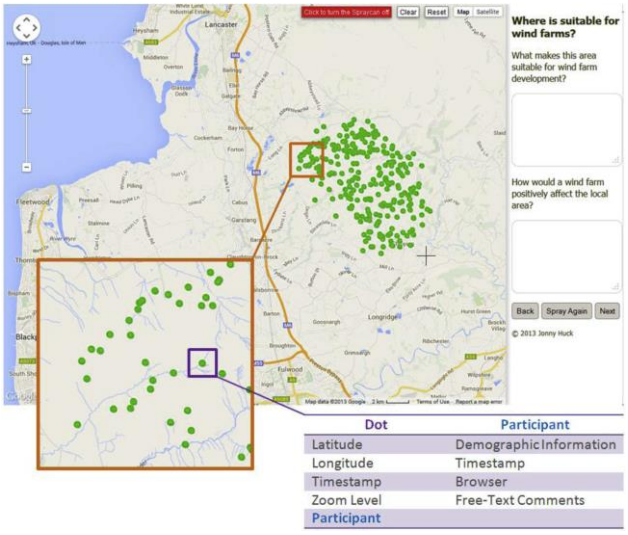

Figure 7 *the Spraycan user interface and the multi-point-and-attribute data structure of Map Me (Huck et al., 2014)*

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Spray can tools used in mapping are not new. Waters & Evans mentioned in 2003 also a spray can tool that allows users to tag information onto diffuse areas of varying density. They tested sprays of PaintShop Pro and Microsoft Paint to study high crime areas in a UK city. The Map Me platform has also been tested as a PGIS. Fire ecosystems (Sanchez-Trigueros et al., 2018) and the religious background of citizens of Belfast (Whyatt et al., 2017) Figure 6, were studied with the spray can tool of a Map Me website. In the mobility project of Belfast the 'dots' of spray are sized according to the zoom level of the map onto which they were generated, and are coloured using a subtractive colour model in which overlapping colours 'blend' together allowing interactions between the different classes to be seen (Map Me, n.d., Whyatt et al., 2017).

The spray can platform is designed specifically to promote creativity, flexibility and extensibility in the analysis of data, so as to permit a greater depth of understanding into the thoughts and feelings of participants than has previously been possible, using a relational data structure referred to as multi-point-and-attribute (Huck et al., 2014). The platform offers thereby a tool that is not available in other platforms and thereby it distinguishes itself. The Map Me website and the literature available are all linked to the same people, so a point of criticism or challenges of the PGIS cannot be found. Furthermore the functionalities of Map Me seem to be the most limited of all the platforms. There is not much more than the functions of ‘spraying’ and regular questions. The tests will show what the strengths and weaknesses of the platform are in comparison to the requirements.

2.3.4. Story Maps

Esri Story Maps let you combine authoritative maps with narrative text, images, and multimedia content. They make it easy to harness the power of maps and geography to tell your story. Esri story maps developed five principles of effective storytelling: (Esri, 2019)

- Connect with your audience
- Lure people in
- Choose the best user experience
- Make your easy-to-read maps
- Strive for simplicity

With these principles everyone can develop their own story map. Esri provides seven types of story maps you can use: A Story Map- Tour, Journal, Cascade, Series, Shortlist, Swipe and Spyglass, and a Basic Story Map.

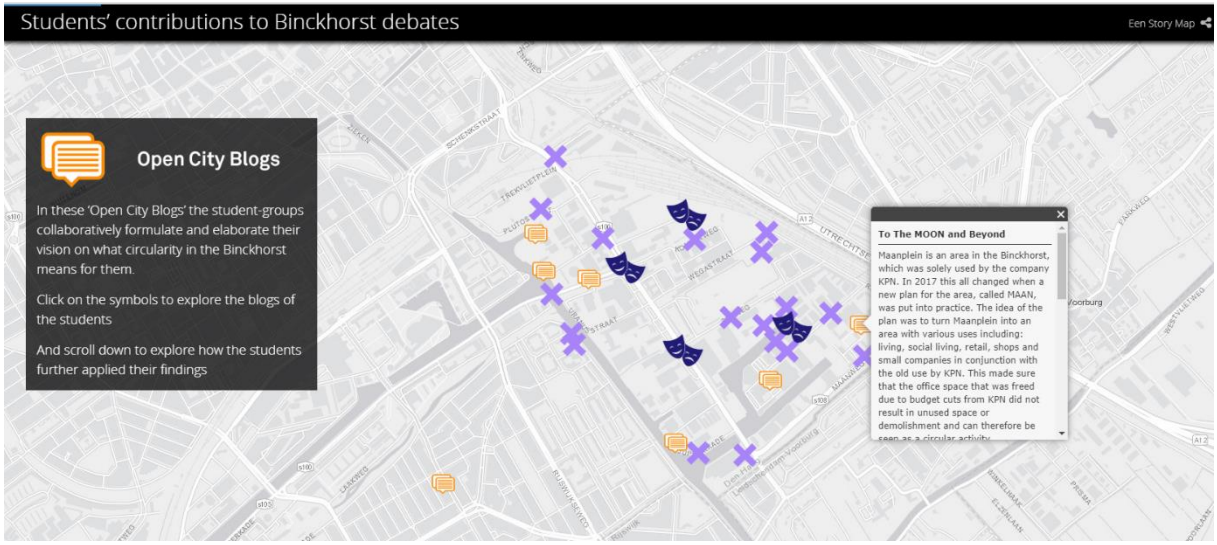

Figure 8 *Story Map example of students' contributions to Binkchorst debates (Bachem, n.d.)*

Within the WUR there is an example of a story map where students have their contribution to Binckhorst debates. Binckhorst is a neighbourhood in The Hague and a popular location for a variety of education institutes, bachelor and master theses, internship assignments and other group work. The story mapping application collects these contributions and encourages to identify links. The story map about Binckhorst consists of excursion blogs, theory theatres, open city blogs and final essays. All the story’s that are made are collected in

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the application and have a geographic location on the map that is displayed in the background. An example is shown in Figure 8. The WUR has on organisation within Esri's ArcGIS Online environment. Therefore it is possible for students of the WUR to work with the provided platforms of Esri among which Esri Story Maps.

The story map concept allows students with varying levels of GIS and mapping to clearly express the spatial story attached to their projects (Battersby & Remington, 2013). In this study of Battersby and Remington they implemented story maps in the classroom and had positive outcomes. ArcGIS Online and story maps provided great opportunities for them to introduce students to web-based mapping and multimedia technologies. Students of all levels of GIS experience were able to create professional-looking dynamic web map applications to support their research. There are some limitations when working with ArcGIS Online because it has not all the functionalities of ArcGIS for the desktop. Also story maps seems to be more of a presentation platform to tell stories then an interactive platform for participatory planning.

Intrigued by the rise of ESRI Story Maps, and drawing on emerging research in interactive cartography and human cognition, the digital, interactive deep maps and spatial narratives constitute a translational and educational vehicle for conveying social-ecological complexity to various audiences (Eanes et al., 2018). Most of the current educational tools and participatory approaches are still largely researcher-driven, may or may not involve end-users in their design and development, and do not always allow participants to interact with one another (Eanes et al., 2018). This interaction is one of the most important stages of a participatory process. Esri claims that story maps are effective in the classroom across a broad range of topics. Educators can use them for instructional purposes, and students and researchers can create Story Maps as an alternative to conventional research papers. The question is if the story map platform can also contribute to participatory planning purposes.

2.3.5. Other platforms

Besides the provided platforms, some other interesting platforms came forward out of literature as well. Most of the products are mobile applications. These platforms will be discussed shortly because they were to interesting not to mention.

- Geonode is a web-based application and platform for developing GIS and for deploying spatial data infrastructures (SDI). It is designed to be extended and modified, and can be integrated into existing platforms. It allows users to save and share customized maps, created by both uploading their own geospatial data and exploiting online publicly available data (Geonode, 2019).
- ODK (Open Data Kit) is a web- and mobile based application. It provides a modular framework for building ad hoc forms, compile them on the field, and send them to a server for Web publication. ODK Build is a web tool allowing users to design forms through an interactive drag-and-drop interface. Once forms are created, they can be loaded into ODK Aggregate, which was configured with a PostgreSQL database. The mobile application ODK Collect (for Android) is used to manage information collection from mobile devices. (Brovelli et al., 2014). The application is a replacement for paper forms with support for geo-locations images, audio clips, video clips and barcodes (ODK Collect, 2019). A flaw is that the use of the application is a bit unclear and not very easy.
- Mapchat is a mobile application that adopts the interactive effect of a map to allow users from different countries in the world on a dynamic map to apply a variety of real-time communication tools to share feelings under their current locations including messages, markers, voice markers, photo markers and movie markers (Mapchat, 2019). Mapchat is available for Android and iOS. What you can do with the application for a participatory purpose is not clear. Besides the application is not much used in the Netherlands and it is not clear what it can contribute to help planning purposes.
- Noisetube is a mobile application that started as a research project in 2008 to turn smartphones into mobile noise level meters to enable citizens to measure their exposure to noise in their everyday environment and participate in the collective noise mapping of their city or neighbourhood (Noisetube, 2019). Noisetube is available for Android, iOS and a website. With Noisetube you can contribute to a wide network, but it is not possible to explore your own obtained data.

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2.4. Review conclusion

PGIS, not a very new concept, but it is one that keeps developing in unforeseen directions. From drawing in maps with communities of developing countries to web and mobile applications. In various ways GIS-supported participatory planning approaches can have a contribution. PGIS are developed to ease and support experts' work with geographical information or to enhance laypersons' access to geographical information and communication between different stakeholders. There is a great deal of literature concerning this PGIS with evaluations of platforms and services that are used in developing countries and for municipality purposes. For PGIS in a higher education setting, there is not much to find about. Therefore a list of requirements was handed to explore PGIS platforms in a higher education setting.

Within research, PGIS is a much more appointed theme than in higher education settings. PGIS can help educators meet diverse learning objectives. A problem is only that students are more time limited. Sometimes students are involved in researches, but to learn students about the concepts and possibilities of PGIS, a next step can still be taken. The implementation of PGIS in GIS courses is more often appointed then PGIS in spatial planning related courses, however PGSI can be a great addition to planning education. Literature sources show that PGIS can have a contribution to the planning field.

Four platforms were described. At first Maptionnaire, this platform is a survey tool which facilitates simple and effective public participation. It offers many possibilities with the developing of a questionnaire referenced to geographic data. The Map Me platform is a bit similar to the Maptionnaire questionnaires. With this website it is possible to create spatial representations on a map using a familiar airbrush-style interface, called a spray can PGIS. Mapillary was a third platform that was proposed. The platform is to host, process and publish street-level imagery and map data and was designed for the crowd-sourced collection of street-level photos. It has also a connection to some of the most popular GIS and mapping applications including ArcGIS and OSM. The last platform, Esri Story Maps, lets you combine authoritative maps with narrative text, images, and multimedia content in seven different map views to tell your story. The platform is linked to the WUR, which makes it great for implementation in an education setting. The other platforms mentioned like Geonode, ODK, Mapchat and Noisetube are also interesting, but not supportive enough for higher education purposes. An application like Noisetube may be useful for specific planning tasks, but for an overall enrichment of courses, the other platforms may be more extensive.

Maptionnaire, Mapillary, Map Me and Story Maps are the platforms that will be further analysed and tested if they connect to participatory planning in a higher education setting.

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3. Methodology

To achieve each research question another method is needed. The research questions will be answered with a combination of literature and practical research and will follow up on each other. The first two research questions are already discussed in the Review section. From this section, a set of requirements and four platforms came forward. These requirements will support the evaluation of the different platforms and to argue which platform connects the best to these requirements.

For the third research question different PGIS platforms will be examined on the base of tests. These tests will firstly be developed, then performed and eventually captured to draw conclusions. To develop the tests a set of own requirements are needed as well. “Which part of Table 1 will be investigated?”, “What is the target group?”, “Are tests feasible in a short time?” are questions that are needed to keep in mind when developing the tests.

For the last research question an evaluation of the tests is important. An evaluation form will be handed out after the completion of the tests about the usability of the platforms for higher education purposes. These forms will be evaluated on the base of the given requirements and the process on its own. Table 2 shows the methodology schematically. And on the next page Figure 9 shows the steps for the test-day consisting the developing-, performing- and capturing of the tests.

Table 2 *Methodology of the research questions*

Question	Research type	Tools
1 & 2	Literature research	Search terms: • Geodesign • Participatory spatial planning • Collaborative planning • Participatory mapping • Planning support systems • Participatory GIS/PGIS • PGIS + spatial planning • PGIS platforms • Maptionnaire, Mapillary, Map Me, Story Maps
3	Literature and practical research given the requirements and the definition of tests • Developing tests • Performing tests • Capturing tests	Testing platforms: • Maptionnaire • Mapillary • Map Me • Story Maps • Web services and social media services
4	Combination of practical research, literature research and the provided requirements. Interpretation and evaluation of tests	

3.1. Test design

In this research the first three stages of a participatory progress (Table 1) will be taken into account for the development of the tests. This is about the type of data, the handling of the data and the visualisation of the data. The research group will consist of a group of spatial planning students. The data visualisation may take some extra time in the tests, but is also included because there will be a substantial variety of result data. When the tests are limited to the data handling, it is still needed for this

\ research that the results are visualised. If the participants do this part as well there will be more feedback on this function of the platforms. Students can express their creativity by experimenting with the platforms. Hopefully in this way, the students will explore the limits of the different platforms.

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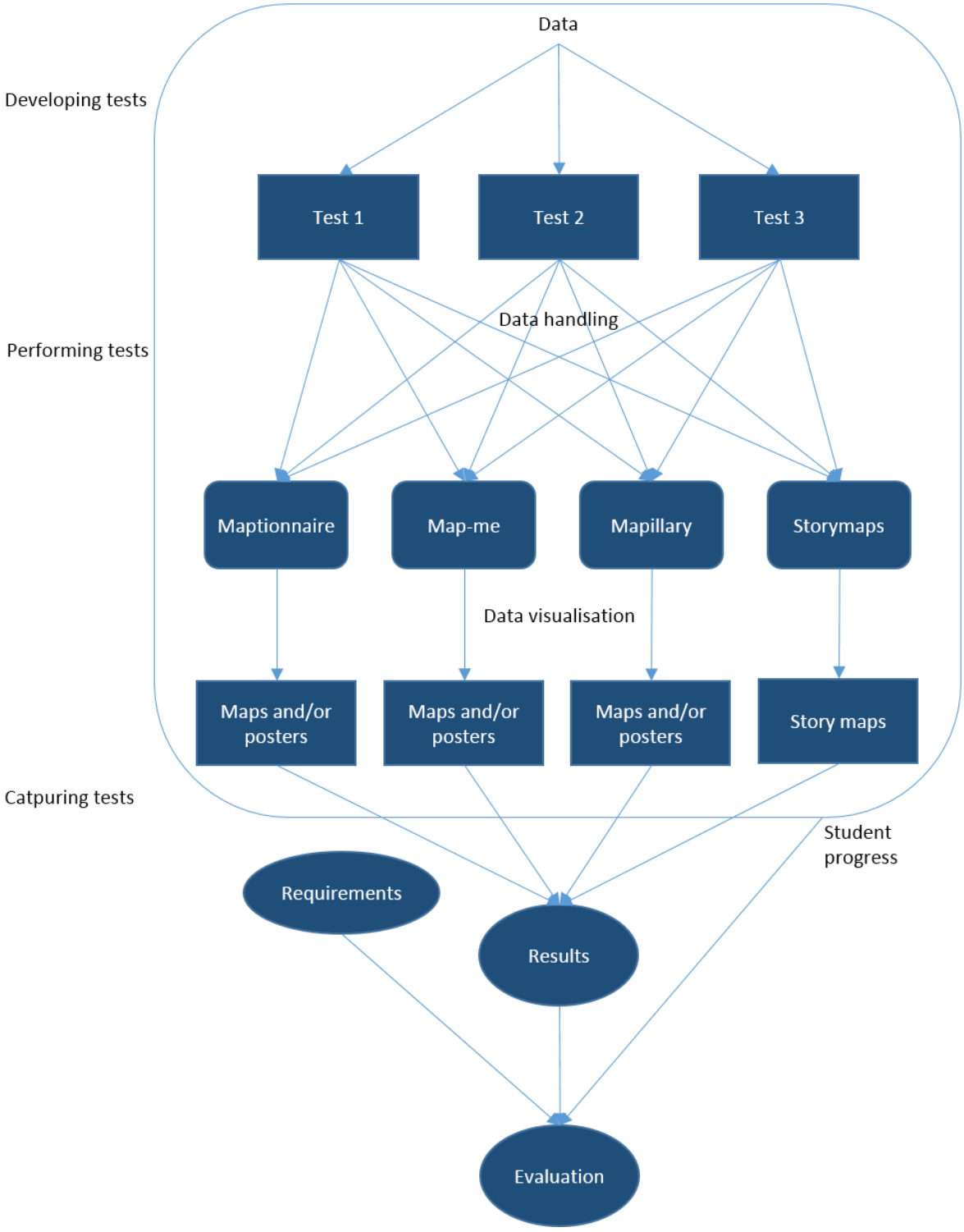

Figure 9 *Schematic representation of the development of the tests*

The interaction and communication stage of a participatory process will not be included in this research because that is too difficult to take in mind in such short research. So the functionality and the controls of the platforms will mainly be tested. The interaction stage connects more to participatory planning, but it will take to many people and to many factors to deal with to take this in account in this research. Students that are willing to participate in the tests will need to discuss their results with loads of actors to join them in the progress. This will be elaborated in the discussion and the recommendation stage of the thesis. The functionality of the platforms is easier to test with a group of students instead of the more participatory part. A requirement is that the

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participating students have enough knowhow about spatial planning and GIS to perform the tests. Second or third year bachelor students of BLP will be sufficient. These students are familiar with the three components that are included in the tests.

Individual tests will be handed out that will check the usability of the platforms, assuming that a high usability offers great participatory planning options. For the amount of participation of the participation ladder, the tests will locate in the middle. To include full citizen power, this research will get too extensive and will consume too much time and a nonparticipation approach is too narrow minded for a PGIS research. Therefore is chosen to include tokenism in this research. Tokenism refers to symbolic effort of including a small number of people from underrepresented groups. In the case of the tests that can include citizens of the areas. Consultation with, and informing these localities are an important factor in this stage of a participatory process. The process of the tests will be based on the scheme of Figure 9. This figure shows the steps that need to be taken to obtain results. The requirements in the figure are the requirements that are coming forward from 2.2..

Three different tests will be developed at different scale levels. The tests have to be executed with each of the four platforms, so each participant is able to compare all the platforms. The topic of the tests will be different because one of the platforms may be more fitted to one of the tests or a scale level in comparison to the others. Some of the results of the platforms can be visualised in a map and other results can be in a poster- or a story map format. Test 1 will be on the smallest scale, in this case a local scale like the city of Wageningen. Test 2 will be more about the surroundings of Wageningen and the region Foodvalley. Test 3 will be at the largest scale, on a provincial level. Every test will consist of a test objective and associated requirements. The tests will be formulated in a way that participants are able to include their own creativity, so the boundaries of the platforms will be investigated and the limits and limitlessness will hopefully come forward. Table 3 shows the different tests, scales and topics.

Table 3 *Division of the tests and their topics*

Test	Scale level	Location	Topic	Source
1	Local	Wageningen	Problem areas	Comparable topic in Studio Participative Planning[1]
2	Regional	Region FoodValley	Innovation areas	Based on the environmental vision of the province of Gelderland[2]
3	Provincial	Province of Gelderland	Preference areas	Based on tourism innovations of the province of Gelderland[3]

However the tests will have the same format, the content will be different. As mentioned the scale level will be a difference and also the type of research objective. The first test is more about the determination of problem detection, the second about the search to innovation areas, solar panel fields in this case, and the last one is more about locating preference areas of touristic and recreational activities (Table 3). All participants need to gather and handle geographic data and generate maps to make eventually some kind of presentation or visualisation with a recommendation for governmental institutions.

For each test the following content is given:

- Test objective
- Test area
- Assignment with criteria that must be met
- Instructions on the platforms

[1] https://ssc.wur.nl/Studiegids/Vak/LUP-30806

[2] https://www.gelderland.nl/bestanden/Documenten/Gelderland/04Ruimte/180417_Bijlage1_180125_Geconsolideerde_Omgevingsvisie_25jan18_aangepast_Links.pdf

[3] https://gelderland.stateninformatie.nl/document/6153141/1/netwerkdag_Toerisme_en_Recreatie

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A large group of 2nd year spatial planning students of the WUR will perform the tests. The test day will be a part of the course 'LUP-20306 Planning and Research Methods'. The students will be divided over three different groups that will perform the three tests. In this way there will be an equal distribution on the three tests and there will be sufficient results to draw conclusions. Each student gets one of the tests handed out with instructions. This test needs to be performed with all the platforms, so each participant can make their own consideration and evaluation of the functionalities of the platforms (Figure 9). The design of the tests are shown on the following pages. There is chosen for a fixed order in the order of the tests because of the schedule of the day, a demo of the platforms can be given in the same order so everyone has the same knowledge before they perform a test. It is also handy to have the story maps at last because of the probable limitations of the platform. This platform is mostly about visualisation and therefore the previous generated data can be used to bridge this problem.

For the test-day a room with enough computers is needed, or students need to bring their own laptop. The computers/laptops need to have an internet connection and ArcGIS software can be handy but is not obligated. The schedule for the test-day is shown in Table 4. In the beginning an introduction will be given on the thesis and about the platforms. Before a test will be performed with one of the platforms a short demo will be given so participants get the hand of it. In this way the participants will need less time to start with the test and have more time to perform the test. A PowerPoint presentation will support the introduction and demo's. This presentation is shown in appendix A. To get a good impression, an half hour is set to explore each platform and perform the test. This time will be needed to get used to the platform and to come up with presentable results. With a shorter time span, participants might not obtain a good impression of the platform or are not able to finish the test. Between each platform a break for the students is needed to freshen up their minds.

Table 4 *Schedule of the test day*

Schedule	**Time**
Introduction on subject and the platforms	8:20 – 8:40
Demo of Maptionnaire	8:40 – 8:50
Perform tests with Maptionnaire	8:50 – 9:20
Evaluation form Maptionnaire	9:20 – 9:25
Break	5 minutes
Demo of Mapillary	9:30 – 9:40
Perform tests with Mapillary	9:40 – 10:10
Evaluation form Mapillary	10:10 – 10:15
Break	15 minutes
Demo of Map Me and ArcGIS Online	10:30 – 10:40
Perform tests with Map Me	10:40 – 11:10
Evaluation form Map Me	11:10 – 11:15
Break	5 minutes
Demo of Story Maps	11:20 – 11:30
Perform tests with Story Maps	11:30 – 12:00
Evaluation form Story Maps and all the platforms	12:00 – 12:10
Post-discussion and collecting test results	12:10 – 12:30/40

With Maptionnaire it is possible to create place-based questionnaires. It is possible to add the participants in an organisation of the platform. They are asked to create their own questionnaire with the platform and to gather geographic data in this way. The students can make up their own respondents, because working with different localities is not possible in such short time. It is only needed that the students get used to the platform. With the responses they can analyse the data via the web application of the platform. The 'Analyse' function will be sufficient to obtain results for this research. Later on, when the platform will possibly in use, it is needed to download the response data to visualise the results in a GIS way. For now the most important part is that students analyse the functionalities of the platform itself.

Mapillary is probably a more difficult platform to test the functionalities for PGIS purposes. Just like Maptionnaire, it is also possible to add 'team members' in an organisation of the web application of Mapillary. Within this organisation three shapes are already made at forehand. These shapes represent the scale levels of

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the three tests. Within a shape the map data can be explored. With the free and open version of Mapillary it is possible to explore the functionalities of the platform. Mapillary has also a function to download the data for ArcGIS Online or ArcGIS Pro, but this is very expensive for three types of areas and will not be needed in this research because the functionalities of the platform can also be tested in this way. Because data cannot be downloaded by participants, they can make screen shots of their maps for the visualisation.

Map Me is a free and open platform where only an account is needed to explore its functionalities. Students can create their own website whit questions and spray possibilities. Just like with Maptionnaire, the students are asked to make up their own respondents. They can download the 'blobs' as CSV files and import these to ArcGIS Online. The use of ArcGIS Online will be recommended because in this way it is easier for now to visualise the results in a map. The ArcGIS Online web application immediately reads the coordinates and shows them on a map. In this way the students have more time to explore Map Me instead of using tools and coordinate systems in ArcMap.

With Story Maps stories can be made and visualised on the basis of maps. The results, data and maps of the previous platforms can be used within this platform. Geodata of the Province of Gelderland and data of other governmental agencies can be used as well. The students are free in their choice about the type of story map, and the data they involve in it. It is the question to what level PGIS can be approached with Story Maps and what kind of potential it has. The visualisation of the results will probably take the most time with this platform. For WUR students Esri's Story Maps is as a part of ArcGIS Online open and free to use.

The three tests that will be handed out to the students are shown on the following pages.

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Test 1 – Accessibility of the WUR

Figure 10 *Scale level Test 1 (OpenStreetMap, 2019)*

Test objective: The municipality of Wageningen gets many complaints about the bike routes to the university. The location of the problem areas and the type of problems are unclear. Therefore the municipality asks students to help them, using PGIS platforms, to locate problems and to improve the accessibility of the WUR campus for bike traffic.

Test area: The city of Wageningen, see Figure 10 for the approximate scale level.

Available data: Geodata, PDOK, CBS, PBL, SCP, literature (journals, books), newspapers, blogs, social media or your own imagery and https://www.gelderland.nl/Kaartenencijfers

Assignment: Make a presentation (with maps and imagery) with the following content:

- 3 Most used bike routes to the campus
- 3 Problem areas on these routes
- Nature of problems
- Substantiation of the findings

Instructions: Make 4 presentations, each using another platform with the associated approach (the platforms are given below). The PGIS platforms can support data collection, data handling and/or data visualisation.

Platform A: **Maptionnaire** (www.maptionnaire.com) demo: https://app.maptionnaire.com/nl/2133/
With Maptionnaire you can create map-based surveys to obtain ideas and insights from residents.
Login with the login details you got by mail, because it was not possible to get a license for Maptionnaire this exercise is split into three parts. First create your own survey that connects to the assignment. An analysis of this survey is not possible. Therefore the second step is to answer the demo in a way you can get results out of it that connects to the content of the assignment (with the corresponding scale). Answer the last question: 'What's best about Helsinki?' with your own name. In the analysis you can filter on your name to view only your results. Use screenshots of the maps and make a presentation/poster on your own creative way.
Link evaluation form Maptionnaire

Platform B: **Mapillary** (www.mapillary.com) demo:
https://mapillary.github.io/mapillary_solutions/demos/amsterdam/
Mapillary is a platform to host, process and publish street-level imagery and map data.
Create an account and go to the application. You can investigate routes, objects (e.g. bicycle paths, benches) and other map features (e.g. traffic signs) to support your research. You can investigate the safety using the presence/absence of traffic signs for example. You can use imagery and screenshots of Mapillary in a presentation/poster on your own creative way.
Link evaluation form Mapillary

Platform C: **Map Me** (http://Map Me.org/) http://Map Me.org/docs/Map Me_Doc.pdf for instructions
With Map Me you can create online surveys for the collection of vague spatial data.
Login with the login details given in the presentation, create a survey and make sure you have at least 5 respondents to that survey. You can use the extra instructions to import a CSV file into ArcGIS Online to analyse your data. You can visualise your data in your own creative way and export it to a poster or presentation.
Link evaluation form Map Me

Platform D: **Story Maps** https://wur-girs.maps.arcgis.com/home/index.html
Esri Story Maps let you combine authoritative maps with narrative text, images, and multimedia content.
You can login with your WUR account and go to the 'App Launcher' (next to your name) to find 'Story Maps'.
Now you can start to create your own story map with the story type you prefer. It is possible to upload your previous maps and data into the story map.
Link evaluation form Story Maps
Link evaluation form overall

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Test 2 – Solar panel fields

Test objective: In the region FoodValley de province of Gelderland works together with the WUR for research and innovations for energy generation. The province asks spatial planning students to help them with new participatory approaches to collect data and to look for possible locations for solar panel fields because the students are used to work with different actors and stakeholders and have knowhow about renewable energy and sustainability.

Test area: Region FoodValley, see Figure 11 for the approximate scale level.

Available data: Geodata, PDOK, CBS, PBL, SCP, literature (journals, books), newspapers, blogs, social media or your own imagery and https://www.gelderland.nl/Kaartenencijfers

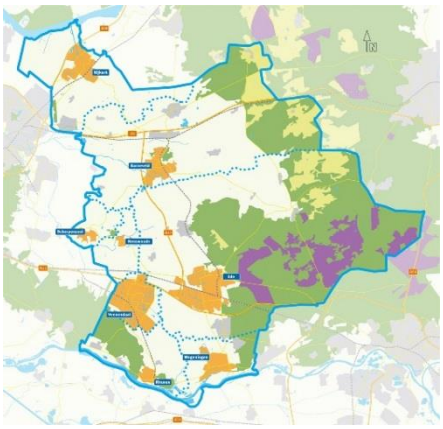

Figure 11 *Scale level Test 2 (Regio FoodValley, n.d.)*

Assignment: Make a presentation (with maps and imagery) with the following content:

- 3 Problem areas for solar fields
- Argumentation of different actors
- Type of problems
- 3 Possible areas for solar fields

Instructions: Make 4 presentations, each using another platform with the associated approach (the platforms are given below). The PGIS platforms can support data collection, data handling and/or data visualisation.

Platform A: **Maptionnaire** (www.maptionnaire.com) demo: https://app.maptionnaire.com/nl/2133/
With Maptionnaire you can create map-based surveys to obtain ideas and insights from residents.
Login with the login details you got by mail, because it was not possible to get a license for Maptionnaire this exercise is split into three parts. First create your own survey that connects to the assignment. An analysis of this survey is not possible. Therefore the second step is to answer the demo in a way you can get results out of it that connects to the content of the assignment (with the corresponding scale). Answer the last question: 'What's best about Helsinki?' with your own name. In the analysis you can filter on your name to view only your results. Use screenshots of the maps and make a presentation/poster on your own creative way.
Link evaluation form Maptionnaire

Platform B: **Mapillary** (www.mapillary.com) demo:
https://mapillary.github.io/mapillary_solutions/demos/amsterdam/
Mapillary is a platform to host, process and publish street-level imagery and map data.
Create an account and go to the application. You can investigate routes, objects (e.g. bicycle paths, benches) and other map features (e.g. traffic signs) to support your research. You can investigate the safety using the presence/absence of traffic signs for example. You can use imagery and screenshots of Mapillary in a presentation/poster on your own creative way.
Link evaluation form Mapillary

Platform C: **Map Me** (http://Map Me.org/) http://Map Me.org/docs/Map Me_Doc.pdf for instructions
With Map Me you can create online surveys for the collection of vague spatial data.
Login with the login details given in the presentation, create a survey and make sure you have at least 5 respondents to that survey. You can use the extra instructions to import a CSV file into ArcGIS Online to analyse your data. You can visualise your data in your own creative way and export it to a poster or presentation.
Link evaluation form Map Me

Platform D: **Story Maps** https://wur-girs.maps.arcgis.com/home/index.html
Esri Story Maps let you combine authoritative maps with narrative text, images, and multimedia content.
You can login with your WUR account and go to the 'App Launcher' (next to your name) to find 'Story Maps'.
Now you can start to create your own story map with the story type you prefer. It is possible to upload your previous maps and data into the story map.
Link evaluation form Story Maps
Link evaluation form overall

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Test 3 – Tourism and recreational areas

Test objective: The coming years the visitor numbers of recreational and touristic activities will increase, but nature areas needs to be preserved. Therefore the province of Gelderland asks spatial planning students to help them, using PGIS platforms, to locate touristic hotspots and gather spatial data of different stakeholders to show a recommendation about the improvement of recreational and touristic areas for the coming years.

Test area: The province of Gelderland, see Figure 12 for the approximate scale level.

Figure 12 *Scale level Test 3 (OpenStreetMap, 2019)*

Available data: Geodata, PDOK, CBS, PBL, SCP, literature (journals, books), newspapers, blogs, social media or your own imagery and https://www.gelderland.nl/Kaartenencijfers

Assignment: Make a presentation (with maps and imagery) with the following content:

- 5 Touristic and recreational hotspots
- Involvement of different stakeholders
- Risk factors for improvement
- A recommendation for the province

Instructions: Make 4 presentations, each using another platform with the associated approach (the platforms are given below). The PGIS platforms can support data collection, data handling and/or data visualisation.

Platform A: **Maptionnaire** (www.maptionnaire.com) demo: https://app.maptionnaire.com/nl/2133/
With Maptionnaire you can create map-based surveys to obtain ideas and insights from residents.
Login with the login details you got by mail, because it was not possible to get a license for Maptionnaire this exercise is split into three parts. First create your own survey that connects to the assignment. An analysis of this survey is not possible. Therefore the second step is to answer the demo in a way you can get results out of it that connects to the content of the assignment (with the corresponding scale). Answer the last question: 'What's best about Helsinki?' with your own name. In the analysis you can filter on your name to view only your results. Use screenshots of the maps and make a presentation/poster on your own creative way.
Link evaluation form Maptionnaire

Platform B: **Mapillary** (www.mapillary.com) demo:
https://mapillary.github.io/mapillary_solutions/demos/amsterdam/
Mapillary is a platform to host, process and publish street-level imagery and map data.
Create an account and go to the application. You can investigate routes, objects (e.g. bicycle paths, benches) and other map features (e.g. traffic signs) to support your research. You can investigate the safety using the presence/absence of traffic signs for example. You can use imagery and screenshots of Mapillary in a presentation/poster on your own creative way.
Link evaluation form Mapillary

Platform C: **Map Me** (http://Map Me.org/) http://Map Me.org/docs/Map Me_Doc.pdf for instructions
With Map Me you can create online surveys for the collection of vague spatial data.
Login with the login details given in the presentation, create a survey and make sure you have at least 5 respondents to that survey. You can use the extra instructions to import a CSV file into ArcGIS Online to analyse your data. You can visualise your data in your own creative way and export it to a poster or presentation.
Link evaluation form Map Me

Platform D: **Story Maps** https://wur-girs.maps.arcgis.com/home/index.html
Esri Story Maps let you combine authoritative maps with narrative text, images, and multimedia content.
You can login with your WUR account and go to the 'App Launcher' (next to your name) to find 'Story Maps'.
Now you can start to create your own story map with the story type you prefer. It is possible to upload your previous maps and data into the story map.
Link evaluation form Story Maps
Link evaluation form overall

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3.2. Test evaluation

As shown in Figure 9 an evaluation will be performed after the tests. This evaluation consists of the progress of the students during the tests, the results of the tests, the post-discussion and the requirements about the functionalities and the use of the platforms for higher education. After each test the participants are asked to fill in an online questionnaire via Google Form about the platform they just used. The questions of the questionnaire will be about the platform's functionalities and if it is possible to collect, handle and/or visualise data with it. The questions will be the same for each platform.

The most questions consists of answers on a 5-point Likert scale format with ordinal data. The participants are asked if the platform is feasible on certain criteria. The scale for most questions goes from 1 ('Yes easily') to 5 ('No not at all'). Only the second question about the functionality and controls goes from 1 ('Very easy') to 5 ('Very difficult'). A mean and standard deviation are inappropriate for ordinal data, where the numbers generally represent verbal statements. These intervals between values cannot been presumed equal. (Jamieson, 2004). The results of the Likert scale questions will be visualised in a bar chart. Additional comments on these questions will support the outcome.

When the tests are performed with all the platforms, there is also an overall questionnaire. This questionnaire consists mostly of multiple choice questions with one answer possible or multiple answers possible. Within this questionnaire participants need to make a consideration about which platform they think is best on certain criteria and which is best overall. Graphs will follow from all the questionnaires that can be analysed. The results of the comparison between the platforms will be visualised in pie charts. The questions where multiple answers are possible will be visualised in horizontal bar charts. This will be the qualitative and measurable data of the tests. The questionnaires are shown in Appendix B.

The post-discussion is an evaluation method of think-aloud testing. Discussions can arise where new insights and recommendations for higher education purposes hopefully will come forward. The notes about of the post-discussion and about the process overall will be used to support graphs and the results of this research. The pros and cons of each platform regarding the requirements will come forward and hopefully a preferred platform overall. With this information the fourth research question can be answered.

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4. Results

First the results of the platforms individually are shown in the platform evaluation. The charts of the same questions of the platform evaluation forms are combined in one figure to show the differences for each platform. Additional comments of participants will support the findings. After the individual evaluation follows the platform comparison. In the final evaluation all the results will be compared and analysed. Also a pros and cons list will be formulated on the base of the requirements. Photos of the test day and students test results are provided in Appendix C.

4.1. Platform evaluation

The options of the evaluation forms are based on a 5-point Likert scale format. Within this format the options go from 1 'Yes easily' to 5 'No not at all'. For each platform there was an evaluation form. For each evaluation form there was a different number of respondents. The respondents that answered question 1 with a 4- or 5 score were further analysed on the base of the topic of the test. Figure 13 shows the responses to question 1.

36 respondents answered the evaluation form about Maptionnaire. One of the respondents misinterpreted the questions, therefore only 35 of the responses are used in the analysis of the results. Five respondents that indicated their test as not performable, did Test 2 and one respondent Test 3. Maptionnaire is therefore found less suitable for the determination of locations for solar panel fields. The platform is more suitable when working on a small scale, like the city of Wageningen (Test 1) and for a topic about bike routes and problem areas.

34 respondents answered the evaluation form about Mapillary. Two of the respondents misinterpreted the questions, therefore only 32 of the responses are used for the analysis of the results. 71,90% of the respondents indicated the tests not performable with the platform. These respondents were almost equally divided over the tests, Mapillary was therefore found equally less performable for each test.

33 respondents answered the evaluation form about Map Me. Two of the respondents misinterpreted the questions, therefore only 31 of the responses are used for the analysis of the results. There were no respondents that found the tests not performable with the platform. Five of the respondents who answered question 1 of the evaluation form with a 1 score performed Test 2 about solar panel fields. The platform seem to connect better to tests with the localisation of areas than routes.

28 respondents answered the evaluation form about Story Maps. One respondent misinterpreted the questions, therefore only 27 of the responses are used for the analysis of the results. Five participants that found their test not performable, did Test 1, four participants Test 2, and two participants Test 1.

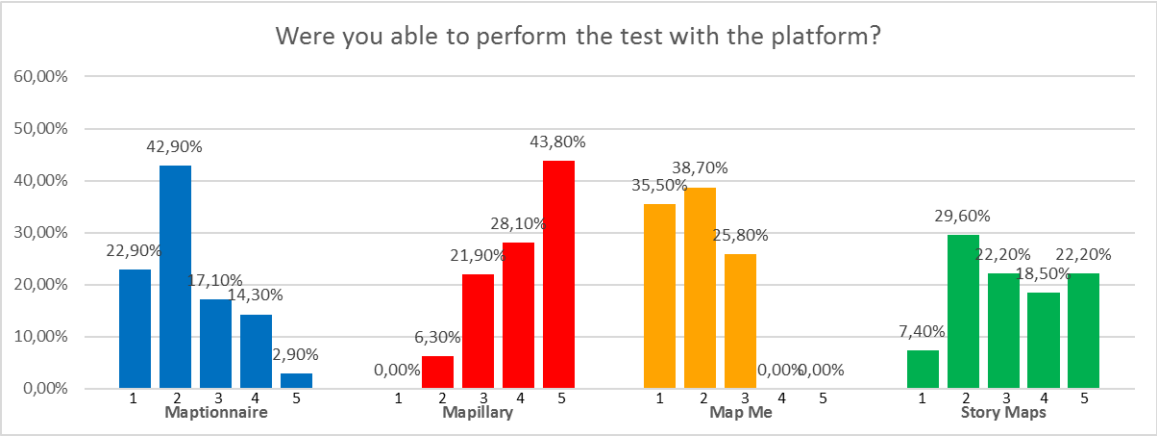

Figure 13 *Answers to question 1 of the platform based evaluation forms*

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Figure 14 shows what participants found of the functionality and the controls of the platforms. Table 5 Supports this figure with comments of the participants. The options for question 2 go from 1 ('Very easy') to 5 ('Very difficult').

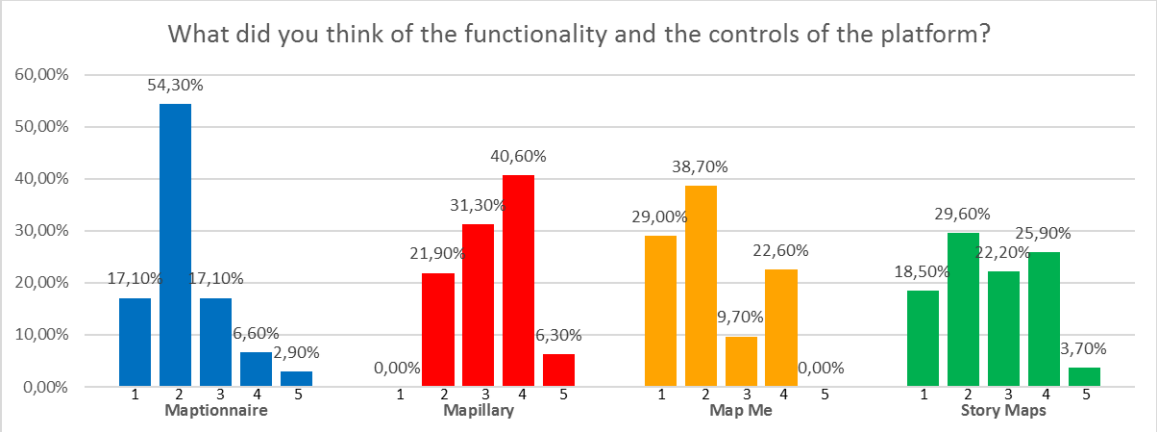

Figure 14 *Answers to question 2 of the platform based evaluation forms*

For Maptionnaire, the positive reactions connect to the outcome of the second question as well. Participants assessed the functionalities and controls of the platform mostly as easy, as is shown in Figure 14. The respondents mentioned especially that the platform was easy to use and clear after the demo. Because of these factors participants found the platform suitable to perform the tests.

The comments about Mapillary were especially about the slowness of the platform when working with tons of data. The functionality and controls of the platform were also not very good assessed according to Figure 14.

For Map Me participants mentioned that the platform worked almost the same as Maptionnaire but that it is less detailed and there are less functions. A problem that occurred for some of the participants was that they had too much blobs. When they wanted to analyse the data they gathered with Map Me and tried to open the blobs in ArcGIS Online, an error occurred. The data files were too large to open because there were too many blobs with spatial data for the program.

With Story Maps the type of story map affected the outcome of the test. Some participants mentioned they had some trouble starting up, but when they chose a different type of story map it all worked fine. Maybe because of this the results are more mixed for question 2. Some story map types take more time to get used to then others. This is also different for what type of story the user wants to tell.

Table 5 *A selection of positive and negative comments of the participants about the different platforms*

	Positive	Negative
Maptionnaire	• Easy to use • Easily accessible for dummies • Clear but also versatile • User friendly • Handy for citizen participation • Intuitive program • Very well explained • Open- and location based questions • Brings order in the chaos of map making • Simple layout, not cluttered	• A bit unclear how to add questions and marking places • Explanation was necessary to perform the test • Controls can be too difficult for a random citizen/laymen • It took some time to get used to the platform • Confusing interface
Mapillary	• Easy to understand • Clear and comprehensive • Plenty of data available • Easy to filter data	• Unclear controls, Difficult to find out how it works • Takes much time to load data, works slow

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	• It gave more insight in how the environment looked like, so locations had a more solid place • Once you get used to it, it is pretty impressive	• Got stuck too much • Too much data, hard to run • More of an analysis than a research platform • Does not connect to all the tests • Options feel a bit limited
Map Me	• Easy to use and intuitive • Easy to visualise areas • Easy to make a questionnaire • Easy to spray • User friendly • Analysing was easy • Answering the survey was easy • Nice for making heat maps	• Less detailed than Maptionnaire • Too much blobs, cannot be opened in ArcGIS Online • Rather technical with making a URL • Not possible to add information to specific points/blobs • Setting up a survey was difficult • Interface needs innovation • Spraying is not accurate • You need to test the spray for the size
Story Maps	• Easy to use, controls worked well • Easy to combine maps and add text • Easy to upload files and pictures • Easy to find maps in the database • User friendly • Nice way to visualise data • A great variety of possibilities • Easy interface • Clean and professional appearance	• Unclear how to use the platform correctly • It is only a presentation form • Difficult in use because of the overload of possibilities • No research tool • Not intuitive • Unfortunate that it is not possible to select a point on the map • Difficult to mark areas

Three stages of a participatory process were tested during the test day. These stages consist of the gathering, handling and visualisation of data. These stages were also included in each evaluation form, the answers are shown in figures 15, 16 and 17 on the next page.

Most of the participants indicated Maptionnaire for these three stages suitable or very suitable. Only for the handling of the data there is a bigger difference between the 1 and 2 score. For each of the stages only a small amount of people answered the question with a 4 or a 5 score.

Mapillary was indicated as suitable for the gathering and handling of the data by a large group of students. There cannot be drawn a direct conclusion over these results. Only a few participants mentioned they found the platform not at all suitable for all three stages of a participatory process. The Mapillary platform seems to be the most suitable for the visualisation of data in comparison to the other two stages. 20 respondents found the platform very suitable or suitable enough for this particular task.

Most of the participants indicated the Map Me platform as suitable or very suitable for gathering data. They liked how easy it was for stakeholders to spray on the map. The next steps that the participants performed were done with ArcGIS Online. Map Me has not his own analyse function and therefore there was chosen to move the data to the online platform of Esri. The visualisation of the data was indicated as very suitable with a step-by-step decrease of scores.

Because Story Maps is more a visualising tool than a tool to gather or handle data, the responses to these questions are quite logical. Not much participants were able to gather data. It was possible to import the previous generated data of the other platforms to tell your story. In this way the participants could perform the test after all. Over 95% of the participants indicated Story Maps as very suitable or suitable for visualising data.

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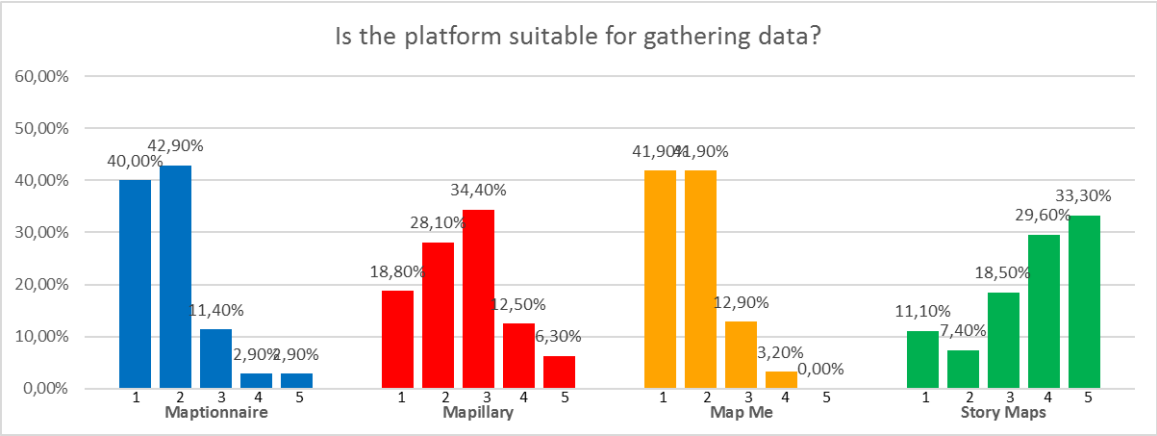

Figure 15 *Answers to question 3 of the platform based evaluation forms*

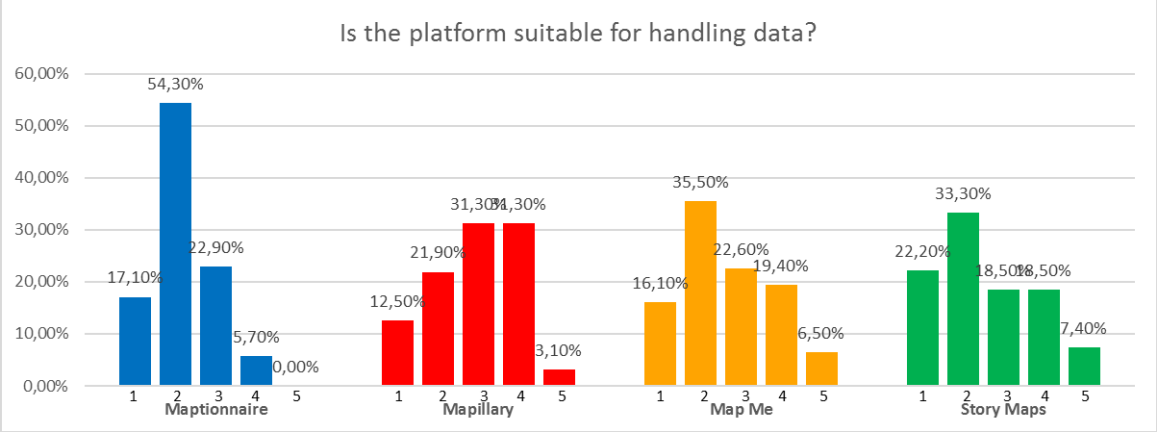

Figure 16 *Answers to question 4 of the platform based evaluation forms*

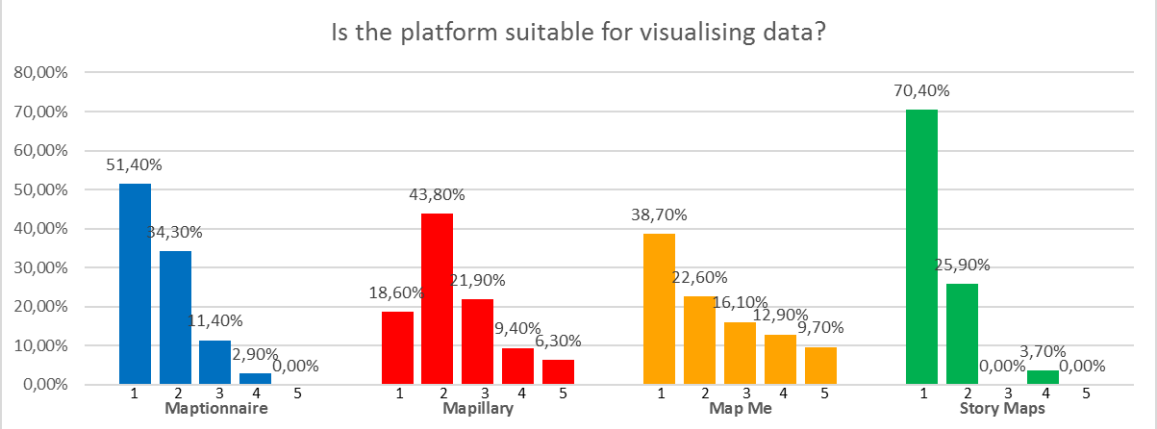

Figure 17 *Answers to question 5 of the platform based evaluation forms*

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For the integration of the platform with other knowledge sources, participants were mostly neutral (Figure 18). For Story Maps the participants were most enthusiastic for this part. It was found easy to upload other types of data in the application or to add maps that were previously generated. A map that is made with ArcGIS Online for example, can immediately be added to the story map.

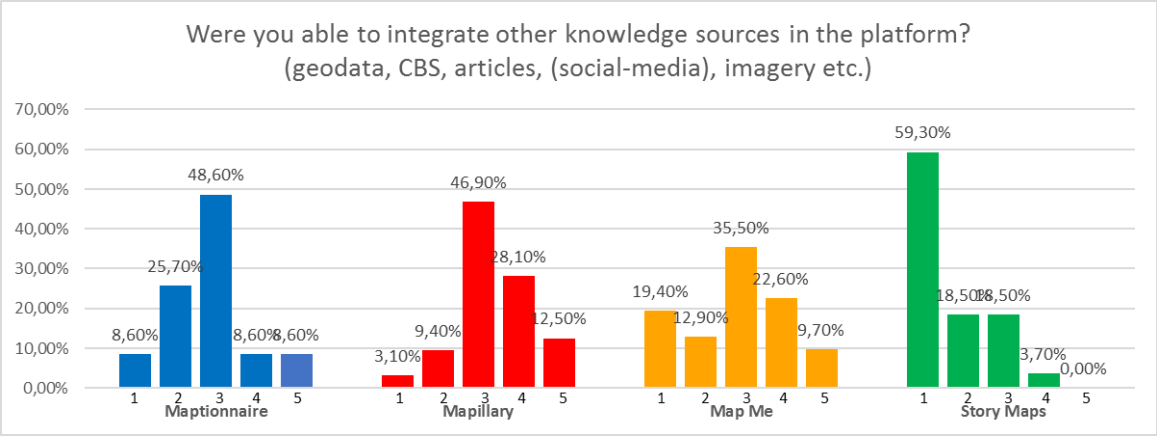

Figure 18 *Answers to question 6 of the platform based evaluation forms*

When working with different stakeholders, participants expect that Maptionnaire would be the most suitable platform (Figure 19). 68,50% answered this question for Maptionnaire with a 1- or 2 score. Map Me and Story Maps were indicated about equally suitable and Mapillary the least suitable. Answers on the follow-up question: 'In what way can the platform be useful when working with different stakeholders?' are shown in Table 6.

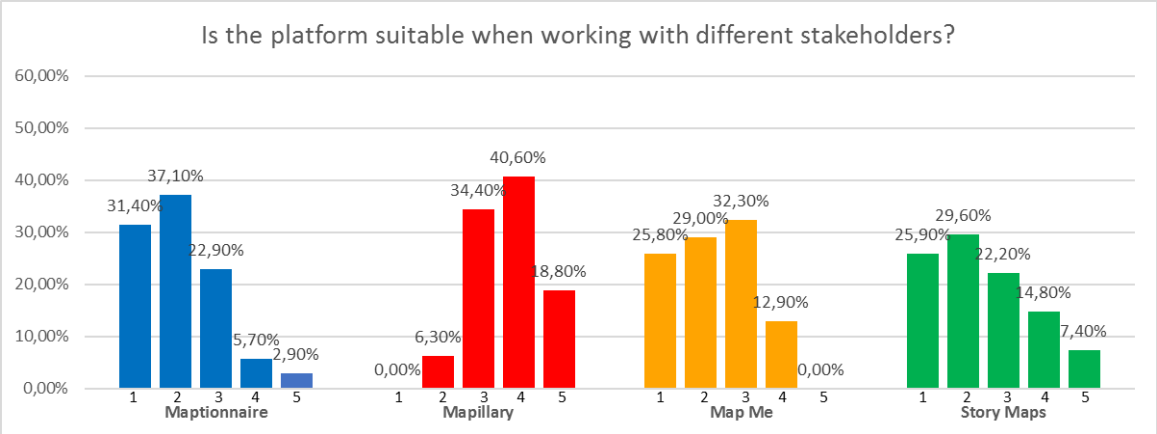

Figure 19 *Answers to question 7 of the platform based evaluation forms*

Table 6 *A selection of additional comments about stakeholder involvement of the platforms*

Maptionnaire	• It is an easy tool to ask different stakeholders about their opinions • Stakeholders are able to implement their own opinion • Stakeholders can participate in the process by locating elements on a map
Mapillary	• Multiple people can upload pictures/data • Stakeholders could point out problem areas, this can be compared to different features
Map Me	• It is possible to collect data of different questions • Stakeholders can indicate areas where they want change • Web link can easily be send around to stakeholders to let them fill in a survey
Story Maps	• It is a nice way to present data to stakeholders • It is a structured way to tell stories and to share maps • You can add a great deal of images/data, so you can reach a wide audience • Stakeholders are able to present and visualise their ideas

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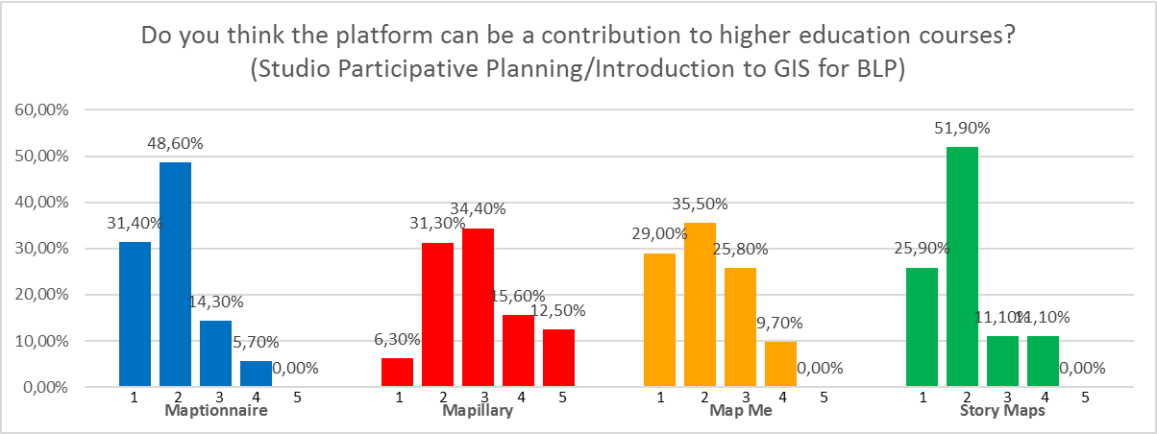

Figure 20 *Answers to question 8 of the platform based evaluation forms*

Especially a large group of the participants indicated Maptionnaire as a possible contribution to higher education sources. 80% of the participants answered 'Yes easily' or 'Yes' to question 8 (Figure 20). It was mentioned that this platform makes GIS more relatable to the study program. Only for Mapillary participants answered this question with 'No not at all'. The results for this question are also very mixed for this platform. It was mentioned about Mapillary, that the idea of the platform was fantastic, but it only did not work properly. About Map Me in comparison to Maptionnaire participants are a bit less positive about its contribution to higher education. The participants liked the spraying method and for a specific type of research it can be a very handy tool. Overall, Map Me seems a bit more basic compared to Maptionnaire. The last platform, Story Maps, could contribute to the communication and interaction stage of a participatory process. The additional comments of the participants on this question are shown in Table 7.

Table 7 *A selection of additional comments about how the platforms can contribute to higher education*

Maptionnaire	• It can be a nice addition to studios to gather data from all kinds of stakeholders • For an analysis, to easily map people's opinions • It can be used as a way to teach students how to do research with questionnaires • To make GIS work more relatable to the study BLP, it is a nice way to combine spatial planning and GIS
Mapillary	• It can be a contribution for the analysis of spatial data about an area that students want to do research in and to find complementary data to the already found data • To compare places over time to analyse what is changed within traffic for example • It can be used in projects with a small scale
Map Me	• It can help students with participatory planning projects to take tests from large groups of people • It can be used to provide an easy data analysis to give an overview of the problems/weaknesses/strengths of an area
Story Maps	• It can contribute as a way of presenting research results to fellow students, a teacher or an institution • In the communication or interaction stage of a participatory process • To use stories to tell something about a research area

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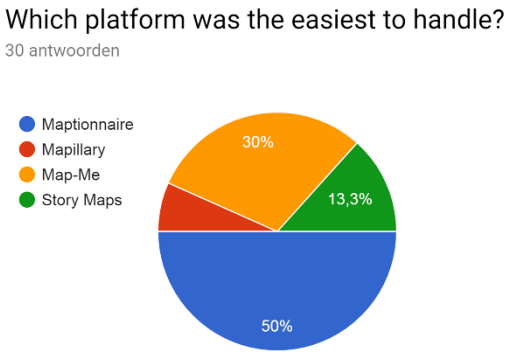
4.2. Platform comparison

After the tests were performed with all the different platforms, the participants were asked to fill in also an evaluation form to compare the platforms. There were 30 respondents to the final evaluation form. Some individual responses seemed to be filled in randomly but this cannot be proven so all responses are taken into account. Half of the participants that filled in the evaluation form indicated Maptionnaire as the easiest to handle (Figure 21). Mapillary was indicated as the least easy. This resulted also out of the evaluation form of Mapillary itself. The platform worked slow and there was too much data to analyse. Some participants indicated that Maptionnaire has the most functionalities, which can also be seen in Figure 22, it does not matter for how easy the platform is found. Map Me was found the second easiest platform to handle. Map Me is found quite basic and has no data options overload. Story Maps was found the third easiest platform to handle and the second platform corresponding to the amount of functionalities.



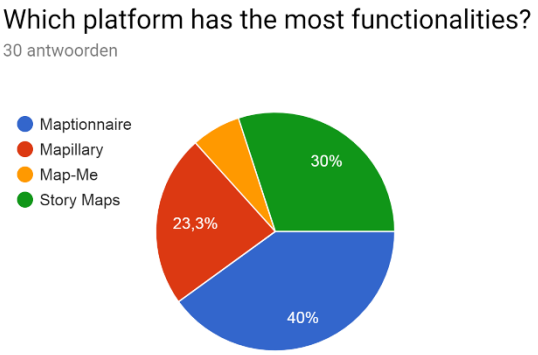
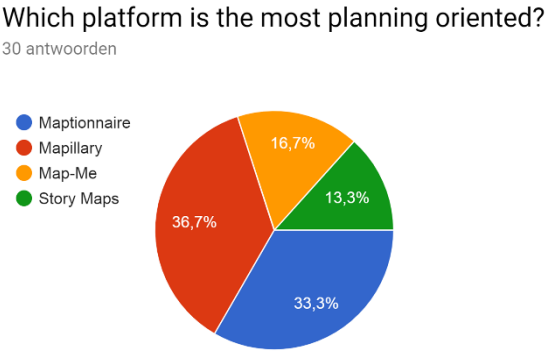


Figure 21 *Answers to question 1 of the final evaluation form* ***Figure 22*** *Answers to question 2 of the final evaluation form*

There is one question where Mapillary scores the best, and that is question 3, Figure 23. Mapillary was found the most planning oriented by the participants. Despite the lags and slowness of the platform, the participants see in Mapillary a platform with potential for the field of spatial planning. This difference is small, but it is an interesting result. For participatory planning, where working with different stakeholders is an important part, Mapillary did not score very well in contrast to the rest. For this stage Maptionnaire scored the best (Figure 24). Maptionnaire was found a very handy tool to gather different opinions of different stakeholders corresponding to geographic data. Map Me is like Maptionnaire also a platform which allows people to gather data of different stakeholders but was found less suitable. 30% of the respondents found Story Maps the best when working with different stakeholders. Participants mentioned Story Maps as a useful tool to visualise and present their data to different stakeholders and organisations in a professional way.



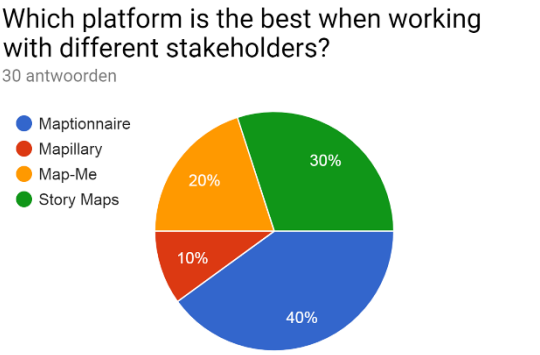


Figure 23 *Answers to question 3 of the final evaluation form* ***Figure 24*** *Answers to question 4 of the final evaluation form*

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What also came out questions 3, 4 and 5 of the evaluation forms of the platforms is mostly confirmed by questions 5, 6 and 7 of the final evaluation form (figures 25, 26 and 27). Maptionnaire and Map Me were found the most suitable platforms for the gathering of a specific type of data. These platforms are also mainly meant for this particular task. Maptionnaire has also his own analysing and visualising functions but these were found less appropriate than Story Maps. Story maps was found by far the most appropriate for visualising data. It is also mainly a tool for this task. It is clear that participants were most enthusiastic about its functions for this part. What is notable is that Mapillary, which scored the lowest on most of the questions, scored okay for the gathering and handling of the data. The platform has a wide variety of different types of data, but most participants indicated that they were not able to work with it. Map Me scored best for the handling of the data. The handling of the data was particularly performed in ArcGIS Online, so it is assumed that this refers to the online surrounding of Esri instead of Map Me itself. The blobs that can be downloaded from the platform can easily be opened in ArcGIS platforms.

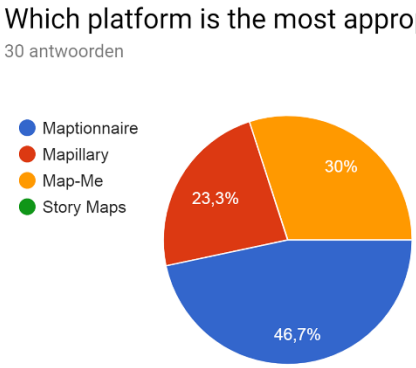

Figure 25 *Answers to question 5 of the final evaluation form*

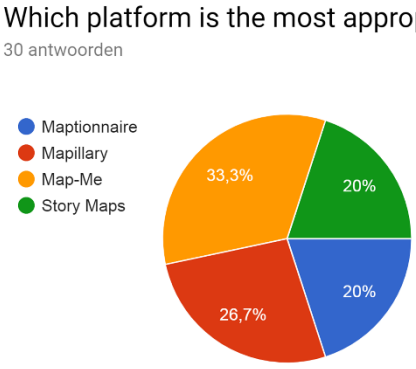

Figure 26 *Answers to question 6 of the final evaluation form*

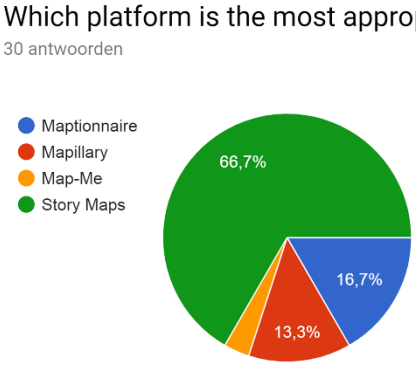

Figure 27 *Answers to question 7 of the final evaluation form*

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4.3. Final evaluation

In the final evaluation form there were two multiple choice questions with multiple answers possible. The results for these questions are quite similar. Maptionnaire and Story Maps got the highest scores on both questions. Maptionnaire was the most recommended platform for higher education courses (Figure 28) and Story Maps was the most preferred platform for question 9, Figure 29. Every platform that was tested was named as a possible platform that can be integrated in higher education courses. The platforms are all very different, so the way the platforms can be integrated will also be different. Story Maps was for example indicated by a student to be earlier integrated in a GIS course. Participants preferred also Story Maps to use during the rest of their study program or even working life. It was found as a professional presentation tool that can be of great use with a corresponding subject. Maptionnaire or Map Me can be of use in Studio Participative Planning for example, to gather stakeholders opinions.

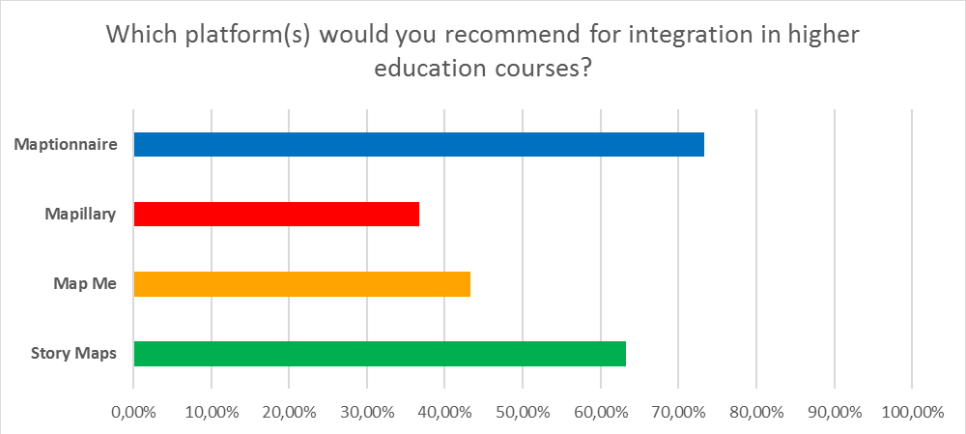

Figure 28 *Answers to question 8 of the final evaluation form*

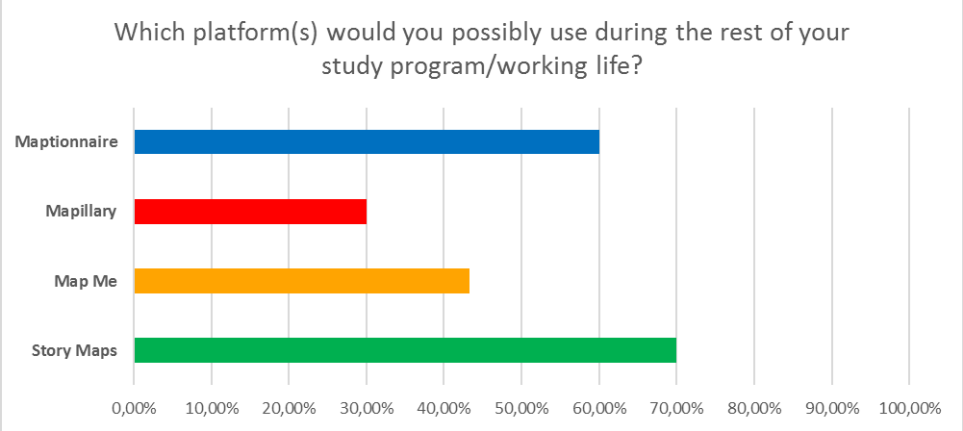

Figure 29 *Answers to question 9 of the final evaluation form*

The participants that indicated Maptionnaire as their preferred platform overall were almost equally divided over the three different tests. For the five participants who chose Map Me as their favourite, four students performed Test 3 and one student Test 2. This preference can be a result of the spraying method. Within Test 2 and Test 3 the content was more about localising areas. And especially for Test 3 about the recreational and tourism areas, it does not have to be very precise. This seems to connect better to the vague spatial data that Map Me can generate in comparison to Test 1 for example. Five of the eight participants that preferred Story Maps performed Test 1. It is possible that these participants could easily found other maps and material of ArcGIS Online that they could integrate in their story map more easily than with the other tests.

Figure 30 shows the responses to the final question of the evaluation form. With this question participants could choose the platform they think is best overall. There is a clear majority that preferred Maptionnaire over the others. After the multiple choice question there was asked why people preferred their option. For Maptionnaire

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the participants mentioned that it is the clearest platform and has the most options. It was also mentioned that Maptionnaire was the complete package of capturing, handling and visualising data. Many participants mentioned that for them it was important that a platform has a great deal of functions and possibilities, but is still very easy in use. This was for most of the people the reason why they chose Maptionnaire. Eight respondents to the evaluation form indicated Story Maps as the best platform overall. They mentioned that the appearance of the platform was very nice and that it was possible to upload a variety of content to the story map. Another much appointed term corresponding to Story Maps was 'professional'. The participants liked the interface and the presentations they could make with the platform. Five respondents preferred Map Me. They mentioned the platform as a simple and yet effective way to gather data. None of the respondents mentioned Mapillary.

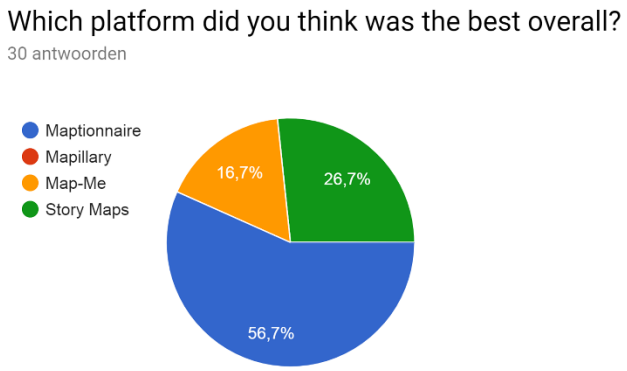

Figure 30 *Answers to question 10 of the final evaluation form*

There is a variety of different results generated from this research. Literature reviews, graphs, opinions, extra comments, evaluations and observations were used to support the findings. A selection of test results and presentations that the participants made are shown in appendix C. The summarised results based on all the findings are presented in Table 8 which includes a list of pros and cons of each platform regarding the requirements.

Table 8 *List of pros and cons for each platform regarding the requirements and findings of this research*

	Pros	Cons
Maptionnaire	• Easy functionalities and controls, many functionalities available • Suitable for working with stakeholders • Questionnaires can be filled in with multiple operating systems and with different hardware • Communication possible via different digital channels and systems • Accessible for multiple users • Open for different materials, document pictures, interactive possibilities etc.	• License needed for further analysis with other geographic systems • It takes some time to get used to the platform
Mapillary	• Suitable for multiple operating systems, available as a web- and mobile application, • Accessible for multiple users • A great deal of data available about routes, objects and traffic signs	• No integration with other knowledge sources • Not easy in functionalities, not user-friendly, data overload • Expensive to download data for other geographic systems

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Map Me	• Easy functionalities and controls, few options overload • Suitable for working with stakeholders • Results are open to diverse geographic systems • Suitable for different operating systems • Open source • Accessible for multiple users	• Less options and controls available • GIS knowledge is needed for analysis of the results • Difficult to fill in questionnaire with a mobile phone
Story Maps	• Integration platform of different knowledge sources • Easy functionalities and controls • Suitable for presenting to stakeholders • Open to diverse geographic systems • Suitable for multiple operating systems • Communication possible via different digital channels and systems • Open source • Accessible for multiple users, closed off for individual stories • Open for different materials, document pictures, interactive possibilities etc.	• It takes some time to get used to the platform • Not suitable for data collection

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5. Discussion

This chapter discusses the methods and results of this research. First the requirements and methods are discussed, then an evaluation is performed on the basis of the platforms and tests and finally a comparison with other researches about PGIS platforms in higher education is carried out.

5.1. Requirements and methods

The requirements that are used in this research are mainly based on the provided requirements from the Land Use Planning group of the WUR. This is only one supplier of a fundamental base of this research. In other higher education settings, other requirements could be provided or needed. It is also possible that the basis of the requirements can change due to new developments. The same applies to the platforms. New platforms can arise, or updates can become available that make a platform more or less suitable.

In this research, not all the facets of a participatory process are taken into account. It was decided to analyse only the data collection, -handling and -visualisation stages. These components relate more to the functionalities of the platforms. The actual participating stage of a participatory process, however, is not tested in this way. To implement the interaction and discussion stages into the tests would be more tedious, because not only a research group of participants (students in this case) is needed, but also a variety of stakeholders or citizens of a test area. Therefore the tests were chosen to be setup in this way. If the starting principles of a participatory process cannot be performed on a platform, further use will also be problematic.

5.2. Platform and test evaluation

Only four platforms were used in this research. Nowadays there are many different PGIS platforms that could be tested or analysed for use in higher education, but certain limits were set and within this research the tested platforms were also the provided ones. Story Maps is another type of platform than the others and is also in use in some GIS courses of WUR. WUR already has a partnership with Esri (using an enterprise login). Because of this, it was easy to test Story Maps as well as a PGIS platform to control whether this web application can be of more use.

For some of the platforms a paid license is needed for an in-depth analysis of its functions and use for higher education. A license for Maptionnaire was unobtainable, which made it more difficult to test this platform. With a detour it was eventually possible to include this platform in the tests, but not all the functionalities, such as analysing user's own response data, could be tested. To download the data of Mapillary for use in other geographic systems (e.g. ArcMap) financial captial was necessary, something that was not available for this research.

The fixed order of the platforms on the test day could potentially have influenced the test results. At first it could take some time to understand the aim of the tests. This could have been a disadvantage for Maptionnaire or Mapillary. With Maptionnaire this was not the case, because this platform was still evaluated as the best overall. With Mapillary it could be difficult to understand the platform at first. Furthermore, the designed tests were possibly less suitable for Mapillary. Particularly Test 2 was found to be less suitable for the majority of the platforms. For other types of tests with different approaches, Mapillary could be better evaluated in comparison to the other platforms. Within the tests, the participants were relatively free in performing the tests. They were allowed to interpret the tests in their own way and to explore the limitations of the platforms. Mapillary might need a more direct approach with step-by-step instructions. It could be used to let students gather their own data in an area with the mobile application.

Most questions of the evaluation forms were based on a Likert scale. Because a mean and standard deviation are inappropriate for ordinal data (Jamieson, 2004), where numbers generally represent verbal statements, this type of statistical analysis was not performed on the bar charts. The Likert scale questions were sometime

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misinterpreted by participants or found too difficult to understand. The scale was from 1 ('Yes easily') to 5 ('No not at all'). Some participants mentioned that it would be more logical to have it the other way around. As a result, some responses had to be omitted because these answers were in contradiction with the additional comments.

For each of the evaluation forms that was performed there was a different number of respondents. This could have influenced the results of these forms. 36 respondents answered the first evaluation form of Maptionnaire in contrast to 28 respondents for the evaluation form of Story Maps. Furthermore, the final evaluation form only had 30 respondents. The test participants that preferred Maptionnaire or Mapillary, for example, possibly did not perform the final evaluation form. The results for the final graphs could have looked very different with six additional responses. Because there was an unequal distribution of respondents for each form, the results were converted to percentages to obtain equally distributed graphs.

The population size of this research is the total number students that follow the course Planning and Research Methods. This group can be seen as a target group for the implementation of PGIS: 57% to 73% of the population competed the evaluation forms. With a confidence level of 95% and a margin error of 5% a sample size of at least 44 people (around 90%) would be needed to represent the population as a statistically significant sample size. But it has been observed that some students performed the evaluation forms in couples, therefore it is difficult to say something about the statistical significance of this research. It is thus assumed that the results can be used as a guidance for a recommendation.

5.3. Other research

It is difficult to compare this research to similar researches that contain a review of PGIS platforms for higher education settings. Most of the researches explain PGIS platforms and, thereafter, perform their research with one platform only (e.g. Mapillary, (Juhász & Hochmair, 2016b) and Maptionnaire, (López-Aparicio et al., 2017)) because they are already involved with this platform. Researches that link PGIS to higher education appoint that PGIS can help educators meet diverse learning objectives, which can help to connect literature on GIS education and PGIS (Sinha et al., 2017). This is quite similar to comments of participants of this research regarding the platforms. Participants indicated that most of the platforms can have their own contribution to higher education and participatory planning or at least stated it makes the step from GIS to PSP more logical.

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6. Conclusion

This research explored the importance and use of PGIS platforms in higher education. The objective of this research was to assess different PSP platforms where GIS is involved and to determine which platform(s) can be implemented in higher education courses given a particular participatory planning approach. A literature research was performed and tests were developed to examine different platforms.

RQ1: What requirements are coming forward regarding the learning outcomes of participatory planning and design courses cluster?

For the analysis of GIS-supported PSP platforms, a list of requirements was set to investigate the contribution of these platforms for higher education. PGIS platforms are required to be integration platforms, have simple functionalities and controls and be compatible with multiple geographic systems. It is also important that a platform is suitable for multiple operating systems and that communication is possible via different digital channels. In addition, a requirement is that a PGIS platform is open source and that privacy is taken into account. Another advantage for the platforms is that it is open for different files like documents, pictures, etc. and that it has interactive possibilities.

RQ2: Which platforms related to PSP are available and which procedures can be defined to explore the options of these platforms?

Different platforms related to PSP were analysed and procedures were defined to explore the options of these platforms. Based on the requirements, four PGIS platforms were assessed; Maptionnaire, Mapillary, Map Me and Story Maps. Based on literature and with the help of a group of second year students who performed tests, the platforms options were explored. The literature review and test results show that a GIS-involved PSP platform can support the requirements and can thus support higher education.

RQ3: How will GIS-involved participatory spatial planning platforms support the requirements? RQ4: What are the pros and cons of each platform regarding the requirements and is there any preferred platform?

Maptionnaire and Map Me are online questionnaire based platforms that can be used as a data providing and handling tool to contribute to planning related subjects. Maptionnaire has more functionalities, but Map Me distinguishes itself with a spraying tool for vague spatial data. Mapillary also has distinguishing functions like the provision of map data, imagery and object detections. The fourth platform, Story Maps, is a platform that is used more for visualisation and representation of spatial data then that it is a participation tool. The different platforms are all appealing to different stages of a participatory process, but the question for this research is mostly about the functionalities of the platforms, regarding the requirements.

What can be concluded is that PGIS platforms can contribute effectively to higher education. Participants of the tests were enthusiastic about the potential that PGIS platforms can have. Maptionnaire and Story Maps were indicated as the most preferred platforms on most of the criteria. A list of pros and cons for each platform, regarding the requirements, is shown in Table 8.

The participants indicated that Maptionnaire can contribute to higher education programmes where stakeholders are involved. It is an easy platform to work with and has a wide range of functions. Especially when working with different stakeholders, the platform can be very useful. A drawback of Maptionnaire is that a license is needed to obtain insights on your own questionnaires to analyse and/or download the data. The second preferred platform, Story Maps, was also indicated as a potential platform for higher education, but as more of a presentation tool. Participants of the tests liked the professional appearance of the platform to make stories with maps on the basis of geographic data. For participatory planning, this platform connects less to a participatory process than Maptionnaire, but to visualise and present results to governmental organisations for instance, it can act as a worthy contribution for students of higher education. When dealing with vague spatial

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data and localising areas, Map Me can be a valuable contribution, although Maptionnaire is more precise and extensive in use. Mapillary is the least recommended platform for higher education use. The platform has very interesting and distinctive functions like object detections, but because there is so much data available, for most scales and projects the platform showed inconsistent performance.

Overall, GIS-supported spatial planning platforms can be of great use in higher education and the working field of spatial planning. The implementation of PGIS in GIS courses is more often appointed than the use of PGIS in courses related to spatial planning. It was expected that a certain level of experience was needed for most of the platforms, but the students were eventually able to perform the tests. Some students indicated that it took some time to get used to all the functionalities of the platforms, but much was possible. PGIS are developed to ease and support experts' work with geographical information or to enhance laypersons' access to geographical information and communication between different stakeholders. What can be concluded now is that, within higher education settings, PGIS can also be of importance. Ultimately, it is recommended to integrate GIS-supported PSP platforms in higher education courses to strengthen students' findings and support their research. PGIS is also an effective instrument to bridge the gap between GIS and spatial planning

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7. Recommendations

In this chapter a recommendation will be made about the possible implementation of GIS-supported PSP platforms to higher education courses on the base of this research. Thereafter opportunities will be suggested for possible further research.

7.1. Platform recommendation

The results revealed that Maptionnaire was the most preferred platform. This platform matches the requirements to a great extent. A drawback of Maptionnaire is that a license is needed to analyse the results of the generated questionnaires. If the financial resources allow it, this is the most recommended platform for PSP related higher education courses. This platform can be a part of the 'Planning and Research Methods' course, to teach students the importance and use of GIS related platforms in PSP. This platform can also be a contribution to follow-up courses like 'Studio Participative Planning'. When the financial resources do not allow the implementation of Maptionnaire, Map Me can be a replacement for this platform. This platform is more basic and has less functionalities. Map Me only appeals to a certain type of information gathering.

The second best evaluated platform was Story Maps. This platform matches also a great deal of the requirements. It is recommended to implement this platform already in the 'Geo-information Science for Planning and Design' course. According to the test results and additional comments there was a demand to get to know this platform earlier in the education program. This platform is not really a participation tool. Most participants indicated that they liked the professional appearance of Story Maps and the contribution it can have to their further study program as a representation tool.

Mapillary was the least preferred platform in this research. This platform does not match the requirements and the participants indicated that the platform showed inconsistent performance. Maybe the platform can be used to get to know a small area or village as an analysis tool in some courses. For this implementation a group of students has to photograph the area and let the platform extract map data. Further research for this implementation will be needed.

7.2. Further research

For further research about GIS-supported participatory planning platforms it will be needed to implement the interaction and discussion stage of a participatory process. These stages are fundamental to investigate if the PGIS platforms can support participatory planning problems in a higher education setting. An example of further research can be to work on a topical spatial planning problem were citizens or different stakeholders can be approached to perform tests, questionnaires etc. that are provided by students who analyse the platforms. Another method can be that spatial planning students form groups were they all act like a different stakeholder and fight for their concerns in a topical planning problem. In this way the PGIS platforms will be used to support the interaction and discussion stage that can occur in a participatory planning process.

For further literature analysis of PGIS, the article 'Does mapping improve public participation? Exploring the pros and cons of using public participation GIS in urban planning practices' (Kahila-Tani, Kytta, & Geertman, 2019) can be used as a supporting reference. This article was released after the completion of the review part of this research.

The spatial data collecting survey of Esri, Survey123, can also be analysed and assessed when further research will be performed on the topic of PGIS platforms for higher education.

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References

Ardoin, N. M., Clark, C., & Kelsey, E. (2013). An exploration of future trends in environmental education research. *Environmental Education Research*, *19*(4), 499–520. https://doi.org/10.1080/13504622.2012.709823

Arnstein, S. R. (1969). A Ladder Of Citizen Participation. *Journal of the American Planning Association*, *35*(4), 216–224. https://doi.org/10.1080/01944366908977225

Battersby, S. E., & Remington, K. C. (2013). Story Maps in the Classroom. *University of South Carolina*, 62–65.

Beddow, C. (2017, June 28). Amsterdam in 360: From Imagery to Map Data in Seven Days. Retrieved March 16, 2019, from https://blog.mapillary.com/community/2017/06/28/amsterdam-in-360-from-imagery-to-map-data-in-seven-days.html

Beyea, W. (2009). Place Making Through Participatory Planning. *Handbook of Research on Urban Informatics*, (September), 55–67. https://doi.org/10.4018/978-1-60566-152-0.ch004

Brovelli, M. A., Minghini, M., & Zamboni, G. (2014). Public Participation GIS: a FOSS architecture enabling field-data collection. *International Journal of Digital Earth*, *8*(5), 345–363. https://doi.org/10.1080/17538947.2014.887150

Brovelli, M. A., Minghini, M., & Zamboni, G. (2016). Public participation in GIS via mobile applications. *ISPRS Journal of Photogrammetry and Remote Sensing*, *114*, 306–315. https://doi.org/10.1016/j.isprsjprs.2015.04.002

Brown, G., Weber, D., & de Bie, K. (2015). Is PPGIS good enough? An empirical evaluation of the quality of PPGIS crowd-sourced spatial data for conservation planning. *Land Use Policy*, *43*, 228–238. https://doi.org/10.1016/j.landusepol.2014.11.014

Campagna, M. (2014). The geographic turn in social media: Opportunities for spatial planning and Geodesign. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *8580 LNCS*(PART 2), 598–610. https://doi.org/10.1007/978-3-319-09129-7_43

Chambers, R. (2006). Participatory Mapping and Geographic Information Systems: Whose Map? Who is Empowered and Who Disempowered? Who Gains and Who Loses? *The Electronic Journal of Information Systems in Developing Countries*, *25*(1), 1–11. https://doi.org/10.1002/j.1681-4835.2006.tb00163.x

Chambers, R., Dunn, Abbot, Jo, C., Harris, T., de Merode, E., Townsend, J., & Weiner, D. (1998). Participatory GIS: opportunity or oxymoron? *PLA Notes 33*, (33), 27–34.

De Vidovich, L. (2018). Place-Based Tools For Participatory Urban Planning: The Potentialities Of Soft GIS. *[Co]Habitation Tactics, Imagining Future Spaces in Architecture, City and Landscape. Conference Proceedings TAW2018*, 583–592.

Eanes, F. R., Silbernagel, J. M., Hart, D. A., Robinson, P., & Axler, M. (2018). Participatory mobile- and web-based tools for eliciting landscape knowledge and perspectives: introducing and evaluating the Wisconsin geotools project. *Journal of Coastal Conservation*, *22*(2), 399–416. https://doi.org/10.1007/s11852-017-0589-2

Elwood, S. (2009). Integrating participatory action research and GIS education: Negotiating methodologies, politics and technologies. *Journal of Geography in Higher Education*, *33*(1), 51–65. https://doi.org/10.1080/03098260802276565

Elwood, S., Feliciano, R., Gulasingam, N., Howard, W., Mackn, R., Medina, E., … Sierra, S. (2007). Participatory GIS: The Humboldt / West Humboldt Park Community GIS Project, Chicago, USA. *Participatory Action Research Approaches and Methods: Connecting People, Participation and Place*, 170–178.

Geertman, S. (2002). Participatory planning and GIS: A PSS to bridge the gap. *Environment and Planning B: Planning and Design*, *29*(1), 21–35. https://doi.org/10.1068/b2760

Geodesign | Integrating GIS with Geodesign - Esri. (n.d.). Retrieved February 25, 2019, from

.

https://www.esri.com/en-us/arcgis/geodesign

Haklay, M. (2013). Crowdsourcing Geographic Knowledge. *Crowdsourcing Geographic Knowledge*, 105–122. https://doi.org/10.1007/978-94-007-4587-2

Huck, J. J. (2012). The Map-me Manual.

Huck, J. J., Whyatt, J. D., & Coulton, P. (2014). Spraycan: A PPGIS for capturing imprecise notions of place. *Applied Geography*, *55*, 229–237. https://doi.org/10.1016/j.apgeog.2014.09.007

Jamieson, S. (2004). Likert scales: how to (ab)use them. *Medical Education*, *38*(12), 1217–1218. https://doi.org/10.1111/j.1365-2929.2004.02012.x

Juhász, L., & Hochmair, H. H. (2016a). Cross-Linkage Between Mapillary Street Level Photos and OSM Edits. *Geospatial Data in a Changing World*, 141–156. https://doi.org/10.1007/978-3-319-33783-8

Juhász, L., & Hochmair, H. H. (2016b). User Contribution Patterns and Completeness Evaluation of Mapillary, a Crowdsourced Street Level Photo Service. *Transactions in GIS*, *20*(6), 925–947. https://doi.org/10.1111/tgis.12190

Kahila-Tani, M., Kytta, M., & Geertman, S. (2019). Does mapping improve public participation? Exploring the pros and cons of using public participation GIS in urban planning practices. *Landscape and Urban Planning*, *186*(April 2018), 45–55. https://doi.org/10.1016/j.landurbplan.2019.02.019

Kahila, M., & Kyttä, M. (2009). SoftGIS as a Bridge-Builder in Collaborative Urban Planning. *Planning Support Systems Best Practice and New Methods*, 389–411. https://doi.org/10.1007/978-1-4020-8952-7

Li, W., & Milburn, L. A. (2016). The evolution of geodesign as a design and planning tool. *Landscape and Urban Planning*, *156*, 5–8. https://doi.org/10.1016/j.landurbplan.2016.09.009

López-Aparicio, S., Vogt, M., Schneider, P., Kahila-Tani, M., & Broberg, A. (2017). Public participation GIS for improving wood burning emissions from residential heating and urban environmental management. *Journal of Environmental Management*, *191*, 179–188. https://doi.org/10.1016/j.jenvman.2017.01.018

Miller, W. R. (2012). Introducing Geodesign : The Concept. *Esri Press*, 1–36.

Opbouw bachelor Landschapsarchitectuur en Ruimtelijke Planning. (n.d.). Retrieved February 25, 2019, from https://www.wur.nl/nl/Onderwijs-Opleidingen/Bachelor/BSc-opleidingen/BSc-Landschapsarchitectuur-en-Ruimtelijke-Planning/Opbouw-studie.htm

Participatory Geographical Information Systems (PGIS) | Participatory Methods. (n.d.). Retrieved February 22, 2019, from https://www.participatorymethods.org/method/participatory-geographical-information-systems-pgis

Rambaldi, G. (2005). Barefoot mapmakers and participatory GIS. *Participatory GIS*, 2.

Rambaldi, G., Kyem, P. A. K., McCall, M., & Weiner, D. (2006). Participatory Spatial Information Management and Communication in Developing Countries. *The Electronic Journal of Information Systems in Developing Countries*, *25*(1), 1–9. https://doi.org/10.1002/j.1681-4835.2006.tb00162.x

Sanchez-Trigueros, F., Carver, S., Huck, J., Matt, R., McBride, B. B., Stumpff, L. M., & Watson, A. (2018). The treatment of public participation data in environment impact assessment: setting up smart systems for the synthesis and mapping of vague definitions. Retrieved from http://eprints.lancs.ac.uk/69449/1/Sanchez_Trigueros_et_al_GISRUK2014_EXTENDED.pdf

Sinha, G., Smucker, T. A., Lovell, E. J., Velempini, K., Miller, S. A., Weiner, D., & Wangui, E. E. (2017). The Pedagogical Benefits of Participatory GIS for Geographic Education. *Journal of Geography*, *116*(4), 165–179. https://doi.org/10.1080/00221341.2016.1215488

Slotterback, C. S., Runck, B., Pitt, D. G., Kne, L., Jordan, N. R., Mulla, D. J., … Reichenbach, M. (2016). Collaborative Geodesign to advance multifunctional landscapes. *Landscape and Urban Planning*, *156*, 71–80. https://doi.org/10.1016/j.landurbplan.2016.05.011

.

Smith, R. W. (1973). A Theoretical Basis for Participatory Planning. *Policy Sciences 4*, 275–295. https://doi.org/10.1177/088840647800200103

Solís, P., McCusker, B., Menkiti, N., Cowan, N., & Blevins, C. (2018). Engaging global youth in participatory spatial data creation for the UN sustainable development goals: The case of open mapping for malaria prevention. *Applied Geography*, *98*(January), 143–155. https://doi.org/10.1016/j.apgeog.2018.07.013

Steinitz, C. (2012). A framework for geodesign: Changing geography by design. Red- lands, CA: Esri Press.

Sui, D. Z. (2015). Alternative GIS (alt.gis) and the Six Senses of the New Mind: Is alt.gis Transforming GIS into a Liberation Technology? *Advances in Spatial Data Handling and Analysis*, *19*, 1–11. https://doi.org/10.1007/978-3-319-19950-4

Talen, E. (2000). Bottom-Up GIS: A new tool for individual and group expression in participatory planning. *Journal of the American Planning Association*, *66*(3), 279–294. https://doi.org/10.1080/01944360008976107

Voigt, C., Dobner, S., Ferri, M., Hahmann, S., & Gareis, K. (2016). Community Engagement Strategies for Crowdsourcing Accessibility Information. *Computers Helping People with Special Needs*, 257–264. https://doi.org/10.1007/978-3-642-31534-3

Voss, A., Denisovich, I., Gatalsky, P., Gavouchidis, K., Klotz, A., Roeder, S., & Voss, H. (2004). Evolution of a participatory GIS. *Computers, Environment and Urban Systems*, *28*(6), 635–651. https://doi.org/10.1016/j.compenvurbsys.2003.12.003

Waters, T., & Evans, A. J. (2003). Tools for web-based GIS mapping of a "fuzzy" vernacular geography. *Proceedings of the 7th International Conference on GeoComputation*. Retrieved from http://www.geog.leeds.ac.uk/people/a.evans/publicinfo.html

Whyatt, J. D., Huck, J. J., Davies, G., Dixon, J., Hocking, B., Jarman, N., … Bryan, D. (2017). Belfast Mobility Project: Integrating PGIS and GPS to Understand Patterns of Segregation.

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Appendices

Appendix A – Test day presentation

Participatory GIS platforms

Test dag
14-05-2019, Niek van der Steeg

Introductie

- Thesis GIS
- Participatief plannen
- PGIS

Introductie

- Thesis GIS
- Participatief plannen
- PGIS

4 Platformen

- Maptionnaire
- Mapillary
- Map-Me
- Story Maps

3 Tests

- Test 1 – Accessibility of the WUR — Wageningen
- Test 2 – Solar panel fields — Foodvalley
- Test 3 – Tourism and recreational areas — Gelderland
- Staan op Brightspace
- Sla al je kaarten/posters/presentaties op eenzelfde plek op

Rooster van vandaag

Schedule	Time
Introduction on subject and the platforms	8:20 – 8:40
Demo of Maptionnaire	8:40 – 8:50
Perform tests with Maptionnaire	8:50 – 9:20
Evaluation form Maptionnaire	9:20 – 9:25
Break	5 minutes
Demo of Mapillary	9:30 – 9:40
Perform tests with Mapillary	9:40 – 10:10
Evaluation form Mapillary	10:10 – 10:15
Break	15 minutes
Demo of Map-Me and ArcGIS Online	10:30 – 10:40
Perform tests with Map-Me	10:40 – 11:10
Evaluation form Map-Me	11:10 – 11:15
Break	5 minutes
Demo of WUR Story Maps	11:20 – 11:30
Perform tests with WUR Story Maps	11:30 – 12:00
Evaluation form Story Maps and all the platforms	12:00 – 12:10
Post-discussion and collecting test results	12:10 – 12:30/40

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Maptionnaire

- https://maptionnaire.com/
- https://app.maptionnaire.com/nl/1621/

- Inloggegevens staan in je mail
- Wachtwoord = WURPGIS123 (allemaal hoofdletters)
- Naam in survey titel (bijv. 'Niek – Accessibility WUR')

Maptionnaire

- 3 onderdelen
  - Maak een eigen questionnaire
  - Vul de Demo questionnaire in
  - Analyseer de antwoorden van de Demo questionnaire

Mapillary

- https://www.mapillary.com/
- https://mapillary.github.io/mapillary_solutions/demos/amsterdam/

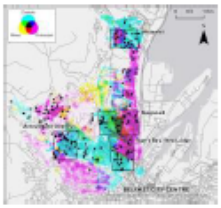
- Maak een account en geef je account naam door
- Ga naar 'Organization' -> 'Shapes' -> 'Explore map data'

Pauze

Tot 10:30

Map-Me

- http://map-me.org/



- Log in met: WURPGIS
- Wachtwoord: WURPGIS123
- Naam in titel (bijv. 'Niek – Accessibility WUR')

WUR Story Maps

- https://wur-girs.maps.arcgis.com/apps/Cascade/index.html?appid=0e9a4a2a12b0484a860b223620b873c1
- https://wur-girs.maps.arcgis.com/home/index.html

- Log in met je WUR account

Evaluatie formulier

Nabespreking

Mail je kaarten en presentaties via wetransfer.com naar niek.vandersteeg@wur.nl

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Appendix B – Evaluation forms

PGIS Survey Maptionnaire/Mapillary/Map Me/Story Maps (the same evaluation form was used for each platform. The evaluation form of Maptionnaire is used as an example for all the platforms.

PGIS Survey Maptionnaire

*Vereist

1. **Which test did you perform?** *
   Markeer slechts één ovaal.

   - ◯ Test 1 - Accessibility of the WUR
   - ◯ Test 2 - Solar panel fields
   - ◯ Test 3 - Tourism and recreational areas

Maptionnaire

2. **Were you able to perform the test with the platform?** *
   Markeer slechts één ovaal.

	1	2	3	4	5	
Yes easily	◯	◯	◯	◯	◯	No not at all

3. **Why?** *

4. **What did you think of the functionality and the controls of the platform?** *
   Markeer slechts één ovaal.

	1	2	3	4	5	
Very easy	◯	◯	◯	◯	◯	Very difficult

5. **Why was it easy/average/difficult?**

.

6. **Could you easily integrate other knowledge sources in the platform? (geodata, CBS, articles, (social-)media, imagery etc.)** *
Markeer slechts één ovaal.

	1	2	3	4	5	
Yes easily	◯	◯	◯	◯	◯	No not at all

7. **Is the platform suitable when working with different stakeholders?** *
Markeer slechts één ovaal.

	1	2	3	4	5	
Yes easily	◯	◯	◯	◯	◯	No not at all

8. **In what way?**

_____

_____

_____

_____

_____

9. **Is the platform suitable for gathering data** *
Markeer slechts één ovaal.

	1	2	3	4	5	
Yes easily	◯	◯	◯	◯	◯	No not at all

10. **Is the platform suitable for handling data** *
Markeer slechts één ovaal.

	1	2	3	4	5	
Yes easily	◯	◯	◯	◯	◯	No not at all

11. **Is the platform suitable for visualising data** *
Markeer slechts één ovaal.

	1	2	3	4	5	
Yes easily	◯	◯	◯	◯	◯	No not at all

12. **Do you think the platform can be a contribution to higher education courses? (Studio Participative Planning/Introduction to GIS for BLP)** *
Markeer slechts één ovaal.

	1	2	3	4	5	
Yes easily	◯	◯	◯	◯	◯	No not at all

.

13. In what way can it be a contribution? *

14. Are there some final things you want to mention about this platform?

Made possible by:
Google Forms

.

PGIS Survey Overall

*Vereist

1. **Which test did you perform?** *
   Markeer slechts één ovaal.
   - ◯ Test 1 - Accessibility of the WUR
   - ◯ Test 2 - Solar panel fields
   - ◯ Test 3 - Tourism and recreational areas

All the platforms

2. **Which platform was the easiest to handle?** *
   Markeer slechts één ovaal.
   - ◯ Maptionnaire
   - ◯ Mapillary
   - ◯ Map-Me
   - ◯ Story Maps

3. **Which platform has the most functionalities?** *
   Markeer slechts één ovaal.
   - ◯ Maptionnaire
   - ◯ Mapillary
   - ◯ Map-Me
   - ◯ Story Maps

4. **Which platform is the most planning oriented?** *
   Markeer slechts één ovaal.
   - ◯ Maptionnaire
   - ◯ Mapillary
   - ◯ Map-Me
   - ◯ Story Maps

5. **Which platform is the best when working with different stakeholders?** *
   Markeer slechts één ovaal.
   - ◯ Maptionnaire
   - ◯ Mapillary
   - ◯ Map-Me
   - ◯ Story Maps

.

6. **Which platform is the most appropriate for gathering data?** *
Markeer slechts één ovaal.

- ◯ Maptionnaire
- ◯ Mapillary
- ◯ Map-Me
- ◯ Story Maps

7. **Which platform is the most appropriate for handling data?** *
Markeer slechts één ovaal.

- ◯ Maptionnaire
- ◯ Mapillary
- ◯ Map-Me
- ◯ Story Maps

8. **Which platform is the most appropriate for visualising data?** *
Markeer slechts één ovaal.

- ◯ Maptionnaire
- ◯ Mapillary
- ◯ Map-Me
- ◯ Story Maps

9. **Which platform(s) would you recommend for integration in higher education courses?** *
Vink alle toepasselijke opties aan.

- ☐ Maptionnaire
- ☐ Mapillary
- ☐ Map-Me
- ☐ Story Maps

10. **Which platform(s) would you possibly use during the rest of your study program/working life?** *
Vink alle toepasselijke opties aan.

- ☐ Maptionnaire
- ☐ Mapillary
- ☐ Map-Me
- ☐ Story Maps

11. **Which platform did you think was the best overall?** *
Markeer slechts één ovaal.

- ◯ Maptionnaire
- ◯ Mapillary
- ◯ Map-Me
- ◯ Story Maps

.

12. **Why?** *

13. **Are there some final thoughts you want to mention about all the platforms? Or a final advice?**

14. **Are there some final thoughts you want to mention about the tests?**

Thank you

If you are interested and want to receive the thesis results when I am finished you can leave your mail address

15. **Mail address**

Made possible by:
Google Forms

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Appendix C – Student's test results

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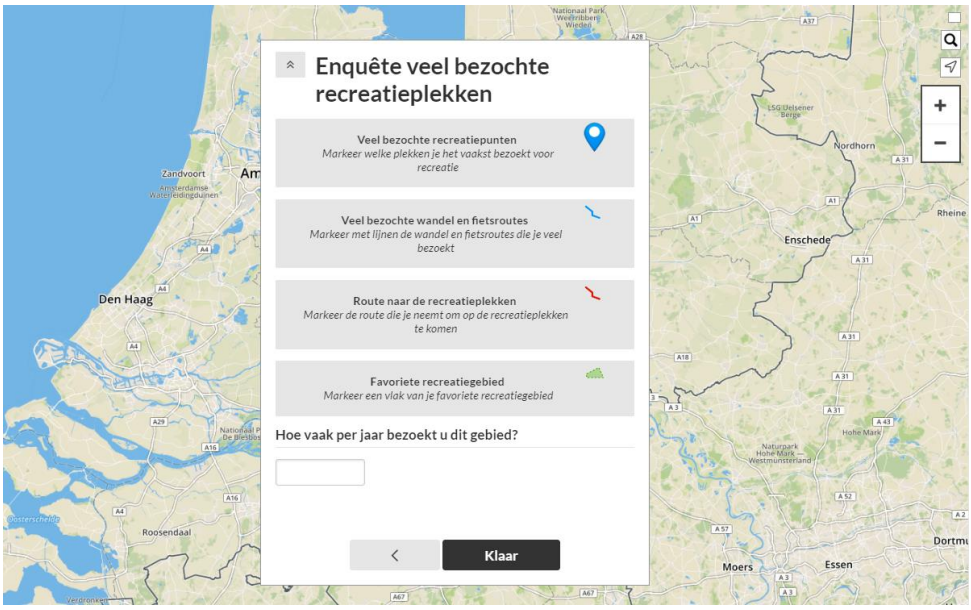
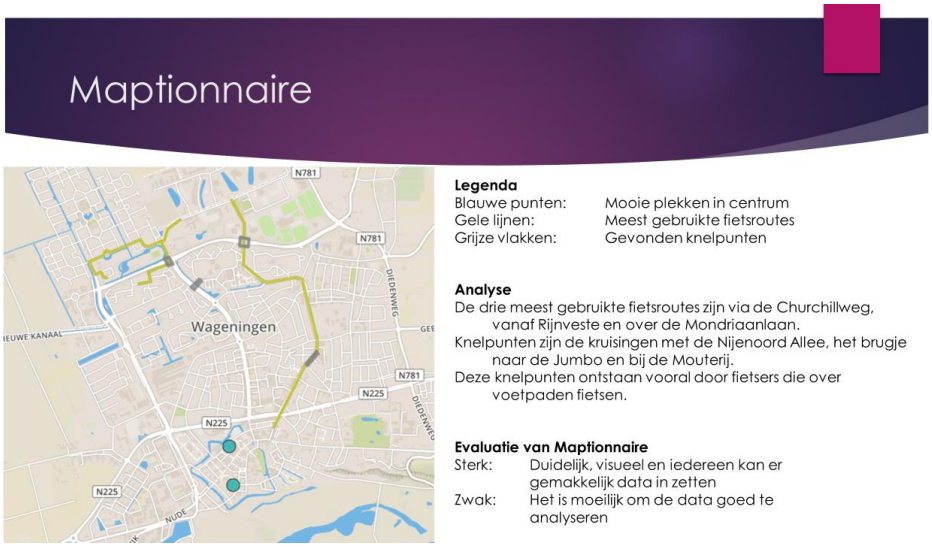
A selection of the **Maptionnaire** results:

By students Matthias and Tom

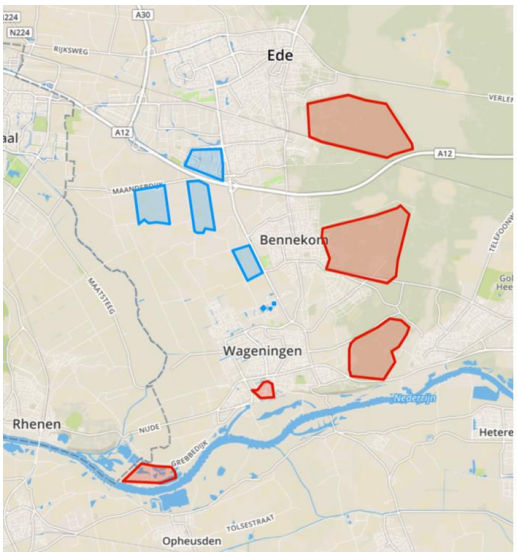


By students Rosa and Thamar



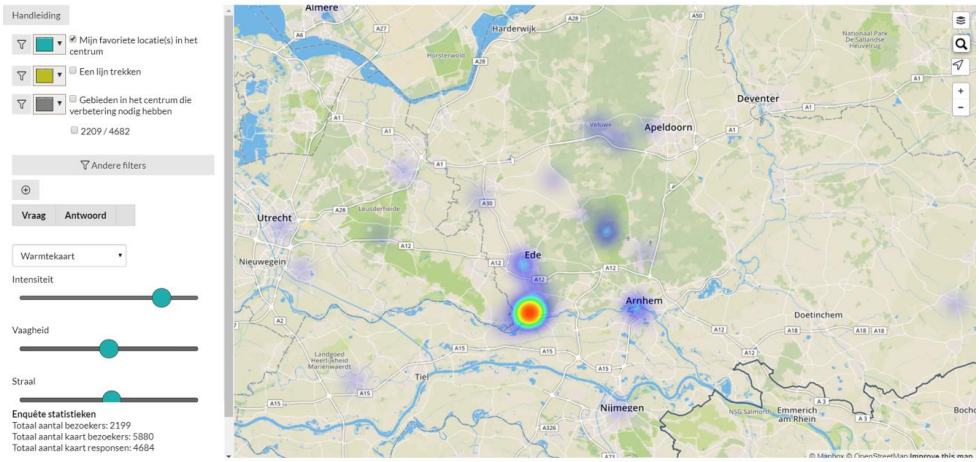
By students Amber and Twan

.



- Probleemgebieden: Bos, Stadscentrum en Natuurgebied
- Kansgebieden: Weilanden, nieuwbouwwijken en op daken van campus

By students Jitske and Rob



You can make heatmaps of chosen locations to detect hotspots.

By students Sander and Josje

Maptionnaire questionnaires:

https://app.maptionnaire.com/nl/6406/ https://app.maptionnaire.com/nl/6402/
https://app.maptionnaire.com/nl/6401/ https://app.maptionnaire.com/nl/6400/
https://app.maptionnaire.com/nl/6399/ https://app.maptionnaire.com/nl/6398/
https://app.maptionnaire.com/nl/6397/ https://app.maptionnaire.com/nl/6397/
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https://app.maptionnaire.com/nl/6379/ https://app.maptionnaire.com/nl/6378/
https://app.maptionnaire.com/nl/6377/ https://app.maptionnaire.com/nl/6375/
https://app.maptionnaire.com/nl/6373/ https://app.maptionnaire.com/nl/6372/

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A selection of the **Mapillary** results:

Bike facilities

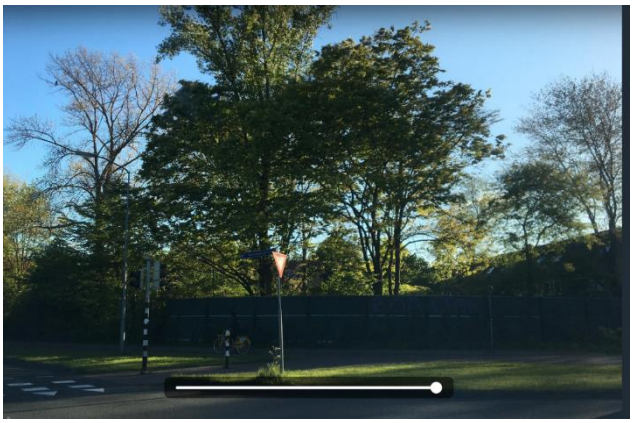
- Bicycles (red)
- Bicycle racks (orange)
- Bicycle paths (purple)

By student Harmen

One of the main bottlenecks in Wageningen (for bikers)

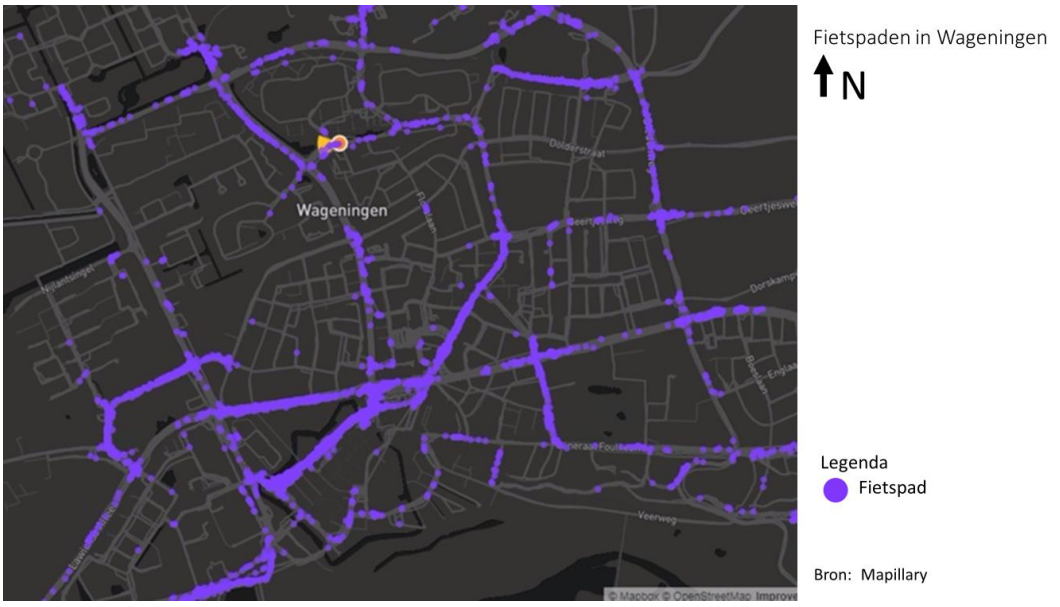
On the crossing of the Nijenoord Allee and the Churchillweg

By student Hugo



By students Sophie and Tim

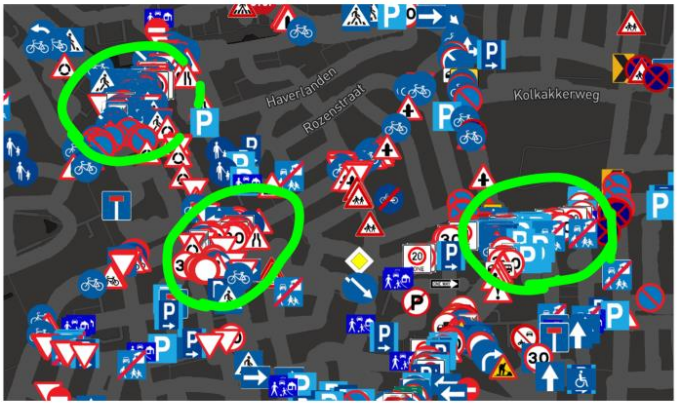
.



By students Erik and Stephanie

1B: 3 Most used bike routes to the campus

1B: 3 Problem areas on these routes



By students Jeroen and Louden

.

A selection of the **Map Me** results:

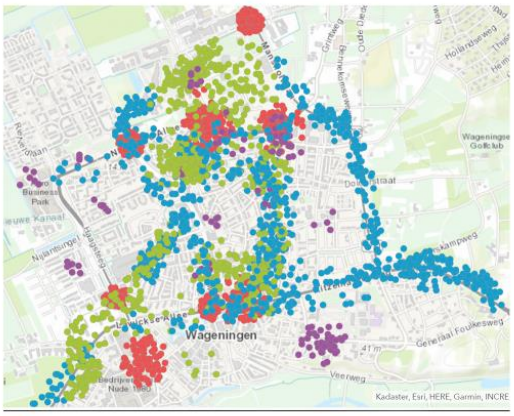
1C: 3 Most used bike routes to the campus

groen = meest gefietst

blauw = meeste doorstroming

rood = minste doorstroming

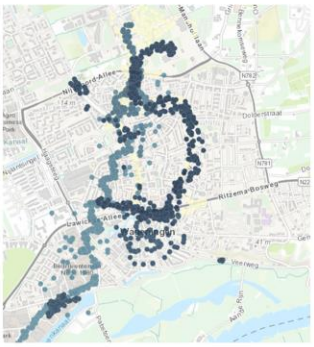
paars = meest onveilig



By students Jeroen and Louden

Bike Routes in Wageningen

Map-Me is not the best tool for us to use, as the spraying is not very precise. For marking areas it can be useful, but for routes it isn't optimal. However, it is a very fast tool compared to the others, and easily understandable. And it is also quite convenient for putting multiple data layers over each other. We could easily put the problem-area-layer over the bike-routes-layer. It is really clear where the problems on the route are right now.

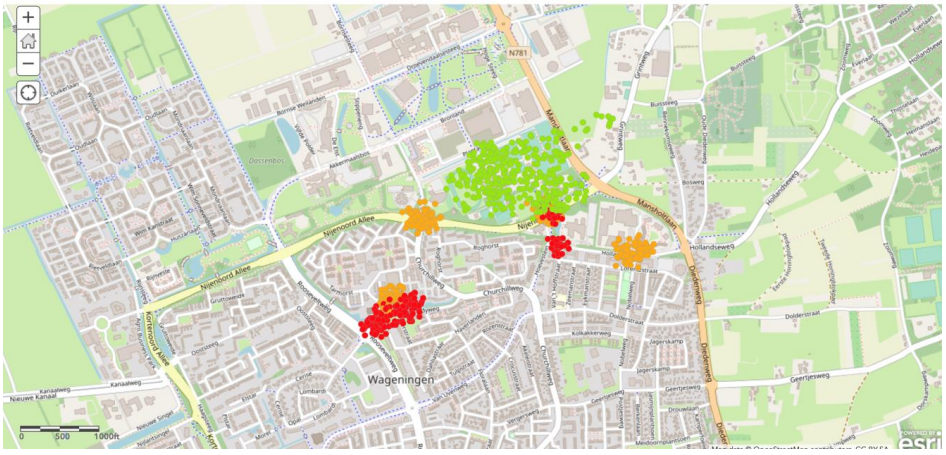


By student Hugo

Legenda

Bron: Map-Me

Mooie punten Opstoppingen punten Gevaarlijke punten



By students Erik and Stephanie

.

Map-me

Legenda
Groene punten: Fijne fietslocaties
Rode punten: Slechte fietslocaties

Analyse
De fietsroute over de Churchillweg, wordt erg onprettig ervaren, terwijl de fietsroutes bij de Rooseveltweg en de Kortenoord Allee erg positief worden beoordeeld.
Verder worden bijna alle kruisingingen met autowegen slecht ervaren

Evaluatie van Map-me
Sterk: Makkelijk in gebruik
Zwak: De grootte van de spray bleef altijd hetzelfde

By students Amber and Twan

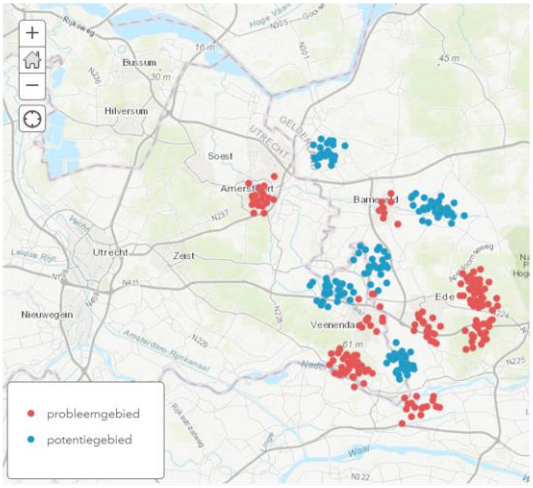
Map-me

Probleemgebieden:

- Bebouwing
- Beschermd natuurgebied

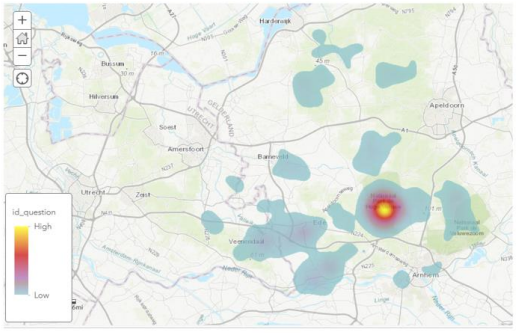
Mogelijke locaties:

- Open gebieden
- In de buurt van infrastructuur en water



By students Thijs and Susan

Heatmap



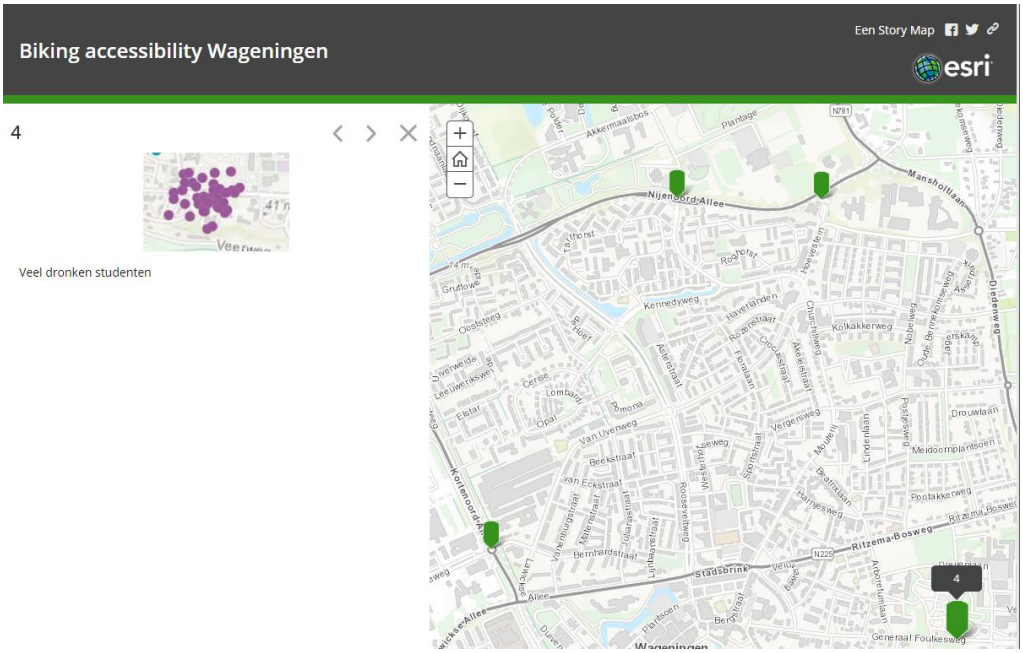
By student Pim

.

Map Me questionnaires:

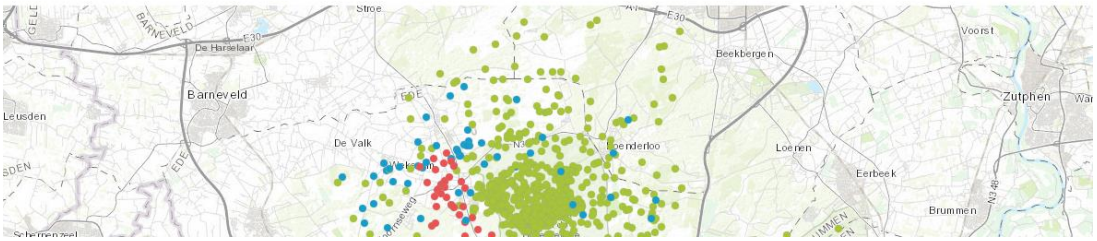
http://map-me.org/sites/fsgfgh
http://map-me.org/sites/Bereikt
http://map-me.org/sites/Bereiken
http://map-me.org/sites/trsmgld
http://map-me.org/sites/Henk
http://map-me.org/sites/amberentwa
http://map-me.org/sites/solar
http://map-me.org/sites/ondzgld
http://map-me.org/sites/rideabike
http://map-me.org/sites/Carlotours
http://map-me.org/sites/catipedia
http://map-me.org/sites/Gelderland
http://map-me.org/sites/vraagjes
http://map-me.org/sites/Google
http://map-me.org/sites/blahhh
http://map-me.org/sites/Bereikbaar
http://map-me.org/sites/TourismGld
http://map-me.org/sites/Solarspace
http://map-me.org/sites/fietspaden
http://map-me.org/sites/SophieTim
http://map-me.org/sites/wagbikeHar
http://map-me.org/sites/Tourism
http://map-me.org/sites/wouter
http://map-me.org/sites/solarfv
http://map-me.org/sites/WURfiets
http://map-me.org/sites/jfdkl
http://map-me.org/sites/thankyou.php

A selection of the **Story Maps** results:

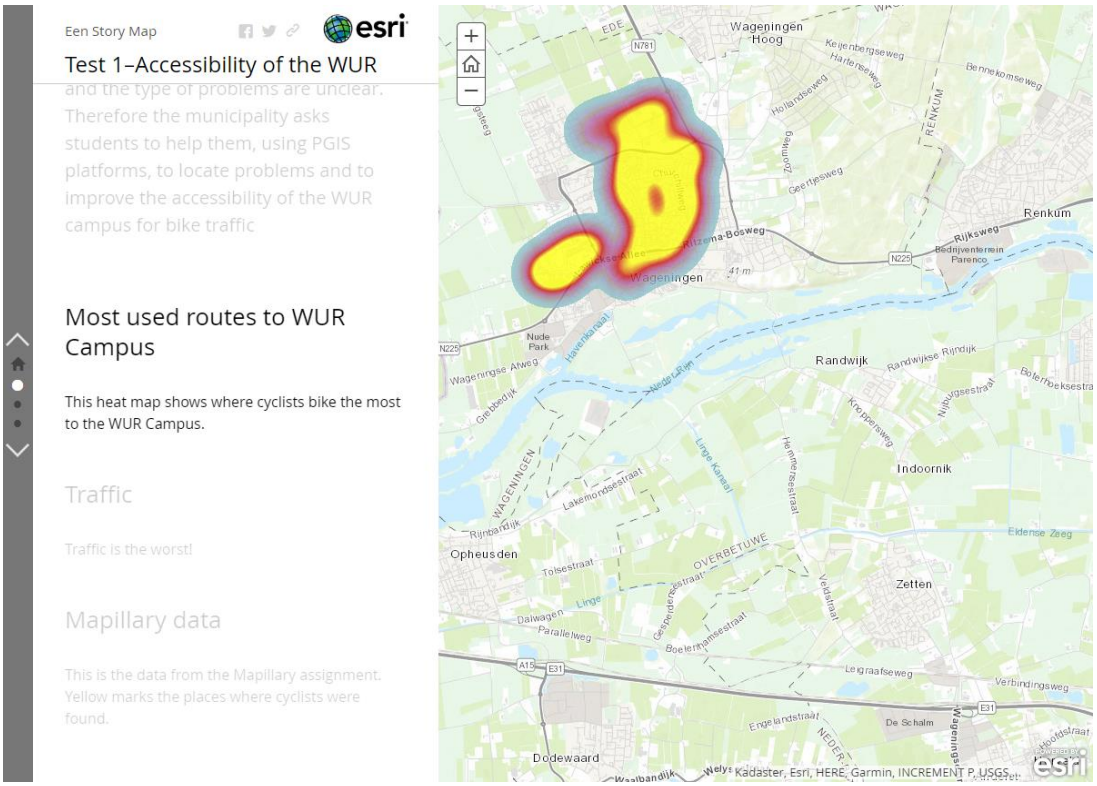


By students Jeroen and Louden

.

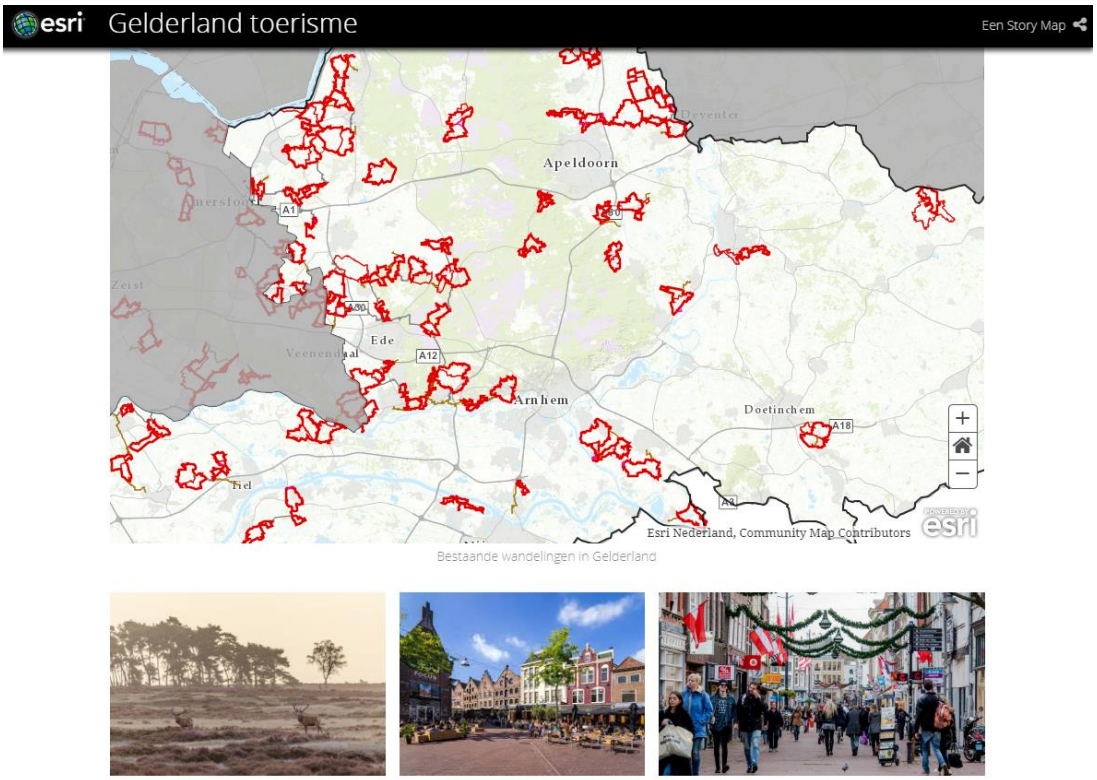


By students Rosa and Thamar

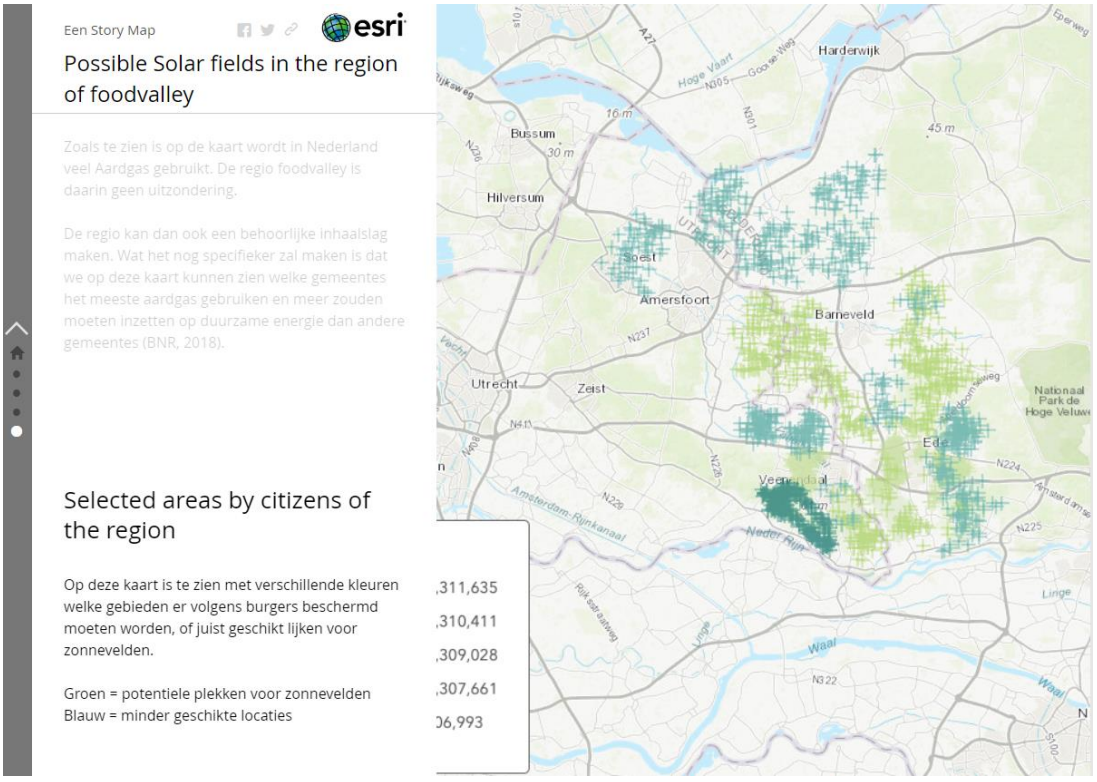


By student Kalle

.

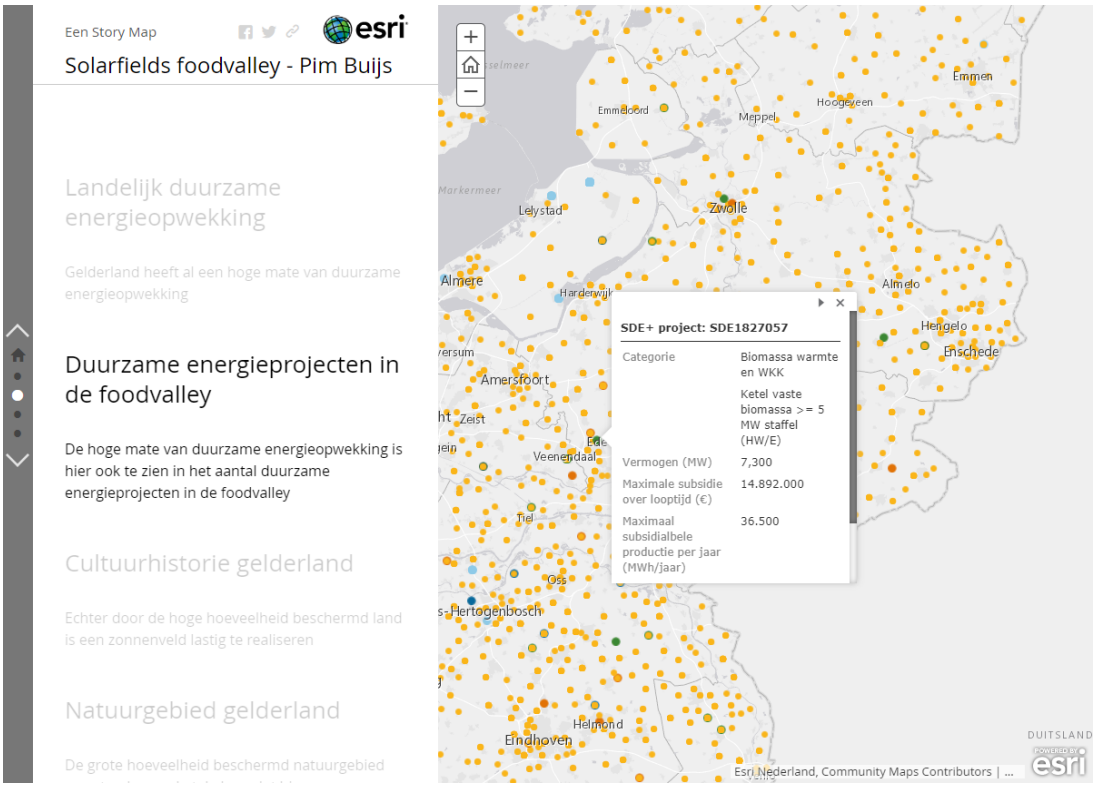


By student Rosanne



By student Sven

.



By student Pim

Story Maps URL's

https://wur-girs.maps.arcgis.com/apps/Shortlist/index.html?appid=1178a1b3e1844225a9d03dbfda1af83c

https://wur-girs.maps.arcgis.com/apps/MapJournal/index.html?appid=0c114185cafe44b582654c2ca45f97b2

https://wur-girs.maps.arcgis.com/apps/MapJournal/index.html?appid=18703b1af9b04226bb329c7bb25ec583

https://wur-girs.maps.arcgis.com/apps/MapTour/index.html?appid=812d18b7a041405d9fa4e52ec173ebd8

https://wur-girs.maps.arcgis.com/apps/MapJournal/index.html?appid=d2e0dda758fe4a1f9efe58279feb29ed

https://wur-girs.maps.arcgis.com/apps/MapJournal/index.html?appid=6cbe1d69a1d64a1b9f52a1fe0a54e85c

https://wur-girs.maps.arcgis.com/apps/StoryMapBasic/index.html?appid=d23d1b6ef0b4499a9c23d96163685d1e

https://wur-girs.maps.arcgis.com/apps/Cascade/index.html?appid=2c0bb0c97dfc4f20bd8446d7d1023605

https://wur-girs.maps.arcgis.com/apps/Cascade/index.html?appid=d55d31667a6d4952ad6d97fae6fde453

https://wur-girs.maps.arcgis.com/apps/MapJournal/index.html?appid=7c3e735824594126953fcec4ba8bea8d

https://wur-girs.maps.arcgis.com/apps/MapJournal/index.html?appid=6cbe1d69a1d64a1b9f52a1fe0a54e85c