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VISUALISING OUTDOOR ENVIRONMENT FROM THE PERSPECTIVES OF CHILDREN AND TEACHERS

KERSTIN NORDIN

Abstract

This study forms part of a Swedish research project aiming to design a method ("Children's Maps in GIS") for consulting children and teachers on children's outdoor environment to inform actors in urban planning processes in a local authority. Following up on consultation projects at four local authorities in Sweden, users of the method identified problems with communicating the results to the heterogeneous group of actors in urban planning dealing with children's outdoor environment. One constraint was lack of examples demonstrating how non-cartographic information in a database can be analysed and visualised.

This study provides such an example based on information from the municipality of Västerås, Sweden, where 90 children aged 10–11 and six teachers were responding on a facilitated map questionnaire included in "Children's Maps in GIS". The results obtained were visualised and presented to and discussed with urban planners in Västerås.

Drawing on results from the meeting with the planners, theories on how children communicate experiences of place and the role of information in communicative planning practices a conceptual visualisation model where developed. The study indicates that the challenge is what to include in the guidelines to take responsibility for the entire communication process.

Keywords:
children's outdoor environment, visualisation, GIS, local authority, planning

Introduction

Spatial information visualised on maps plays an important role in spatial planning (Davoudi, 2011; van Herzele and van Woerkum, 2011; Healey, 2010). However, "the difficulties in quantifying and mapping social and cultural relations have led to their marginalisation in plan-making processes..." (Davoudi, 2011, p.434). These difficulties is also reported concerning communicating children's place experiences to decision makers in urban planning (Freeman and Vass, 2010; Cele, 2006; Chawla, et al., 2005; Kylin, 2004; Chawla, 2002). Maps drawn by children can provide a mean for planners to get some understanding of children's experiences of their neighbourhood. Especially when a planner can meet one child at a time and talk about the map (Freeman and Vass, 2010). However, in most urban planning processes, this is not an option as there are several actors participating and not just one planner. The actors have different roles in planning processes, being stakeholders, professionals with different kind of expertise, or politicians. Many of these have not first hand, everyday experiences of the local neighbourhood that is in focus for a planning intervention. They must rely on information from other sources, for example in maps.

In this study, we use information provided by children (10–11 years) and their teachers in a consultation project in the municipality of Västerås in Sweden to illustrate a model for how non-cartographic information could be visualised by using GIS (Geographic Information System). The local administration carried out the consultation as part of a redevelopment project in a suburban neighbourhood in Sweden. Children provided information about how they use and experience the outdoor environment in their leisure time. Teachers provided information about how they used the outdoor environment in teaching and for recreational purposes during the school day. A digital map questionnaire was being used for the consultation, which was carried out in school, during school hours. A facilitator helped children and teachers if asked to. Teachers use the outdoor environment in teaching and for recreational purposes during the school day. Many of the actors in urban planning processes have not first hand, everyday experiences of the local neighbourhood. They adhere to different departments and have different roles in planning processes, being professionals or politicians. How the outdoor environment is visualised contributes to the conception of the outdoor environment. For example, if maps only show playgrounds it is easy to forget that the local square, the wood and even the parking lot is part of children's everyday environment.

GIS packages offer sophisticated tools for displaying and visualising spatial information and associated data such as texts, numbers and photos. However, qualitative, non-cartographic data built on personal experiences and meanings attached to places are still new in GIS (Rantanen and Kahila, 2009; Pavlovskaya, 2006). There are no *technical* obstacles

using GIS software for storing, analysing and visualising qualitative and quantitative spatial data (Elwood and Cope, 2009; Pavlovskaya, 2009). However, an obstacle can be the *construction* of GIS as a quantitative method (Pavlovskaya, 2009; Elwood and Cope, 2009). Examples on how non-cartographic data can be handled in GIS are needed to extend the GIS repertoire (Elwood and Cope, 2009).

The following questions were guiding the study: 1. What data is relevant to visualise from the perspective of children and teachers as well as actors in urban planning processes? 2. How can sketches and texts, drawing on local experiences concerning children's outdoor environment, be visualised? 3. How can these data be combined with other kind of data to present new aspects on children's outdoor environment? The result of the study is a developed conceptual model for visualisation as a point of departure for further studies.

In the section *Points of departure*, the theoretical perspectives framing the study is discussed. Then follows a description of the location and context of a consultation project that produced data used for the study reported on in this paper. The *Method* section describes the design approach applied in the study. The section *Result* demonstrates examples of visualisations leading to a conceptual model for visualising different aspects of the outdoor environment from the perspectives of children and teachers. The paper ends with a discussion and reflections on the conceptual model as well as further research.

Points of departure

This study is part of a research project aiming to design a method, "Children's Maps in GIS (CMGIS)". The target group for using the method are actors in urban planning at the local administration who wants to consult children (aged 10–18 years) and their teachers about children's local outdoor environment. The method consists of a map questionnaire in a GIS-application. The questions are addressing physical as well as social aspects in the outdoor environment. At the time of the present study, four different local authorities in Sweden had used CMGIS in consultation projects. When reviewing these projects, the project leaders stated that the results from the consultations were relevant within their own project. However, they were concerned about the difficulties in communicating the results of the consultation to actors in other departments (Trafikverket, 2013; Nordin and Berglund, 2010).

In this paper, the term "actors in urban planning" includes spatial planners as well as planners at social departments and planners of management and maintenance of open space. Other actors could be politicians and other decision makers having an influence on children's outdoor environment. Some of these actors have access to GIS, others not. To

communicate the results to all kinds of different actors in urban planning concerned with children's outdoor environment, the raw data in a geographic database need to be visualised by someone having access to, and some basic skills in, GIS.

In Figure 1, we outline the communication process supported by the CMGIS method. In the study reported on here, attention is paid to the task of the *GIS-user* in the middle of the communication process. The aim is to formulate a conceptual model to guide the *GIS-user* in visualising the local perspectives of children's outdoor environment, in a way that can be relevant for different actors in an urban planning context.

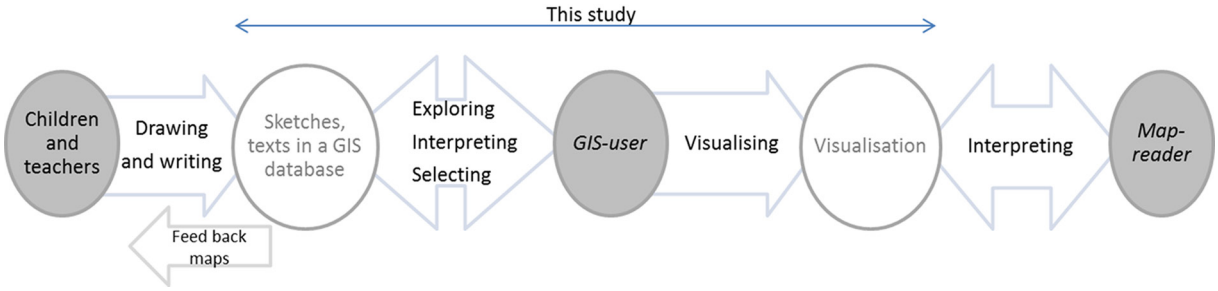


Figure 1
The communication process in CMGIS

GIS have been used in several community projects, within the frame of PPGIS (Public Participation GIS). The common idea is that local communities can use GIS to collect and visualise aspects and values that otherwise may be overlooked. Although most of the projects concerns community groups with adults, for example Dennis (2006) provide an example where young people use GIS to make their voice heard.

Engaging children in projects initiated by adults raises questions about the level of children's participation (Lansdown, 2010; Shier, 2001). Lansdown (2010) suggests that consultative participation could be relevant when it comes to urban planning. Children's consultative participation is in his description "where adults seek children's views to build knowledge and understanding of their lives and experiences" and "... it does recognise that children have expertise and perspectives which need to inform adult decision making" (Lansdown, 2010, p.20). The method CMGIS is designed to be used in consultation of children as well as teachers. To inform decision-making concerning children's outdoor environment, it is crucial that the information is collected and communicated in a way that is relevant for actors in urban planning processes.

The context of data collection, analysis and visualisation, as well as the process by which information is produced and agreed on is of great importance when considering whether information is going to have any influence on decisions and actions (van Herzele and van Woerkum, 2008; Innes, 1998). It has been suggested that people who are active in

producing information also are engaged in the objectives and can share the experience with others (Innes, 1998). It is supported from studies in planning practices that personal experiences count as relevant information in communicative planning processes (Davoudi, 2011; Nilsson, 2003; Innes, 1998). It gives rise to questions about who is engaged in collecting, analysing and visualising data. The idea behind formulating guidelines for visualising is that if an actor in urban planning processes produces the information, it may enhance the communication process and construction of knowledge within the administration.

As a frame of reference indicators formulated in the seminal project "Growing Up in Cities" (GUIC) (Chawla and Malone, 2003) was drawn upon. Chawla and Malone (2003) discuss the differences between adult defined indicators of urban quality and how young people (10–15 years old) themselves use and evaluate their cities. They note that there are strong similarities over time and in different locations for how young people evaluate their cities. Reported as qualities are when young people "…felt accepted by adults and safe to move about, meet friends and take part in a variety of activities" (ibid., p.121). When describing their neighbourhood in negative terms, young people put forward traffic, crime and littered open spaces (ibid., p.123). Other projects have reported similar results (Horelli, 1998; Woolley, et al., 1999). A point of departure for the visualisation model is that both qualities and problems from the perspective of children need to be put forward.

The map's scale, its focus and items direct the attention and frame the discussion, and thereby the outcome. How a map is interpreted and understood depends not only on what is in the map, but also on the intention and prior knowledge of the map-reader. The act of interpretation is also an act of knowledge construction (Innes, 1998). van Herzele and van Woerkum (2011) demonstrate that visualisation on maps enables but also limit how knowledge is socially created. A visualisation of the outdoor environment dividing the territory into different areas of jurisdiction (private, public), or visualising it as an entity with social and experiential aspects provides different maps, construct the conception of the outdoor environment differently.

Children's Tracks and soft GIS

When designing a new method like CMGIS, experiences from similar projects are most valuable in order to inform the design process. Of special interest in this study are two methods developed in a Nordic context using GIS for producing spatial information connected to local place experiences, "softGIS" in Finland (Kyttä, et al., 2013) and "Children's Tracks" in Norway (Norsk Form, 2010). The Finnish method "softGIS" aims to incorporate local knowledge into planning processes using map-based questionnaires delivered through the Internet to a statistical sample of households. A special application is adapted to children and young

people (Kyttä, et al., 2013; Rantanen and Kahila, 2009). Kyttä, et al. (2013) demonstrates how GIS can be used for spatial analysis and visualisations when having access to statistically valid data. In contrast, the Norwegian method "Children's Tracks" was developed in a practice-based context and aims to map children's interests in outdoor spaces to secure access in urban planning to areas for play and meeting friends. Children do the mapping during school-hours, responding individually to a questionnaire presented on a computer. A teacher, urban planner or other adult is present to facilitate the process (Norsk Form, 2010).

These two methods represent different strategies for producing and communicating information. Within the "softGIS" approach, researchers process the information obtained to produce facts. It is also possible for planners to process and interpret the information themselves. A "Development Forum" gives public access to the results through internet (Rantanen and Kahila, 2009). Within "Children's Tracks", the guidelines suggest that children and teachers discuss and analyse the results as a part of education in environmental or social sciences. The information obtained can also be used to inform planning practices (Norsk Form, 2010). However, how this can be done is not specified in the guidelines.

Children's Maps in GIS

The method CMGIS is designed to be used by practitioners in real planning projects, in consultation projects with children and teachers. The method CMGIS comprises the whole process from collecting to visualisation of information. Previous studies have focused on collecting information (Berglund, 2008; Berglund and Nordin, 2005; Berglund and Nordin, 2007) and on how CMGIS was used in a consultation project at a local administration (Nordin and Berglund, 2010). The study presented in this paper has focus on how to visualise GIS data.

Västerås was the second local authority in Sweden to use the method CMGIS for consulting children and teachers about children's outdoor environment. CMGIS was used in the context of a redevelopment project in the neighbourhood of Bäckby in 2010, and was initiated and carried out by the Parks Department and the Neighbourhood Administration of Bäckby with methodological support from the research team. A landscape architect from the Parks Department and a youth recreation leader from the Neighbourhood Administration were appointed as facilitators, meeting children and teachers. However, the redevelopment project was delayed and key persons within the consultation project were, for different reasons, not at hand when the redevelopment project started again in 2012.

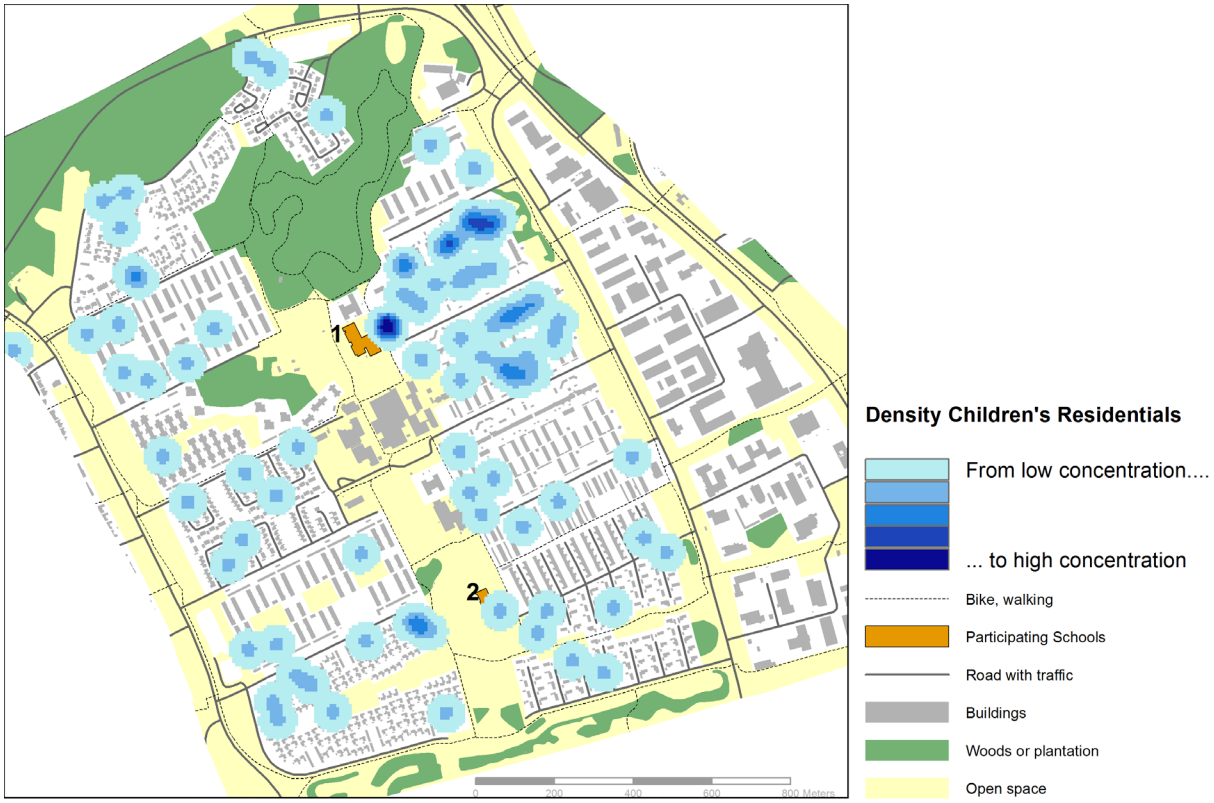


Figure 2
The Bäckby area in Västerås. Residences of participating children are visualised as concentration shades. The participating schools are marked 1 and 2 on the map.

Bäckby is a typical neighbourhood from the late 1960s (VästeråsStad, 2010) (Figure 2). The dense residential area in the north-eastern part consists of apartment blocks, with large, well-kept courtyards containing play equipment, grass, benches and tables. The rest of the area is mainly occupied by detached and semi-detached one-family houses with their own gardens and some small public playgrounds. In the central area, there are playgrounds, football fields, lawns and the two schools that participated in the consultation (sites 1, 2 in Figure 2). Commercial and public services are clustered around the local square. In the north, there are wooded areas, while larger wood-like plantations are situated in the south. A bus route traverses the green area near the square. In the eastern part, small-scale industries and retailers are located. Roads with quite heavy traffic surround the neighbourhood. The children's residences are located throughout the whole area, but with a concentration in the north-eastern part.

The consultation project in Bäckby, Västerås

School managers were informed and teachers were invited to let their classes take part in the consultation. Ninety children aged 10–11 years (school years 4 and 5 in Sweden) responded to the questions in Table 1, presented in a digital map-based questionnaire. Three teachers from each school participated, representing their school and not themselves. All children lived within the neighbourhood, but seven of them also lived outside the area for part of the time. Permission was obtained from the parents of all children participating in the consultation.

The consultation concerns physical as well as social aspects on the outdoor environment. The responses were in the form of sketches and texts. A sketch is a point, line or polygon that is drawn directly on the map by using a sketch-tool included in the GIS software. The digital backdrop map showed an orthographic photo with some cartographical features highlighted, such as buildings and roads, with the school in centre of the screen. Inputs were made on a scale from 1:1000 to 1:10 000. When a sketch was made, some text information could voluntarily be added. On questions C2–C4 some suggestions were given (checkboxes) in the questionnaire, but there was also an opportunity to write a freely formulated text. To questions C5–C7, there were no pre-formulated responses given, one can respond by just writing a text of one's own. The questionnaire was intended to obtain local information about use, experiences and suggestions. Two facilitators from the local administration introduced the map-questionnaire to each child and, when asked, helped with technical support, orientation or writing.

Table 1 gives an overview of the questions in the questionnaire, numbered from C1 to C7 (questions to children), and T1 to T5 (questions to teachers). There was an opportunity to respond to each question several times. For example, in question C3 there were 187 lines drawn on the map, indicating routes used in leisure time. It was possible to choose one or several checkboxes with pre-formulated texts and to write free text. Question C1 is included in the questionnaire to enhance orientation and the sketches are not supposed to be shown on any map.

Table 1
Overview of the questionnaire used in the consultation. Questions addressed to children are numbered C1–C7 and questions addressed to teachers T1–T5. These numbers are used throughout the remaining text to identify questions.

Question	Number of responses	Spatial data Associated data
C1 Where do you live?	90 responses	Point, not visualised on maps No text
C2 What routes do you use to school?	119 responses	Line Check boxes and free text
C3 What routes do you use in leisure time?	187 responses	
C4 What areas do you use outdoors?	160 responses	Polygon Check boxes and free text
C5 Are there any dangerous or unpleasant places?	79 responses	Point Free text
C6 Do you have a favourite place?	136 responses	
C7 Do you have any suggestions for improvements?	91 responses	
T1 What areas are used in teaching?	14 responses	Polygon Check boxes and free text
T2 What routes are used during school hours?	20 responses	Line Check boxes and free text
T3 Are there any dangerous or unpleasant places?	14 responses	Point Free text
T4 Has the school any favourite places?	19 responses	
T5 Suggestions for improvements?	20 responses	

The responses consist of spatial features (point, lines and polygons) as well as associated information (Table 2). Each sketch *indicates* a position, rather than *specifying* the exact location. According to earlier studies, the indications are good enough for planning purposes (Berglund, 2008). There are four kinds of associated information:

1) Information about the respondents (Respond, School, Grade, Sex)
2) Pre-formulated texts in checkboxes (CheckboxNo, CheckboxText)
3) Free text written by the respondents themselves (FreeText)
4) Automatically generated data (Area)

The data was stored in a geographical database for subsequent analysis, and distributed to one of the facilitators as shape files (ESRI ArcMap™ GIS 9.2). Maps, one per question, showing the sketches, were distributed to children and teachers as feedback on their participation.

Table 2
The associated information is represented in a table. The example is showing raw data associated to question C4. Translation of CheckboxText: 10 Play ice hockey, bandy; 1 Play, play ball; 0 Meet friends; 11 Do something else. Translation of FreeText: Talk. The column "Respond" contains a randomly generated id-number, e.g. 973682 have provided 3 responses.

School ID	Grade	Respond ID	Sex	Checkbox No	Checkbox Text	Free Text	Area kvm
20	5a	989335	M	,,,,,,,,,,10,,,	Spela hockey, bandy		552,26
20	4a	973682	K	,,0,,,,,,,,,,,	Träffa kompisar		3123,63
20	4a	973682	K	,,0,,,,,,,,,,,	Träffa kompisar		5368,06
20	4a	973682	K	,,,,,,,,,,11,,	Göra något annat	Prata	3470,19
20	4a	944956	M	,,0,,1,,,,,,,,,	Träffa kompisar, leka, spela boll		1402,09
20	4a	944956	M	,,,1,,,,,,,,,	Leka, spela boll		4006,55
22	5c	978169	K	,,0,,,,,,,,,,,	Träffa kompisar		22,35
22	5c	978169	K	,,,1,,,,,,,,,	Leka, spela boll		357,03
22	5c	978169	K	,,,1,,,,,,,,,	Leka, spela boll		9,33
22	4c	984396	K	,,0,,,,,,,,,,,	Träffa kompisar		310,11
22	4c	984396	K	,,,1,,,,,,,,,	Leka, spela boll		1047,44
22	4c	959647	M	,,0,,1,,,,,,,,,	Träffa kompisar, leka, spela boll		758,64

Methods used in this study

The result from the consultation project in Bäckby, Västerås was chosen as a suitable set of data to use for elaboration in this study. The size of the studied population as well as the interests from planners to take part in the results was two relevant selection criteria.

In this study, design is employed as a research strategy. A design process can be described as a conversation-like iteration between possibilities and constraints in formulating a possible solution. It is a suitable strategy in research looking for solutions on ill-defined problems, not just intending to describe a situation. One result of a design process is an artefact (Zimmerman, Stolterman and Forlizzi, 2010; Lawson, 2005; Schön, 1983), and when applied as a research strategy, one outcome is also conceptual knowledge (Zimmerman, Stolterman and Forlizzi, 2010). In this study, the aim is to formulate a conceptual model for visualisation that eventually can be tested, modified and included in the CMGIS-guidelines. The study is framed by the intention that the guidelines are intended to address a person that is familiar with GIS, a GIS-user; however, the GIS-user is not necessarily the actual user of the information (see Figure 1). The GIS-user is supposed to produce visualisations that are addressing a heterogeneous group of actors in planning processes that are interested in children's outdoor environment, but for one reason or the other, not having access to GIS.

Procedures

The study is comprised of two main steps:

1) Heuristic elaboration of different modes of making spatial analysis and visualisations
2) Meetings with planners to get input on what to include in the visualisation model from the perspective of actors in urban planning processes

Literature studies and reflections on the outcomes of the elaboration as well as the meetings were carried out throughout the study.

1) Heuristic elaboration

The elaboration of the data from the consultation was iteration between data from the consultation, the aim of making children's outdoor environment visible, the understanding of the situation and using available tools in a common GIS-package.

Questions guiding the iteration were: 1) what is relevant to visualise from the perspective of children and teachers as well as actors in urban planning processes, 2) how can sketches and texts be visualised, and 3) how can these data be combined with other kind of data to present different aspects on children's outdoor environment?

To analyse text responses, a combination of different information processing activities such as data selection, categorisation, generalisation and counting were applied in a heuristic process (Miles and Huberman, 1994). For spatial analyses, we used tools like Merge, Select by Location, Select by Attribute, Kernel Density and Line Density (ESRI ArcView 9.x and ArcView 10.1). These or similar tools are part of toolkits which is in general often used in GIS packages.

2) Meetings with urban planners in Västerås

During spring 2012, meetings at the Västerås City Council were held in order to receive input on the design process from different groups of planners. Three separate meetings were held, with employees at the Urban Planning Department, the Parks Department, and the Social Services Department respectively. The meeting with the Urban Planning Department raised the most relevant issues regarding visualisation of local information, and the reporting below concentrates on that meeting. Eight people from the Urban Planning Department and two from the reference group in the redevelopment project in Bäckby participated in the meeting, which took place at the Planning Department at one of their regular meetings. Most of the participants were urban planners working with development projects in different parts of Västerås, but two of the participants also had experience of working with child issues. The meeting was audio-recorded and complemented with some written questions to the participants about GIS skills and individual opinions about different

modes of visualisation. The audio recording was then transcribed and analysed, using categorisation of issues raised by the participants during the meeting.

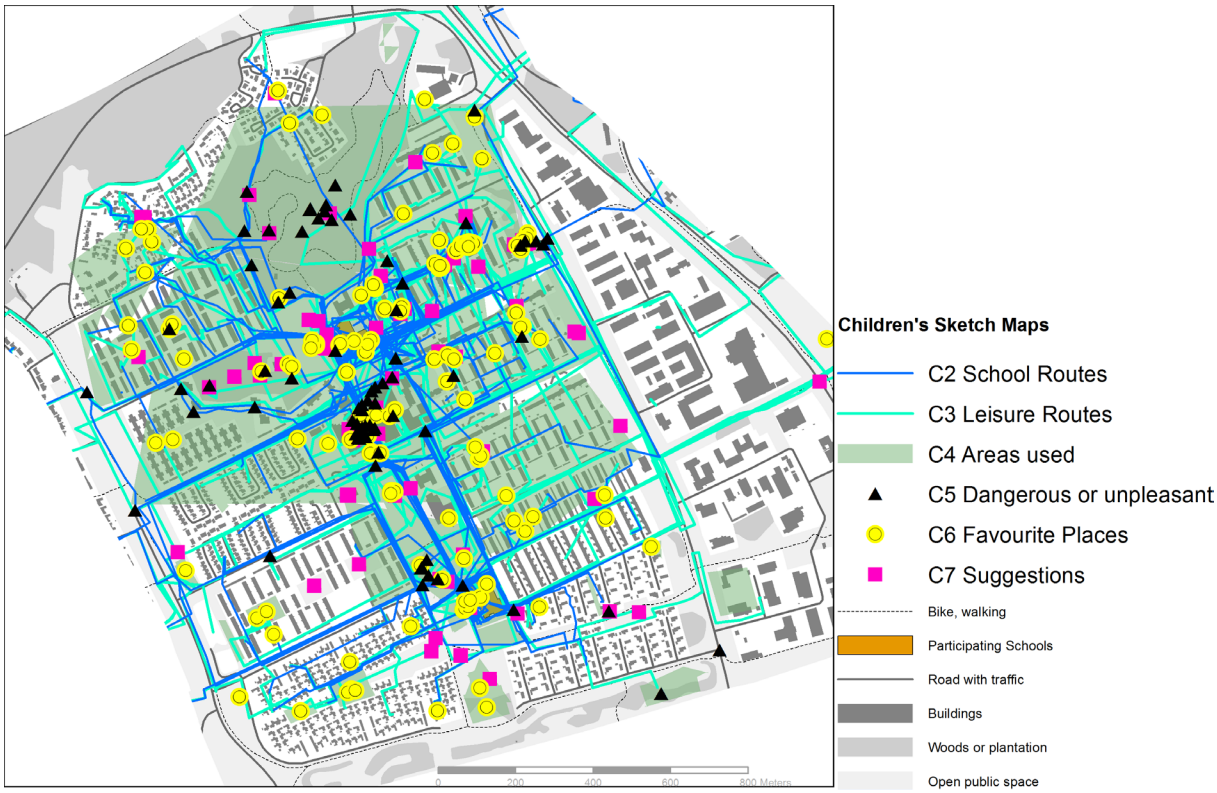
A set of visualisations were presented on the meetings and the participants were asked to comment on the content of the maps as well as the relevance of different modes of visualisations.

Result – a visualisation model develops

In the following paragraphs, we discuss some examples of visualisations presented on the meeting at the Urban Planning Department. We provide some comments from the meeting to illustrate the input from the participants and the process that led to the conceptual model for visualisation presented at the end of this section.

If all spatial information – provided as sketches from the consultation with children – is shown in one map, the result is as shown in Figure 3. The data in the map is not easy to read and it is only showing the spatial part of the responses.

Figure 3
Sketch map visualising all sketches produced by children consulted in Bäckby.



Initially, two strategies for visualisation were applied when preparing maps for the meetings with the planners:

1) Describing responses thematically
2) Analysing spatial relations

1. Describing responses thematically

One way of describing the result from a consultation could be to visualise the responses thematically. The data makes it possible to make an almost overwhelming number of visualisations. During the study, responses where visualised thematically according to the questions in the questionnaire, school-affiliation, age and sex. The strategy chosen for the meeting was to visualise the responses on each question on separate maps, in order to present the data in a clear way. Other possibilities for presenting the data were mentioned orally. Despite the theme for a map, it could be visualised as sketches or give a more generalised picture of the responses.

Sketches or generalisations

In Figure 4, the upper map shows the original sketches (points) in response to question C6, "Favourite places". Some of the points are placed on top of each other, which makes it difficult to identify places visually with high concentration. The same problem concerns identifying routes, or parts of routes, that are sketched in several responses.

In this study, places and routes indicated by many sketches were identified by using two tools for spatial analysis provided in a standard GIS package: Kernel Density and Line Density (ESRI Arc Map 10.1). Both tools are easy to use and provide a raster with smooth transitions between classes (ESRI ArcGIS 10.1). The lower map in Figure 4 shows the result of applying the Kernel Density tool to point sketches. The highest concentrations are visualised with the most intense red hue and it gets less intense as the sketches are more scattered. The Kernel Density has been used to visualise results from community mapping or PPGIS-projects (Wridt, 2010; Brown and Reed, 2012; Thompson, et al., 2011).

The parameters used for rasterizations were intended to reflect the accuracy of the sketches. The parameters were the same for all rasterizations (cell size 8 m, search radius 50 m). The Equal Interval option with 9 classes (0-values excluded) was used for classification, with the lowest class made invisible. Line sketches were rasterised using the Line Density tool. The parameters were the same as above (cell size 8 m, search radius 50 m). These parameters were heuristically defined. So far, it has not been tested if these parameters are appropriate in other contexts.

One question to the participants concerned the relevance of sketch maps and/or generalisations as density calculations. In response to this question, the following reasoning occurred:

A: I absolutely think the density maps are good. They are so clear. The interpretation is already done. Otherwise, you have to do the interpretation yourself and then maybe…

B: But you can't see 100% what children themselves have drawn…

Some minutes later, A returned to the issue:

A: I am thinking about what is relevant in planning processes. We have an assignment to make a programme for Bäckby and we are at the scale of a neighbourhood. It has to be generalisations. Then you cannot consider every point. … What will the politicians go for? It must be a very clear message.

The spatial visualisations, both sketches and density maps, seemed to be relevant in order to start a discussion. Sketches, although messy, communicated what children themselves had drawn. On the other hand, the density maps produced a simplified and clearer picture.

Figure 4
Different visualisations of the same data, the response to question C6, "Favourite places". Upper map: Sketch map. Lower map: Rasterised version of the same area created using the Kernel Density tool (ESRI Arc Map 10.1).

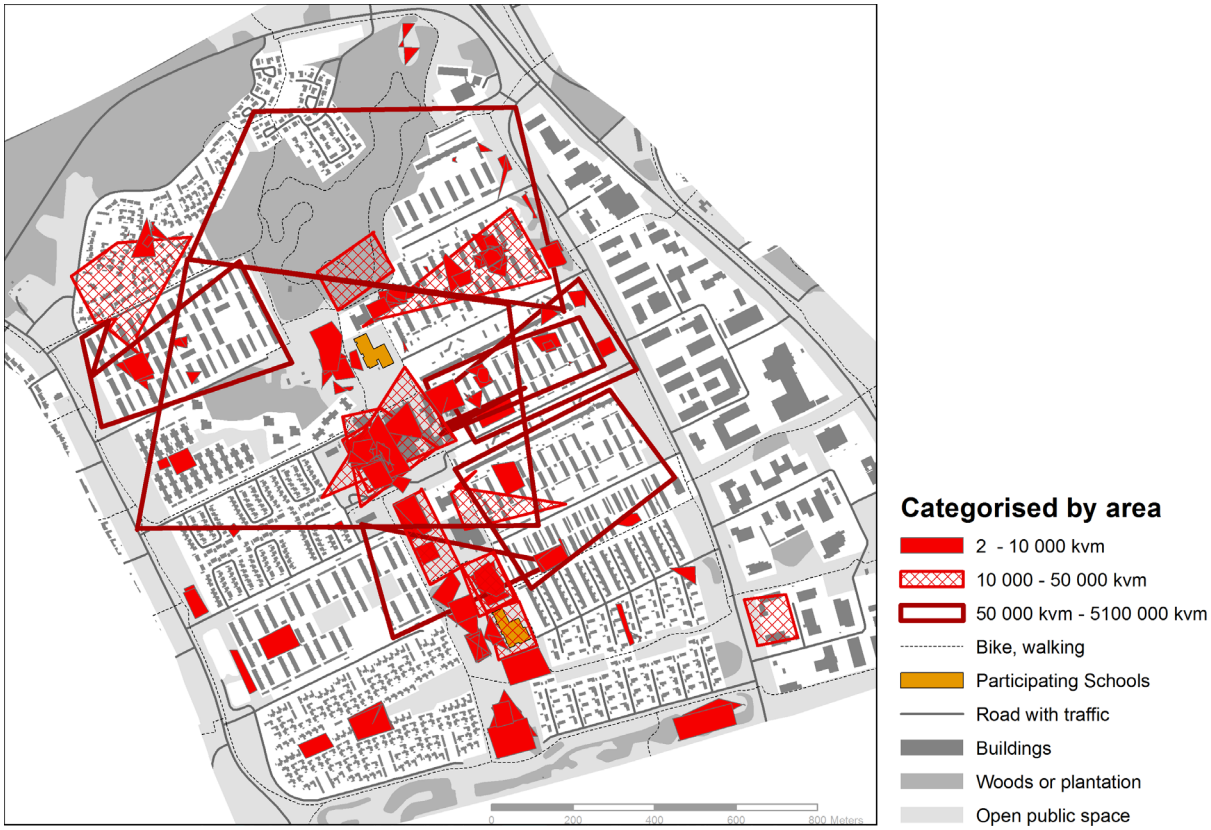


Figure 5
Sketches in responses to question C4, "Areas used".
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Another approach was taken concerning the visualisation of polygons. The responses were interpreted as representing both small, very precise places and territories for roaming around. The main challenge was to balance the visual impression between large and small areas. The larger areas covered several smaller areas and attracted attention. To equalise the visual impact, the tool Graduated colours were used to visualise different sizes of the polygons (Figure 6). The categories where heuristically chosen as being relevant in this case.

Visualising information about the respondents

Information about the respondents concerned children's school affiliation, school year and sex, while only school affiliation was recorded for the teachers. For example, sketches showing routes used in leisure time (question C3 in Table 1) could be selected according to sex in order to visualise routes used by boys and girls respectively. Some argued that this was the most relevant as there are national and local political initiatives asking for information presented according to sex (SCB, 2004). However, age and school-affiliation also seemed relevant.

The conclusion from the meeting with the planners was that there were different opinions about what information to include in a visualisation model about the respondents.

Counting responses

One way of making the text associated with the sketches visible was by counting the numbers of checkbox alternatives chosen and presenting the results in a chart (Figure 6). Such a chart proved to be most useful when visualising the responses to question C4, "Areas used". The example in Figure 6 shows a number of children that checked "Meet friends", "Play", "Athletes, Sport" or/and "Something else" as additional information to the sketch. School affiliation was chosen as a sub-category in this example. It could have been sex or age instead. The category "Something else" consisted of responses formulated as free text concerning different issues.

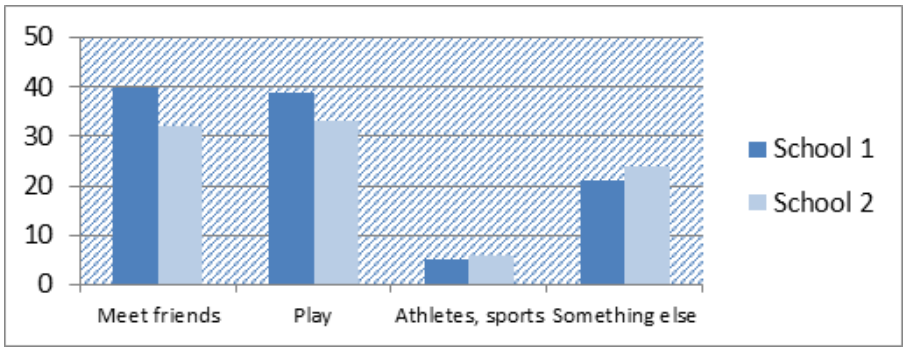


Figure 6
Chart showing numbers of checkbox responses to question C4, "Areas used" (see Table 1) provided by children from each school.

The chart offered a way of visualising that appealed to some of the planners. They asked for more comparisons between different areas and investigations to better understand what this chart indicated.

Labelling or categorisation of freely formulated texts

Associated to the spatial responses to question C5, "Dangerous places", C6, "Favourite places", and C7, "Suggestions" where freely formulated texts. If all texts were put on the map, the map was "talking" and communicated a broad spectrum of issues. Just labelling the freely formulated text on the maps seemed to be useful as a way of communicating the voice of the children, but did not address a specific actor or a responsible department.

2. Analysing spatial relations

However, focusing on one question at a time provides a fragmented view of the outdoor environment, whereas by relating responses to two questions to each other, new aspects may emerge. From a child's perspective it seemed important to put forward responses concerning C3, "Leisure routes". This question got most responses (see Table 1). One way of doing this was to compare with the responses on C2, "School-routes". By putting them side by side and look at the maps in question, one can compare them visually (see Figure 7).

Figure 7
Relation between school-routes and leisure routes. Line density maps visualising responses to (left) question C2, "School routes" and (right) question C3, "Leisure routes".

There are special national initiatives for mapping children's school routes (Trafikverket, 2013), but the routes used in leisure time is less well known. Putting the responses in relation to each other could put some light to the whole issue of children's free movement in a neighbourhood. This is just one example of many more possible analyses, more or less relevant in different planning situations.

By combining the responses from the questionnaire with other available sources of information, new aspects can be visualised, a strategy used by Rantanen and Kahila (2009) and Brown and Reed (2012). In this study, the strategy was used when visualising the distribution of responses to question C5, "Dangerous or unpleasant places" on public areas and private areas (Lantmäteriet GSD, Property Map). The map in Figure 8 shows that the local squares as well as the wood, both public areas, have a concentration of marks. On the other hand, showing responses on C6, "Favourite places", areas on private land are highlighted.

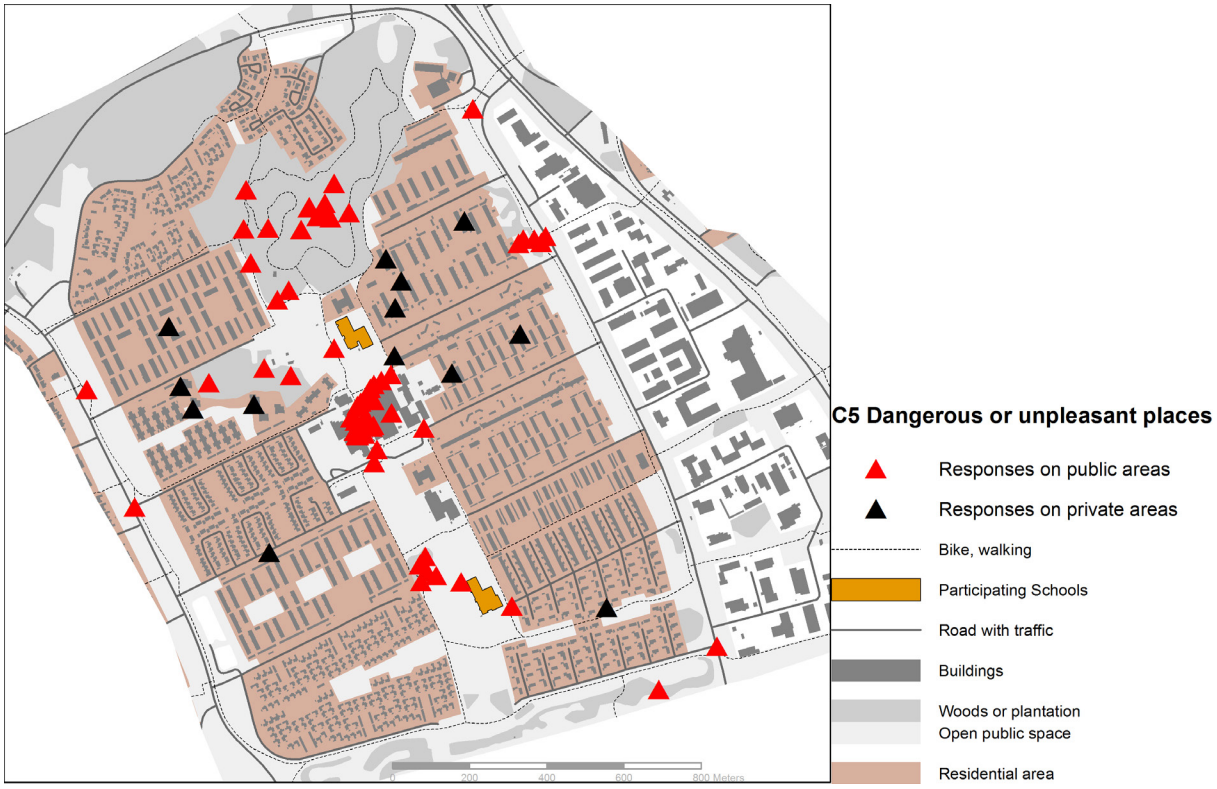


Figure 8
Distribution of responses to question C5, "Dangerous or unpleasant places". Red dots indicate responses located on public areas and black triangles indicate responses located on private areas.

Spatial relations between the response and for example the green-structure plan or a plan proposal could present interesting results.

Observations from the meeting

Most of the results seemed to be in line with what the participants of the meeting expected. The most surprising result and the most discussed issue concerned Bäckby Wood. One of the participants commented that the visualisation of C3, "Leisure Rotes" (Figure 7) did not have any responses in the Bäckby Wood, but that the wood had several inputs concerning C7, "Dangerous and unpleasant places" (see Figure 9). This started a discussion on how to make sense of this observation.

A: I must say I think it is awful that they use the wood so little.
Me: What is the reason?
A: Well, we think it is a great resource, but they think it is a dangerous place. Where does it go wrong? How can you re-design the wood in a way that it will become a resource?
B: Precisely. Västerås is structured according to the neighbourhood woods. We have built on the fields in order to spare the woods. It has been a planning doctrine for the whole city.
C: For whom are we saving the woods? Not for these children.

A: I mean, as I remember it, there is a lot of spruce and pine. Maybe one should take away some, to make it more transparent and lighter… You have to give it some thought.

C: They do not show that they have any suggestions either. They are not interested in making it better.

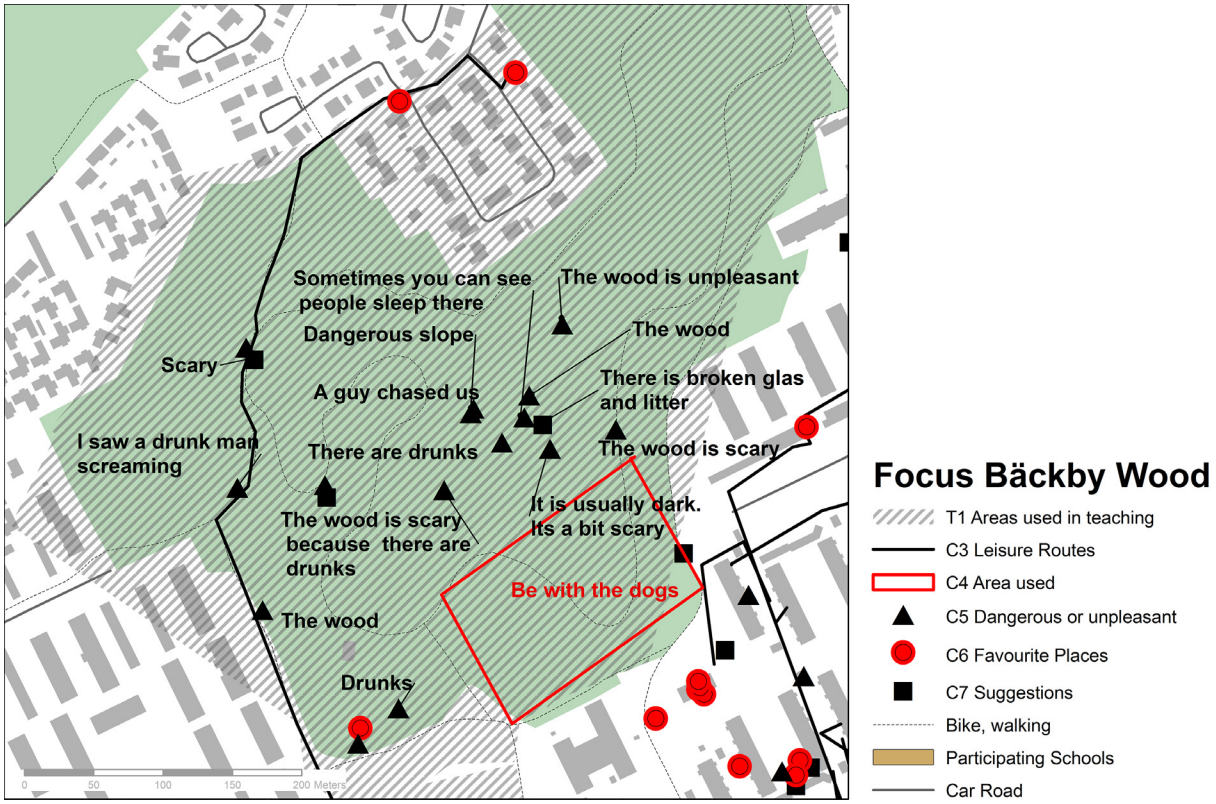
As this conversation indicates, the visualisations can be interpreted in several ways. Participant A suggested actions to make the wood more attractive for children, participant B was worried about the relevance of planning doctrine and participant C interpreted the results as the wood having no value for children. The dialogue reported above indicates the importance of visualising different aspects and to let people meet, interpret and make sense of the information together in order to avoid interpretations from just one perspective, or with just one intention.

Another observation was that the strengths in the outdoor environment were not clearly communicated in the visualisations presented at the meeting. Experiences from all local projects in Sweden using CMGIS indicate that children put most effort into informing about perceived good qualities of their neighbourhood. On the other hand, planners and managers tend to focus on problems – issues that need to be acted upon (Nordin and Berglund, 2010). What seemed to be lacking was a synthesis, a comprehensive overview of the qualities as well as problems reported on in the responses. These observations were relevant in the design of the conceptual model.

3. Synthesis

In the following, synthesis on two different scales are illustrated. "Focus" provide an opportunity to visualise all responses for a special place, like the Bäckby Wood (Figure 9). On the other hand, "Strengths and Weaknesses" provide an overview of the whole investigation area, but in a more generalised way (Figure 10).

Focus



When focusing on an area of special interest, both sketches and texts can be visualised in one map. This provides a more holistic view of the responses than focusing on one question at a time.

Figure 9
Example of focus map showing sketches and texts concerning Bäckby wood.

Strengths and weaknesses

One way to be explicit about strengths and weaknesses in children's outdoor environment is to categorise and visualise the responses on two maps, as shown in Figure 10. These maps were also an attempt to provide the overview and "easy message" requested in the meeting with the Urban Planning Department in Västerås.

Figure 10
Example of a comprehensive synthesis, showing an overview of strengths and weaknesses in the outdoor environment from the perspective of children and teachers.

What should be considered strengths and weaknesses in children's outdoor environment is debatable. In this study, indicators of strengths and weaknesses are drawing on indicators presented by Chawla and Malone (2003). In the present case, strengths in the outdoor environment were related to children's free movements (question C3), areas used mostly for meeting friends and play (question C4) and favourite places (question C6). Other strengths are areas and routes used for teaching (question T1 and T2) and favourite places (question T4) indicated by teachers. In this study, school-routes (question C2) is not included in the visualisations, as routes used in leisure time (question C2) are indicating the possibility to move around in an area. Weaknesses in the outdoor environment were indicated by the responses to questions concerning dangerous and unpleasant places (question C5, T3), and suggestions for improvements (question C7, T5).

A conceptual visualisation model

To summarise, the conceptual model consists of three main strategies as described below.

1) Describing responses thematically
   a) Spatial information as sketches as well as generalisations
   b) Associated text information as labels (free texts) and charts (number of responses with pre-formulated texts)
2) Analysing spatial relations
   a) Between responses within the dataset

   b) Between responses from a CMGIS consultation and other (formal) data
3) Making synthesis
   a) Focus on one area of special interest
   b) Comprehensive overview indicating strengths and weaknesses in children's outdoor environment

In the next section, the visualisation model is discussed in relation to the perspectives of children, teachers and actors in urban planning processes.

Discussion and reflection

The developed visualisation model shows how multiple aspects of an outdoor environment can be visualised from the perspectives of children, teachers and planners respectively. The consultation project in Västerås offered an opportunity to meet planners in their own working environment and present information from their own municipal area. This trans-disciplinary approach contributed to the design of the visualisation model. By participating and at the same time making observations, engagement by the participants in issues concerning children's outdoor environment was noted, and how the same visualisation could be interpreted in different ways. If the engagement was due to the presence of an outsider (and researcher), chairing the meeting could not be determined. How, and if, these visualisations are informing decision making in line with the responses is a question for further research. In this study, the researcher prepared the visualisations. However, there is a need for investigating whether the proposed procedures fulfil the ambition to be easy to use in the context of a local authority.

This study focused on communication with planners at the local authority. However, one important actor as regards children's outdoor environment is the body responsible for planning and management of private areas, especially areas managed by housing companies. By visualising the distribution of responses on public and private areas as illustrated in Figure 9, this could be made explicit and opened up for a discussion.

The developed model suggests a set of complementary visualisations; they are all needed in order to catch some of the multiple aspects of children's outdoor environment as put forward in the questionnaire. Just visualising the comprehensive synthesis make the connection to the local experiences disappear. Some thematic maps and one or two spatial analyses complement the overview. However, there are at least two problems with this approach. One is that there is a risk of producing too many maps for an actor in urban planning to embrace. The other problem is the issue about the shared responsibility between the designer of the method and the user of the method for putting forward a child-perspective.

The critical issue is how the responses are going to be interpreted by different actors in urban planning processes. Comments from the meeting with the planners put forward the risk that the responses can be interpreted in a way that is harmful to local perspectives. Different interpretations can be made from the same visualisation, as indicated in the dialogue about Bäckby wood. If the intention is to interpret the map to find areas for new buildings, the Bäckby Wood may be seen as an area for new building projects, although it is used for teaching according to responses from the teachers. Allowing multiple interpretations to be openly discussed might be a strategy to embed information in practice (Chawla, et al., 2005; Innes, 1998; van Herzele and van Woerkum, 2011).

The GIS-user (see Figure 1) is a key-person as mediator between the database and the map-reader. The knowledge of the GIS-user concerning the context and his or her intention for conducting the visualisation is framing what information is produced in this stage of the communication process. If the GIS-user is a facilitator or the project-leader, one can presume that the child-perspective guide the choices made during the analysis and visualisation process.

A criticism of the process of consulting children and then making "off-site" analysis and visualisations is that children and teachers are not given the opportunity to make their interpretation and share it with e.g. planners. One challenge with that approach is that planners at different departments plan the outdoor environment. Another challenge is the time constraints that are limiting the possibilities for planners to take part in time-consuming activities.

The approaches mentioned above do not necessarily need to conflict with each other. In a planning process, they could be used in different stages as being more or less appropriate and relevant when informing planners in different contexts about children's outdoor environment.

Conclusion

The aim was to design visualisation modules that were possible to manage with some GIS skills and with a standard GIS package available in a local authority. The model developed in this study uses a combination of easy-to-use tools provided in a standard GIS package to visualise quantitative and qualitative data. The study indicates the importance of giving planners a possibility to interpret the results in relation to their own context and in discussion with others. However, further studies are needed in order to test the model in practice and to follow up on how or if the information is used in decision-making.

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