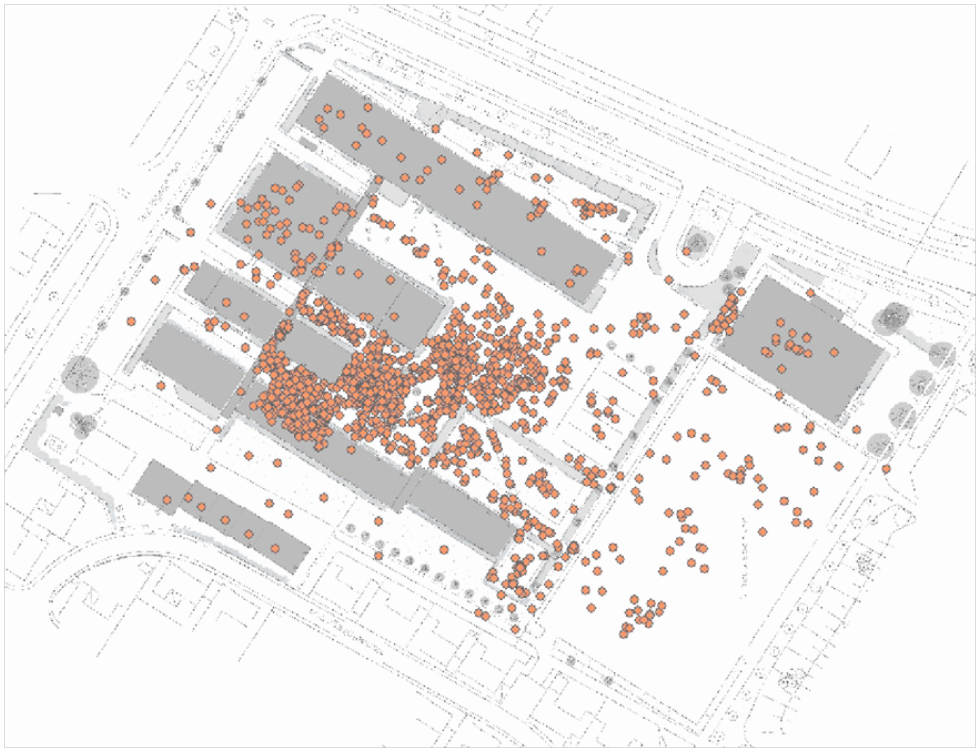
RAPPORT

Movium Partnerskap



Greening school grounds to promote children´s play and development

Fredrika Mårtensson and Mark Wales

Fakta om rapporten

Movium Partnerskap-projektet Skolgårdsintervention (124 14) som här avrapporteras syftade till att dokumentera effekterna på barns lek och utveckling av att göra skolgårdar grönare. De preliminära resultaten bygger på tidigare forskning som bedrivits inom ramen för Movium Partnerskap-projektet Skolgårdsutveckling (I och II) som bedrivits i samarbete med forskare runt om i Sverige med institutionen för arbetsvetenskap, ekonomi och miljöpsykologi vid SLU i Alnarp som bas.

Movium Partnerskap projekt 124 14

Utgivare: Tankesmedjan Movium, SLU

ISBN: 978-91-576-9654-0 (electronic)

Partnerskap

SLU

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Harald Klein
Movium Partnerskap

Content

Preface

In this report we present the preliminary results from a longitudinal study on school ground greening initiated 2010. A former student within environment psychology at SLU, Emma Crawley, had at the time a position as a "School ground inspirer" in Malmö. She presented the idea of doing an intervention study. What a good idea! As researchers from SLU we got involved in a very exciting process of developing the two school grounds together with staff in "The park service and management" at Malmö Stad and children and staff at the schools. Petra Bengtsson at Malmö Stad was a great facilitator for us in this work. We are also very thankful for the Partnerskap Movium funding which allowed us to carry out data collection on children´s play and activity, before and after the refurbishment. The project "School ground intervention" allowed us to compile the data from both 2010 and 2012. This bulk of research will make up an important baseline for any upcoming efforts to evaluate the more long-term effects of greening. The effects of greening a site tend to transgress the time span of any ordinary research project. Now well into the ninth year after original planting it should be time to get back into the field to investigate what an effort to green children´s environments can imply for the everyday life and activity of a school ground. We hope that the publication of these results will stimulate to take on this task! Behind the compilation of this report are several research colleagues who have taken responsibility - also beyond the finances of the project - to get the data scrutinized: I want to thank Märit Jansson and Allan Gunnarsson from Department of Landscape architecture, Planning and Management in SLU in Alnarp, Anders Raustorp, department of Food and Nutrition and Sport Science, Göteborg University, Cecilia Boldemann, department of Public Health at Karolinska institutet and Maria Johansson in environmental psychology at the department of Architecture at Lund university. Mark Wales, department of Work science, Business economics and Environmental psychology has been helpful in analysis and corroboration of the report.

Fredrika Mårtensson

Background

This project began in 2010 as a result of Malmö city's Green School Grounds initiative which involved the redevelopment and greening of two school grounds in Malmö. The present part of the project "School ground intervention" was to finalise the compilation and analysis of data from previous projects: Skolgårdsutveckling I and II. The material collected before the green intervention has been published in scientific journals (Mårtensson and Jansson, 2012; Mårtensson et al., 2014). The longitudinal character of school ground greening made it crucial to also make follow-up studies after some time had passed and the vegetation had become more established, before drawing further conclusions on the effects of school ground greening. The aim of the project was to continue the work with a focus on analysing the data collected in order to see how schoolyard design as a whole and the presence of vegetation affects children's activity and use of their schoolyard.

The primary hypothesis was that a greener school ground would afford greater possibilities for active play and socialising and contribute to more open and flexible settings in which more children play together regardless of sex, age or ability. One of the schoolyards was significantly greener than the other prior to the start of the redevelopment, whilst the other schoolyard consisted predominantly of hard surfaces.

At the two schools, data was collected before (September 2010) and after (September 2012) the vegetation was established. The design consisted of weeklong studies containing a set of methods which were to document the effects of the green interventions on the children's use and activity and discuss the overall implications for children´s wellbeing, satisfaction with breaks and overall school yard life. This pre-and post-study of school ground greening provides a unique chance for the combination of the qualitative and quantitative examination of schoolyard use and activity over a longer period of time in relation to particular changes and variables. We also hope that the results could feed into efforts made to improve and ensure the quality of schools

and preschools at the national level and into work on school ground greening in different local communities.

Method

The two school grounds had substantially different designs, one being dominated by paved open spaces (hereafter referred to as the Grey school) and the other by open grass fields and woodlands (hereafter referred to as the Green school). The following description of samples and settings are based on earlier published material in Mårtensson et al. (2014) where one can find more elaborate descriptions of the methods used.

Both schools were located in neighbourhoods dominated by detached or semi-detached single-family houses with similar socio-economic status in terms of parental education, income level, proportion of single-family households and ethnicity. However, there was a private school close to the Grey school said to attract more and more well-off children, which could indicate that the socio-economic status turned lower at this school during the research period.

All eligible children were invited to participate in the study. The headmasters welcomed the project and arranged meetings at which teachers were informed, and we presented the purpose and implications of the study at regular parent-teacher meetings. Consent forms for 197 children were returned, making up 87% of all eligible children (75% at the Grey school and 90% at the Green school), and ultimately 83% of the children contributed with valid step counts and self-reports of school ground use for most of the days: at the Grey school in the fourth grade (n=56, 3 classes) and sixth grade (n= 61, 3 classes) and at the Green school in the fourth grade (n= 34, 2 classes) and sixth grade (n= 36, 2 classes). At the Grey school about 500 children in the third to ninth grades had access to a school ground of 13,500 m^2 (30 m^2 per child), and at the Green school about 300 children in the first to sixth grades had access to a school ground of 15,000 m^2 (around 50 m^2 per child). Illustrations and descriptions of the design and vegetation at the two school grounds drawn on base maps with additional information from orthophotos provided by the municipality, as well as field studies by the research team, were used.

The *Grey school ground* was dominated by open areas of tarmac and gravel with access to a large gravel soccer field to the south. Green areas such as grass, shrubs and trees covered less than a fifth of the total area available, and contained no multi-layered

vegetation. There were some grass areas, pruned shrubbery at the edges – much of it thorny (e.g. *Rosa canina*) – and only a few trees. Near the fourth graders' classrooms there was a paved area containing a circle of trees forming a small collection of native species (e.g. *Betula pendula* and *Sorbus intermedia*) and some benches and rocks. The area also contained walls for ball games, table-tennis tables, and fields for foursquare games, basketball, floor ball and soccer. A shed contained balls, stilts, frisbees etc. Near the sixth graders' building there were some benches, a globe sculpture and a container area surrounded by planks and bordering a short-term parking area with a mixture of shrubs along the side.

The *Green school ground* had a more varied design but also many plain, open surfaces and an equal proportion of green areas (grass, trees, shrubbery, woodlands) and grey areas (sand, gravel, tarmac). There were areas of gravel and paved surfaces close to the buildings with foursquare courts, fields for basketball and floor ball, a wall for ball games and some play equipment. Around the buildings were also areas with shrubs, trees and rocks, like the place called 'the shrubbery' (*Lonicera sp.*) under a shade tree (*Salix sp.*) near the fourth graders' classroom. Beyond the buildings there were open lawns, gravelled soccer fields, a playground with swings, bars and climbing frames and rocks, forming an outdoor classroom. At the edges were a few large trees (mainly *Salix sp.*) and woodland areas with trees, shrubs and hilly terrain. The woodland areas included a 'school forest' planted about 15 years ago, now forming a closed middle layer (e.g. *Alnus incana, Tilia cordata* and *Prunus avium*) with limited field and shrub layers, and 'the pines', an older forested area with pine vegetation and multi-layered vegetation (e.g. *Pinus sylvestris* and *Betula pendula*) forming small rooms and paths, and providing sticks, berries and conifer cones.

The following data collection was carried out at the schools during 2010 and 2012:

1. The children's level of *physical activity* (total steps) was measured using pedometers. The children wore the pedometers every day for a week from the beginning of school until the first lesson after the lunch break.
2. Systematic *observations* of the children's activities during breaks were completed every day which noted the type of play, the locations of different activities, the physical intensity and genders involved.
3. The children's *use of the schoolyards* was mapped, as well as their *mood* during break (happy-sad and alert-tired) and *mode of transport* to school using a simple questionnaire and the filling in of a map by the children of places visited and their movements following their morning and lunch breaks.

4. A *questionnaire* was also filled in by the children which asked them what they thought about their schoolyard and breaks. It included questions about their favourite places in the schoolyard, their favourite activities during breaks, their attitudes towards breaks and different activities and their opinions towards nature and how it makes them feel, as well as their opinions on different modes of transport when travelling to school.
5. Follow up *documentation* of new vegetation (with focus on the grey school ground) and *informal interviews* with children concerning the new additions to their schoolyards.

The majority of the data collected from 2010 and 2012 has been entered into SPSS for statistical analysis and into ArcGIS. The amount of data bits on school ground use differ between 2010 and 2012, both when it comes to the observations and children´s self-reports: One example: Green School: 445 Observation entries in ArcGIS in 2012 compared to 772 entries in 2010. Grey School: 217 Observation entries in ArcGIS in 2012 compared to 523 entries 2010.

What does this say about the reliability of data and the possibilities to draw conclusions? We need to ask ourselves if these differences depend on how the researchers carried out their task across the years and/or how on the inputting of data into the system was made by assistants across time. Differences in the self-reported data from children could be due to dissimilarities in instructions and time allocated for the children to carry out the task.

The possibility for data triangulation by cross-checking changes between the observations and self-reported maps could be explored; for example, a reduction in Year 6's use of the football pitches based on self-reports was supported by the observation data which also showed a reduction in overall sports activity in the area. The different types of data together allow analysis with combinations of qualitative map based information and quantitative data on play types, physical activity and self-reports on the children's relationship to breaks and school ground. To give an example,

information of children's self-reported school ground use alongside observations has added an extra layer to the results. Observations give us a snap shot of the total school ground activity at certain times in certain areas during break times; whereas self-reported school ground use tells us where individual or categories of children are and how they move around the yard during their breaks. We can combine systematic classifications of children´s play behaviour across the different settings of the school yard with information of self-reported use by individual children or specific age groups. This allows for comparisons of play types/mood between different categories of children, relative school ground activity at large and exploration of the activity profiles of girls and boys, for children of different age.

Results

The results are divided into two sections. Both sections will look to compare the effects of the schoolyard interventions, before (2010) and after (2012), on the children's activities during their breaks.

The *first section* will concentrate on general comparison of the data collected from the two schoolyards and to explain changes between the pre- and post- evaluation. The results are presented method by method and variable by variable, but they could readily be interchanged and combined where necessary to support analysis. The results of this study are multifaceted and sometimes certain results don't reveal much until the next layer of results is peeled back to reveal new details or answers to changes. The *second section* will peel back another layer and look more closely at specific groups and individuals in relation to their activity during breaks following the redevelopment. For example, how have the changes affected the least active children in comparison to the most active children? How has girls' use of the schoolyards changed in comparison to the boys' activities?

Physical activity

It was previously reported (Mårtensson et al., 2014) that levels of physical activity (mean number of total steps) at both schools were relatively similar prior to the interventions. It was also reported that sport and different games involving balls or chasing were very important for levels of physical activity at both schools at the time. However, boys dominated sports activities. Girls were said to have a hard time competing with boys for use of these spaces. e.g. football pitches, but there were also many boys who had low levels of physical activity, possibly for similar reasons. The conclusion was drawn that spaces for sport generate physical activity, but also inactivity due to lack of access to spaces, crowding and waiting times. Breaks contributed to around 30% of girls' and 40% of boys' daily requirement of physical activity. It was also found that children with access to a greener schoolyard are not necessarily more active (Mårtensson et al., 2014).

Post-intervention figures show that general levels of physical activity at both schools have reduced. These reductions have affected certain groups more than others; in particular when concerning the proportion of children classed as low-active in different year groups. Classifications of activity levels for the children were based on recommendations of daily physical activity (Tudor-Locke et al., 2008), where boys receiving less than 10,000 steps per day and girls receiving less than 7000 steps per day were deemed as low-active. These figures were then corrected based on time in school accounting for 50% of children's daily physical activity (Tudor-Locke et al., 2009) and new classifications were achieved for low-activity: ≤ 5000 steps for boys and ≤ 3500 steps for girls.

Results show that the changes at the green school affected boys much more than girls with regards to the proportion of each year group classified as low-active. There was a significant increase in the proportion of boys in Years 2 (+32%) and 4 (+46%) classed as low-active at the green school, whilst only the Year 2 girls saw an increase in the proportion deemed low-active. There was a slight reduction in the proportion of Year 6 (-4%) boys deemed low-active, as well as slight decreases for Year 4 (-1%) and 6 (-

7%) girls. In contrast, at the grey school here was an increase in the proportion of children deemed low-active in all year groups both for boys and girls.

GREEN	2010 BOYS	2012 BOYS	CHANGE	2010 GIRLS	2012 GIRLS	CHANGE
YEAR 2	10%	42%	32%	0%	11%	11%
YEAR 4	14%	60%	46%	5%	4%	-1%
YEAR 6	33%	29%	-4%	7%	0%	-7%
GREY						
YEAR 4	16%	38%	22%	8%	32%	24%
YEAR 6	21%	52%	31%	0%	31%	31%

Table 1: The proportion of low-active children based on classifications of ≤ 5000 steps for boys and ≤ 3500 steps for girls

At the grey school, these increases could possibly be linked to the reduction in the amount of ball games (and a slight reduction in sports) in relation to overall play activity following the intervention. Sport's share of overall play activity reduced at the green school following the intervention and may have had some effect on overall levels of physical activity. Sport's reduction could possibly be linked to the conversion of a small ball court into a new green room with bushes, rocks and logs and the conversion of a large football pitch into two smaller pitches.

However, whilst general levels of physical activity diminished, it is important to take a closer look at differences and similarities within and between different groups of children and at individual children in order to examine the way in which they have been affected by the interventions. In particular, differences in the least active children at both of the schools.

Play behaviour

This section examines the influence of the green interventions at the two schools on the children's use of the school ground for play. Systematic observations were made before and after the interventions which recorded and classified the different types of play taking place during morning and lunchtime breaks during one week. Changes in the make-up of the spectrum of play types in relation to physical elements and different areas of the schoolyard are presented. It was expected that the introduction of more greenery would result in an increase in physical activity play (Pellegrini and Smith, 1998) and a greater variety of play types involving a larger share of the children. It is important to note that the following results are based on observations and whilst they are split according to sex, they do not show differences between age groups. However, the children's self-reported activities, presented in a separate section, allow for analysis of the different age groups' use of the schoolyard.

At both schools, a variety of different play types were identified during breaks in the schoolyards. It was previously reported (Mårtensson et al., 2014) that pre-intervention activity at the grey school ground was dominated by three play types; ball games accounted for almost half of all play activity while chasing games and sports accounted for just over 40% of all play activity. This could be related to the abundance of hard surfaces between school buildings, in combination with children having good access to balls and other play equipment served from a staffed shed at the school ground. In addition to this they have access to a large fenced off area containing different pitches for sports.

In contrast, the range of play at the green school, which had a more even split between grey (sand, gravel, tarmac) and green (grass, trees, shrubbery) elements pre-intervention, was reported as being much greater due to the versatility of the schoolyard supporting a wider spectrum of play (Mårtensson et al., 2014). For example, the green school's schoolyard supported greater levels of pretend play and green exploration in contrast to the grey school's grounds. It was also reported that greenery promoted more open-ended play in which play evolve in close interaction

with the particularities of place, while areas with a mix of green and built elements afforded a more varied set up of different types of play activity.

Following the intervention at the grey school there was a significant reduction in the number of ball games (-11,7%), although it still remained the prevailing play type. Sport's share of total play activity was also slightly reduced (-3%). Could the reduction in hard, open spaces be responsible for the reduction in ball games and sport activity which in turn could partly explain the overall reduction in physical activity at the school? Following the intervention it would appear that activity was redistributed over the other remaining play types, which all saw slight increases in their share of total play activity. This redistribution was at the expense of reduced ball games and sports due to the introduction of greener elements which support other types of play types.

	2010					2012					
Activity	Girls (30.7%)	Boys (47.2%)	Mixed (8.6%)	Not categorized by gender (13.5%)	Total	Girls (19.3%)	Boys (52,8%)	Mixed (16.8%)	Not categorized by gender (11,2%)	Total	Proportional difference 2010-2012
Total	93	143	26	41	306	31	85	27	18	161	
Ball games	55	63	13	13	144 (47,1%)	6	36	9	6	57 (35,4%)	-11,7%
Green exploration	1	0	0	0	1 (0,3%)	0	3	0	0	3 (1,9%)	**+1,6%**
Locomotor activity	2	7	1	11	21 (6,9%)	6	6	0	5	17 (10,6%)	**+3,7%**
Play equipment	0	0	0	0	0	2	0	2	0	4 (2,5%)	**+2,5%**
Pretend play	4	2	0	0	9 (2,9%)	4	2	2	0	8 (5%)	**+2,1%**
Rough and tumble	2	2	0	1	5 (1,6%)	2	2	3	1	8 (5%)	**+3,4%**
Chasing game	20	21	6	13	60 (19,6%)	11	11	9	3	34 (21,1%)	**+1,5%**
Sport	9	48	6	3	66 (21,6%)	0	25	2	3	30 (18,6%)	-3%

Table 2: Play type before and after the intervention at the Grey School (Jansson & Mårtensson, 2014, Mårtensson et al., 2012).

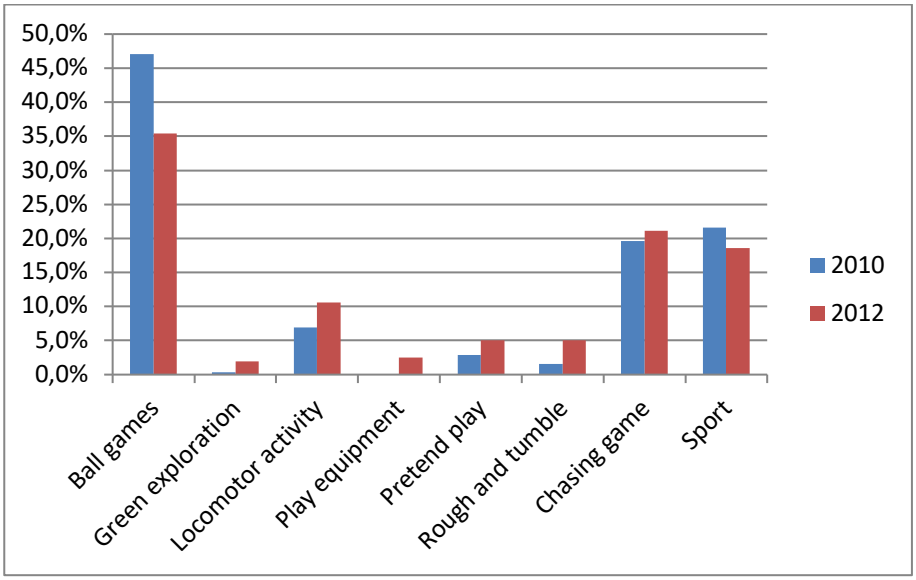

Figure 1: Play type before and after the intervention at the Grey School (Jansson & Mårtensson, 2014, Mårtensson et al., 2012).

In contrast, a reduction of 7% in sport was perhaps the most significant negative change at the green school, whilst locomotor activity saw an increase in almost 6%. There were other slight increases and decreases, but overall the spectrum of play remained as varied as was reported prior to the intervention. The versatility of the green school's schoolyard, even before the intervention, is apparent when comparing the graphs showing the change in play types at the two schools.

	2010					2012					
Activity	Girls (36,1%)	Boys (36,1%)	Mixed (22,5%)	Not categorized by gender (5,3%)	Total	Girls (36,9%)	Boys (43,3%)	Mixed (19,3%)	Not categorized by gender (0,4%)	Total	Proportional difference 2010-2012
Total	164	164	102	24	454	174	204	91	2	471	
Ball games	34	19	21	3	77 (17%)	6	67	16	0	89 (18,9%)	**+1,9%**
Green exploration	16	14	6	2	38 (8.4%)	18	14	4	1	37 (7,9%)	-0,5%
Locomotor activity	33	22	14	5	74 (16,3%)	**62**	26	16	0	104 (22,1%)	**+5,8%**
Play equipment	31	25	20	4	80 (17,6%)	36	18	15	1	70 (14,9%)	-2,7%
Pretend play	31	19	11	2	63 (13,9%)	31	18	15		64 (13,6)	-0,3%
Rough and tumble	6	12	3	0	21 (4,6%)	4	13	8	0	25 (5.3%)	**+0,7%**
Chasing game	6	10	18	0	34 (7,5%)	16	17	14	0	47 (10%)	**+2,5%**
Sport	7	43	9	8	67 (14,8%)	1	31	3	0	35 (7,4%)	-7,4%

Table 3: Play type before and after the intervention at the Green School (Jansson & Mårtensson, 2014, Mårtensson et al., 2012).

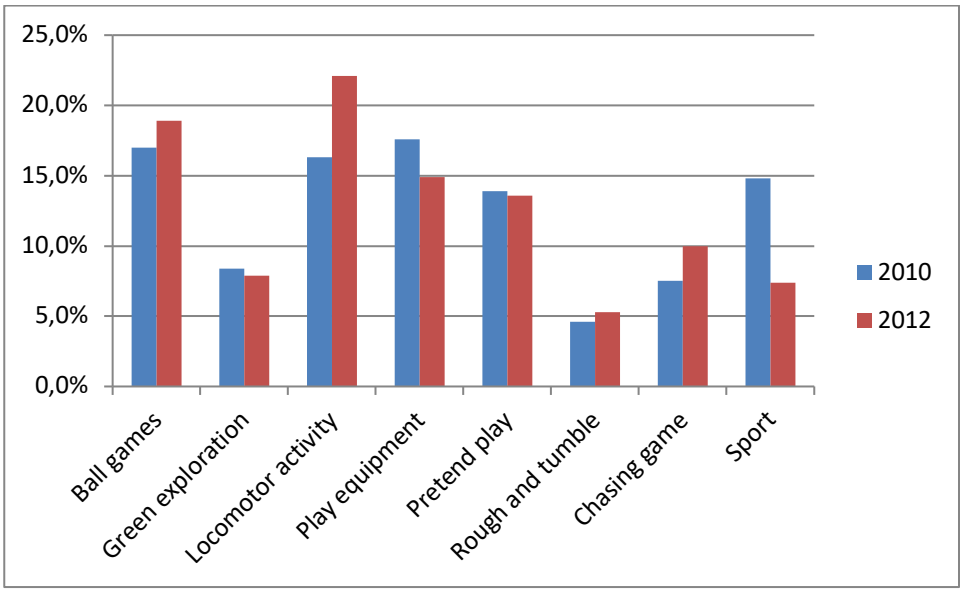

Figure 2: Play type before and after the intervention at the Green School (Jansson & Mårtensson, 2014, Mårtensson et al., 2012).

Observed school ground use

The clearest changes in the connection between the physical environment and play type at the green school have occurred in two areas previously reported as being popular areas for sport: the small ball court and the football pitch (Mårtensson et al., 2014). These two areas stick out when comparing the spread of play activity across the schoolyard in 2010 and 2012; in 2010 there was a high frequency of sport activity (pink dots) in these two areas. The map from 2012 reflects the change in the small ball court's function from ball court to a versatile green area which now affords a range of different play types. Sports activity has also reduced considerably on the football pitch (although ball game activity has increased), which was divided into two smaller pitches during the intervention. There has, however, been an increase in sports activity on the large area of grass south of the football pitch and on the large ball court by the entrance to the school. Perhaps the reduction in the size of the football pitch has displaced sports activities to these areas? Locomotor activity also increased slightly and this is apparent on the maps; much of this increase appears to have occurred in the north end of the central courtyard.

Figure 3: The distribution of play types before (2010) and after (2012) the intervention at the Green School indicating how green additions and shrinking play fields relocates the

sport activity (pink markers) to other parts of the school ground. For more information on the different play types see Jansson and Mårtensson (2012).

There are some clear differences which show up on the children's maps based on self-report which are not apparent on the maps from observations. Observations give us an idea of the types of activities in the schoolyards' various areas and which activities are linked to particular environments, but the children's self-reported maps give us a better insight into how much the children are using the different areas following the interventions:

The large playground at the green school has seen a huge increase in activity according to children's self-reports, but little change in the type of activity in the area (play equipment use). The role of the green intervention which had implemented greenery specifically around the play areas should be further investigated.

The central courtyard at the grey school experienced substantial changes in the frequencies of different play types occurring there according to observations. On the other hand the area is less frequented at large according to children's self-reports. The role of the green intervention for changing play patterns among the children needs to be further analysed in relation to the two specific measure points from 2010 and 2012. The development has to some extent been discussed in relation to the strategies used by the schools to prevent wear and tear and the succeeding development of vegetation as experienced by children (Jansson et al. 2014)

Girls and boys

Prior to the intervention, there was a clear difference between the two schools with regards to mixed play, that is play involving both boys and girls. The green school's more versatile outdoor environment promoted more mixed play, which accounted for almost a quarter of all play activity. This is in contrast to the grey school's outdoor environment which primarly catered ball games, chasing games and sport, and thus only a small fraction of mixed play (8,6%). The most significant change was seen at the grey school, where the proportion of total play activity involving both girls and boys

doubled from 8,6% to 16,8% between 2010 and 2012. These gains came largely from increases in pretend play, rough and tumble play, chasing games and play on play equipment, whilst mixed play involving sport or ball games shrank slightly. However, the proportion of play activity involving just girls has reduced significantly from 30,7% to 19,3% at the grey school, whilst boys retain the lion's share of overall play activity, which accounts for almost 53% of all play activity. In contrast, the share of overall play activity at the green school between boys and girls was evenly split before the intervention and although boys experienced a slight increase, it still remains evenly split post-intervention. There was a slight reduction in mixed play at the green school.

Self-reported school ground use

The following results are based on the children's daily mapping of break time activity; they plotted their movements during breaks and pinpointed specific places visited.

The green school ground

In Year 4 there was an increase in activity on the large, open grassy area between the embankment and the school buildings, and an increase in visits to the periphery areas along the top of the embankment. The area along the slope had received new trees, as part of the intervention, and on the other side there had been an activity of planting herbs with the children among the shrubs in the woodland. Is it possible that these additions (and the actual activity) had made the area more enticing for the children? Observations show a complex mix of different play types after the intervention, including pretend play, green exploration, chasing games, locomotor activity and rough and tumble play. Further analysis also reveals that play in this area is dominated by girls.

Activity has also increased on the play equipment between the football pitches and wooded area for this age group. Prior to the intervention there was nothing separating the play equipment from the football pitch, but the introduction of new green components between the two has converted what was a large open space into two smaller rooms. Perhaps this minor intervention has created clearer boundaries

between the two spaces and more defined places which allowed the children to use the play equipment uninterrupted? It should be noted, however, that Year 6 children's use of these areas has not been affected to the same degree. Perhaps the children in different age groups use the peripheral areas for different reasons? Perhaps the added greenery has added new dimensions which are more attractive to younger children than older?

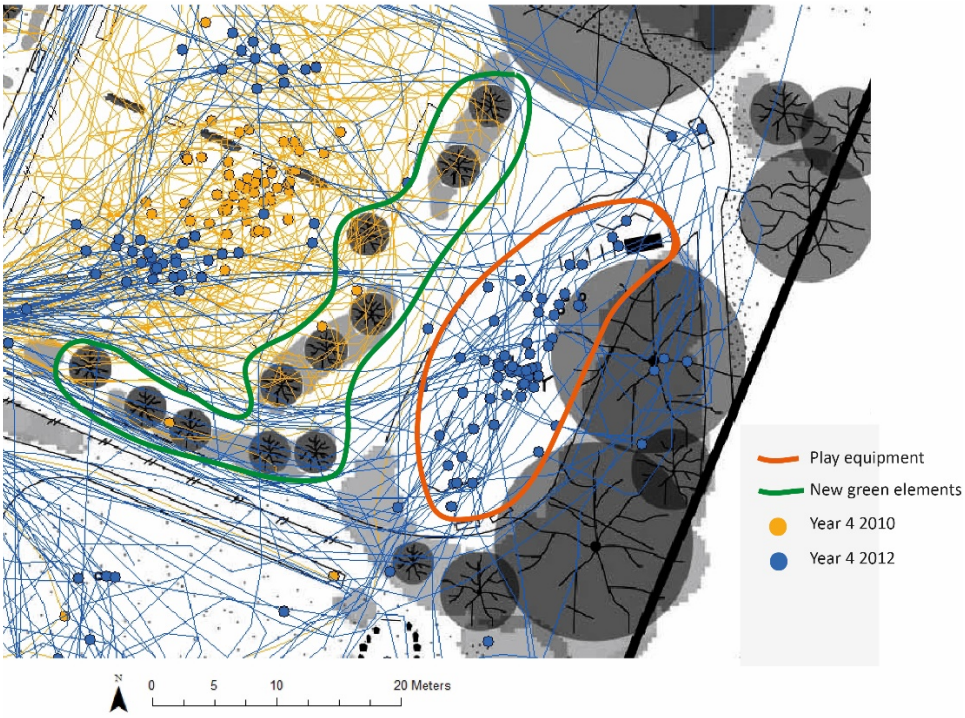

Figure 4: The Year 4 children´s self-reported use of the school ground with more extensive use of the playground area after the planting of trees and herbs

Whilst Year 4 children's self-reported maps revealed increases in the use of certain areas, Year 6 children's maps revealed decreases in their use of particular areas following the intervention. The largest changes have occurred in programmed sports areas (a small ball court and football pitch) which were changed during the intervention. There is a reduction in activity on the football pitch, which was converted from one pitch to two separate smaller pitches. Did these changes in the properties of the two areas affect the places' affordances relative to the specific needs of the older children?

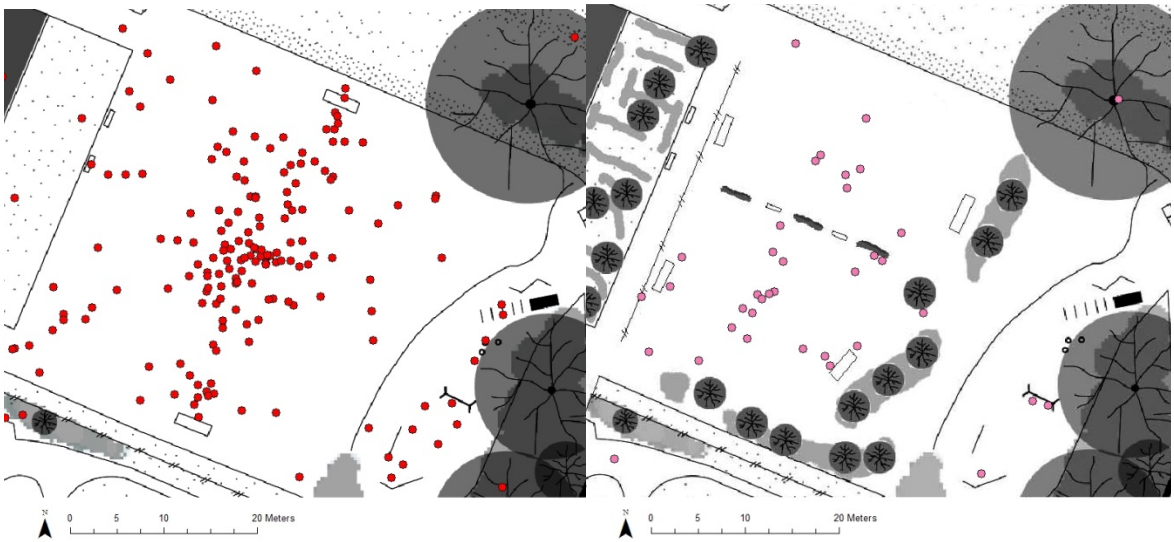

Figure 5: The children Year 6's use of the football pitch area in 2010 (left) and 2012 after the remake of it into two smaller pitches.

Likewise, the conversion of the small ball court into a more green room with rocks, bushes and logs has also seen the displacement of Year 6 children from the area, which is now mostly used by younger children. This change is supported by data on observed play types in the area, which revealed a shift in activity from sports in 2010 to a combination of different play types that include socialising (sitting and talking), chasing games, green exploration and locomotor activities as hopping between the logs. Another change in between the years which is worth noting is that Year 6 children do not stay inside during break times as much as they did prior to the intervention.

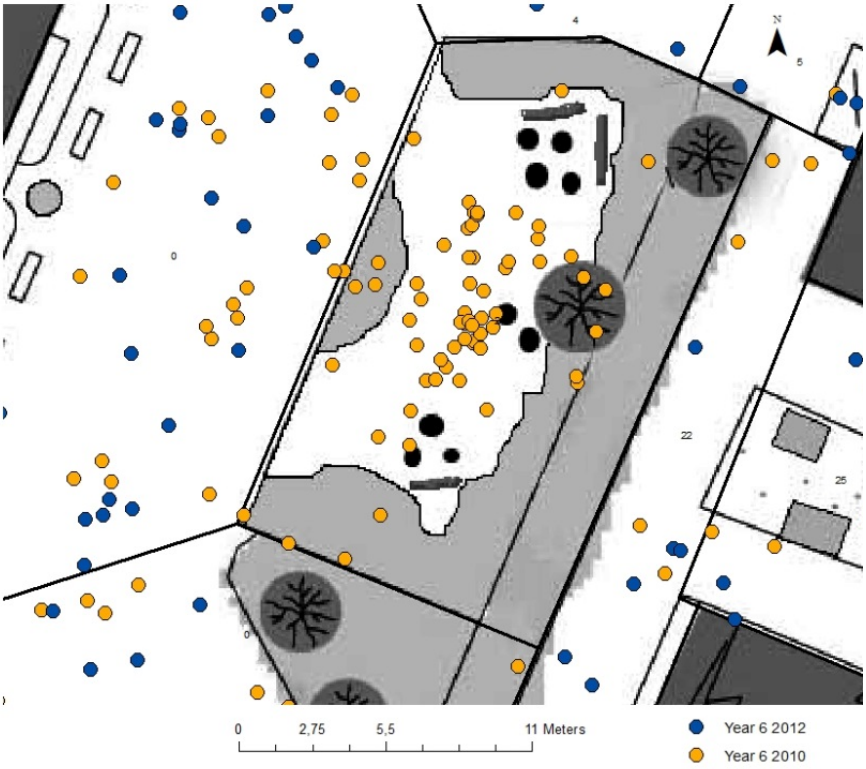

Figure 6: The use of the ball court area by Year 6th children following its transformation into a green room. Note that the base map is post-intervention.

The grey school ground

The most notable changes at the grey school post-intervention involve the reduction of the number of children in certain areas. There was still a clear split in Year 4 and Year 6 children's use of the schoolyard, with a tendency for children to stay close to the buildings which contain their own year group; with Year 4 children's activity focused to the left hand side of the schoolyard and Year 6 children's activity more to the right. Following the intervention this differences had become even more pronounced. This indicates that an addition of greenery at a school ground runs the risk of getting apprehended by older school children as not being done for their sake, but for the younger kids play. A fire-escape along the larger building housing the older schoolchildren prevented the vegetation from being planted in closer proximity to this building. This physical distance probably contributed to distance the older school children from the green play areas.

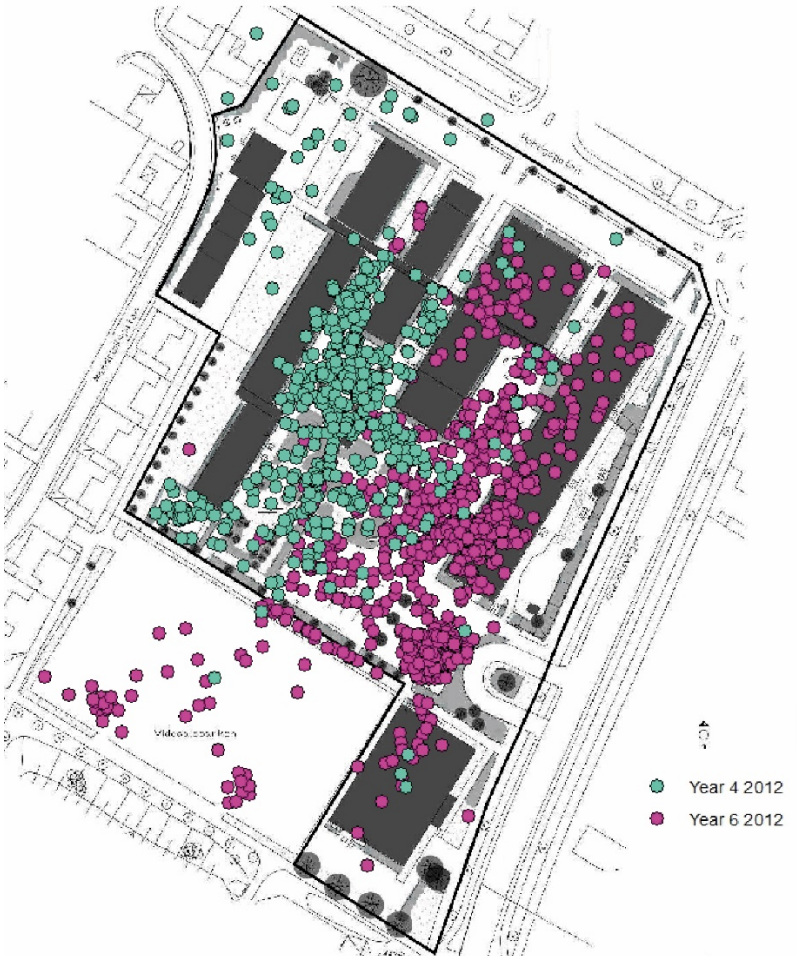

Figure 7: School children in year 4 and 6 tend to use separate parts of the school ground and this division of the ground became further emphasised with more greenery planted in between the areas.

Year 4 children's activity is now much more concentrated in key areas with a large accumulation of activity in the middle courtyard close to their school buildings, where the tree circle and ball courts are. Observations in these areas reveal that they are still predominantly used for socialising, although there has been a reduction in ball games and an increase in chasing games. It is also worth noting that Year 4 children reported less indoor stay during breaks following the intervention.

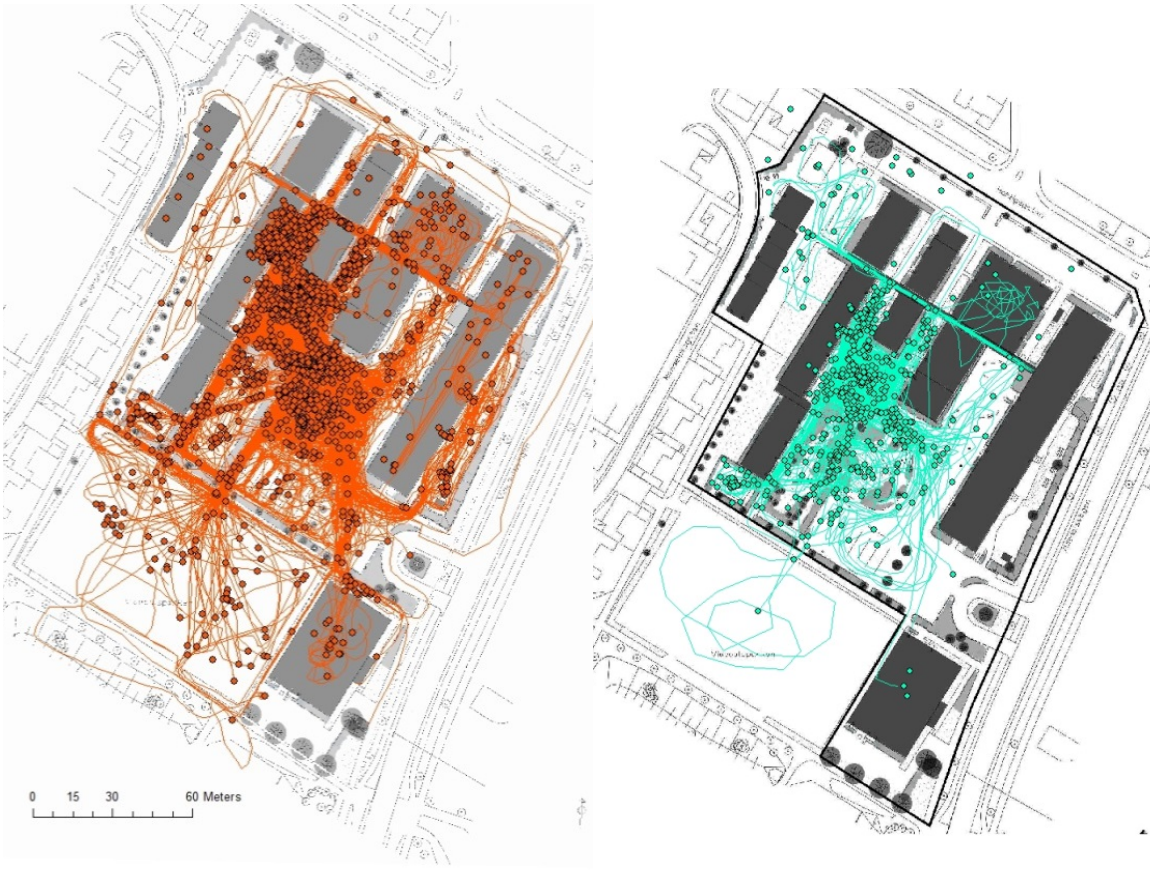

Figure 8: The self-reported use of the school ground among Year 4 children in 2010 (left) and 2012 (right) showing that their activity had turned much more concentrated to particular areas close to their class room after the remake.

In the zone between Year 6's and Year 4's buildings, where the largest changes to the schoolyard have taken place, there has been a considerable reduction in activity; particularly with regards Year 4 children. Previously the area was a popular area for ball games and sport. Following the creation of a hilly area with mixed vegetation and planting boxes, the level of activity in the area has dropped. On the other hand observations reveal that area contribute with new activities not previously represented in these areas; including socialising, pretend play and chasing games. Pretend play barely existed at the school ground before the intervention.

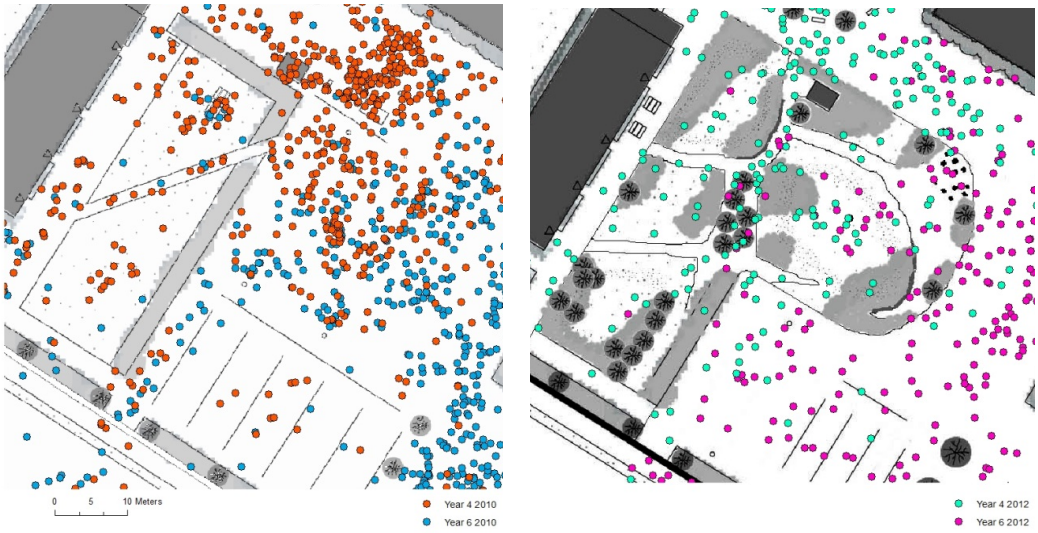

Figure 9: Children´s use e of the area before (left) and after (right) the green intervention by Year 4 and Year 6 indicating an overall decrease of activity in the particular area.

Prior to the intervention there was also considerable activity (Year 6 children in particular) along the borders of the school; by the main entrance, around the short-term parking area and outside of the schoolyard's boundaries. Following the intervention there is almost no reported use of these areas. Have these children found somewhere new to spend their breaks following the intervention? Or has the school restricted children´s use and exchange with the surrounding district?

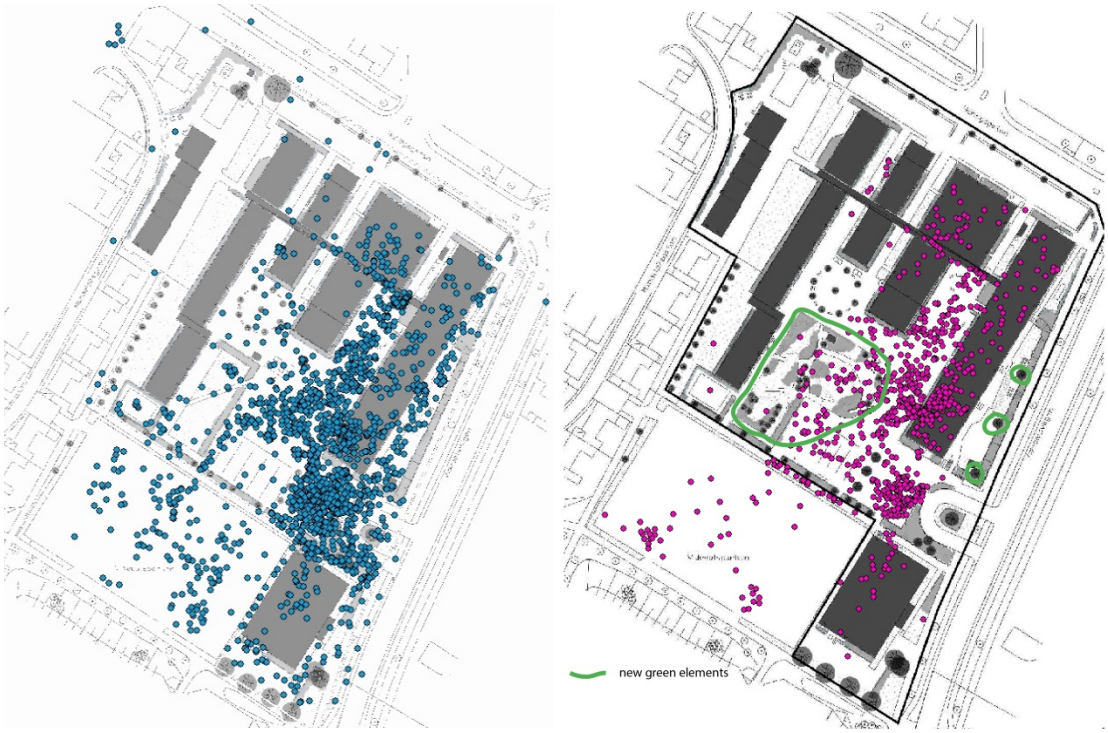

Figure 10: Self-reported use of the Grey school by Year 6 before and after the intervention indicating a more restricted use of the grounds after the intervention.

It would also be interesting to focus on the use of the school ground according to age groups – where are the different age groups, how much do they move around, what distances do the cover during breaks etc. It is clear from the results that Year 2 (not reported in this report) move around the most and use more of the schoolyard, than Year 4 and Year 6. Should the schoolyard be more tailored to the different age groups?

Emotional state

These results are based on the children's daily self-reported valence and arousal following morning and lunchtime breaks during five consecutive days. The key aim was to examine if green settings are associated with positive emotions in children which in turn may contribute to making more children physically active.

Prior to the intervention the majority of children at the schools were in a positive mood during breaks (Mårtensson et. al, 2012). Year 4 girls at the green school reported higher valence than Year 6 girls and vice versa at the grey school. At both schools, Year

6 girls reported lower arousal than Year 4 girls. Boys at the green school reported higher valence, whilst Year 6 boys at both schools reported lower arousal than Year 4 boys.

Related to their self-reported use of the grounds it was reported that alert and happy Year 4 and Year 6 children at the Grey school tended to utilise the green fringes of the schoolyard more than neutral children. In addition, happy and alert Year 6 children indicated that they used the grey fringe, open areas and hill terrain more than neutral children. At the grey school it was previously reported that happy and alert Year 4 children spent more time in the bike parking area, outside the school ground and indoors in the canteen and corridors. Reports also showed that neutral children's tended to denote straighter transports across the schoolyard than other children, possibly indicating less playful activity. Happy and alert Year 6 children indicated that they stayed more in the fringe of the school ground, in the shrubbery by the short-term parkin, outside the school ground and around the school buildings. Based on this data it was concluded that being happy and alert during breaks are associated with the children being moving around more and approaching the borders of the school - possibly taking on more challenge and having more adventure while socialising with peers (e.g. in the canteen and corridors).

In 2012, as in 2010, the majority of children reported being happy and alert during the breaks. At the green school, fewer sad and tired children reported being indoors and there was an increase in activity by this group on the large, open grass area. They also found their way to the new green setting which had been a ball court before. Possibly this secluded green area can have some characteristics which children who are sad/tired seek out for comfort.

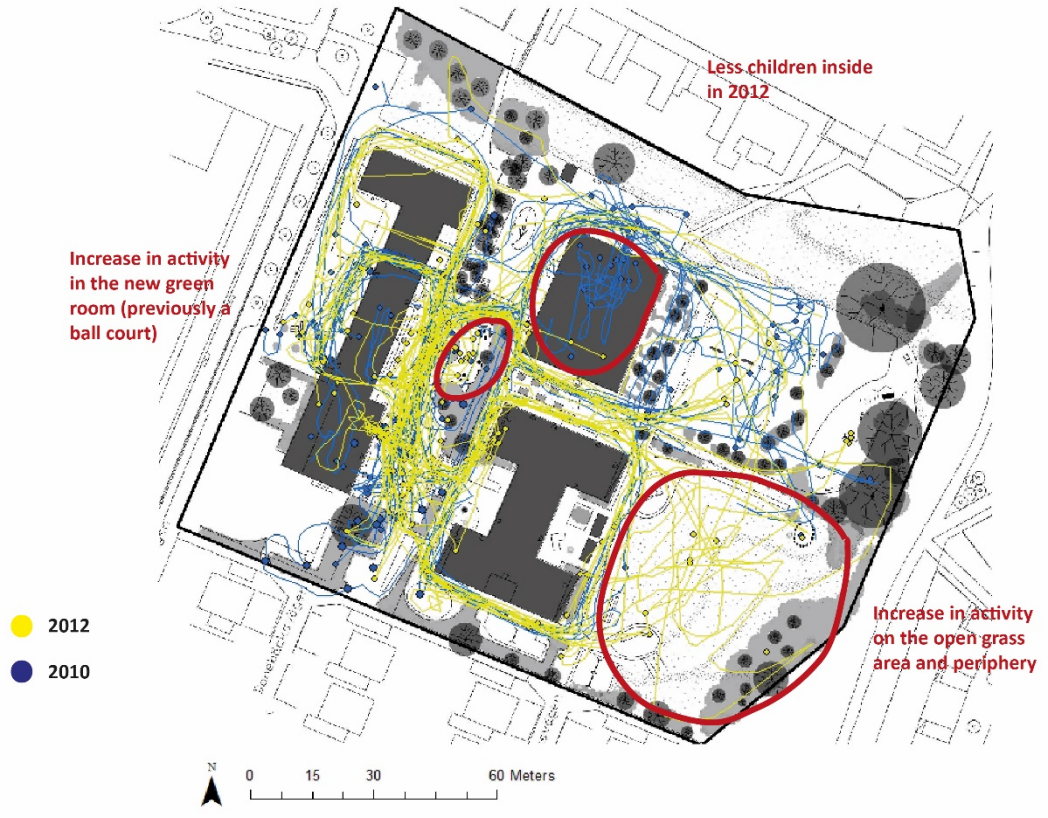

Figure 11: An overview over how sad and tired reported using the green school ground in 2010 and 2012. Indicated is less indoors stay and more use of an open grass area and the secluded area which previously had been a ball court area (Mårtensson et al., 2012).

At the grey school, changes in sad/tired children's use of the schoolyard after the intervention mirrored those changes seen in the children's self-reported schoolyard use. In 2012, there was little to no use of areas outside the school's boundaries or along the front of the school. Sad/tired Year 4 children were also indoors more pre-intervention.

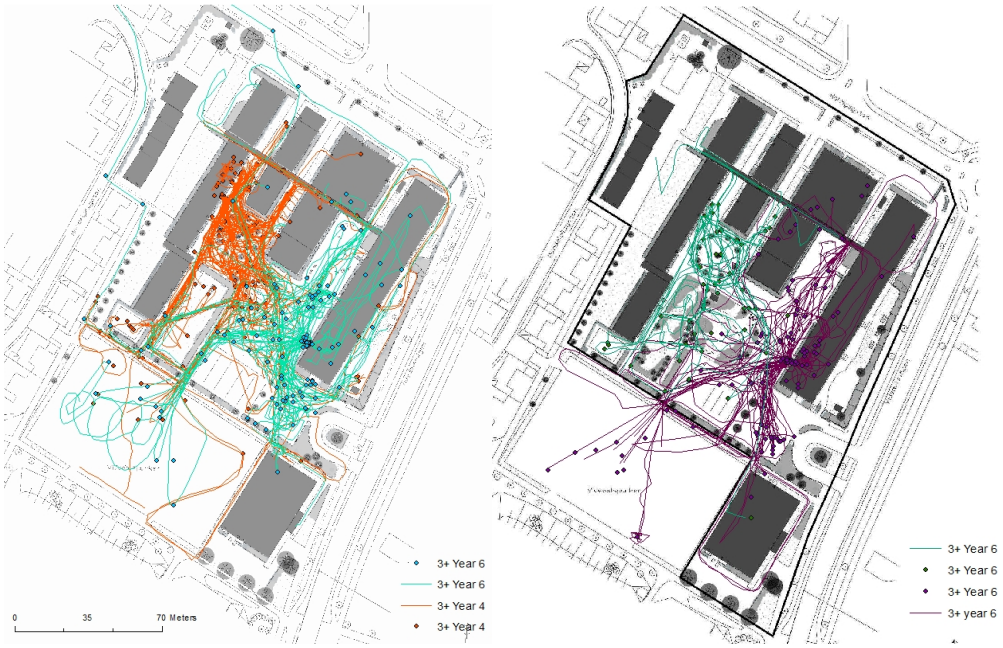

Figure 12: An overview over how sad and tired children's self-reported activity at the Grey school ground in 2010 and 2012 (Mårtensson et al., 2012).

Children's views and perspectives

The purpose of the children's questionnaires was to make it possible to compare children's opinions on their breaks and schoolyards before and after the interventions. Do children enjoy their breaks more? Do they think their breaks are too long or too short? Have their favourite places/activities changed? Does the new schoolyard cater for their needs? Have their opinions of different activities changed? It would also make it possible to see if their relationship to nature/green settings has changed and how it makes them feel.

It was previously reported (Mårtensson et. al, 2014) at both schools that different types of spaces for ball games and sports were commonly listed as favourite places; ball games and sports, as well as chasing games, were common favourite activities during breaks. Areas directly outside classrooms were also generally popular. Children at the green school more often reported places categorised as nature as favourite places. They also spoke of places connected to the landscape in general such as "the forest" or

"the pines", whilst children at the grey school spoke more of places near nature or of specific, delimited natural elements such as "bushes" and "stones."

Following the interventions, follow-up studies were made over four years at both schools with a particular focus on documenting the vegetation and its establishment and also the children's perspectives and use of the new additions. One article describes children´s relationship to the vegetation and its establishment across the years (Jansson et al. 2014). In addition, the studies aimed to capture the participatory process and different pedagogical approaches at the two schools. Documentation of the vegetation's development was more comprehensive at the grey school as it was chosen as a focus site for studying this due to the more extensive intervention at the school. Methods included field notes, photos and measurements of plant growth, ground coverage and wear and tear patterns. It also involved informal interviews with managers, maintenance personnel and teachers with regards maintenance. The children's use and experience of the new areas were examined using qualitative methods in order to capture the children's perspectives first-hand, in everyday situation. Methods consisted of documentation via participatory observations during planning meetings and field studies that included observing the children's use of the school grounds and informal interviews with groups of children. One article present the results on children's overall experience of their school ground being remodelled and their own participation (Jansson et al. 2018).

Favourite activities and favourite places

The results so far has made that there are some clear differences in the overall use of the school ground between different categories of children at both schools. This section takes a closer look at the effect of the interventions on specific groups, with the hope of gaining knowledge on how the outdoor environment can promote activity, for example, for the least active children.

At the grey school, it was previously reported (Mårtensson et al., 2014) that Year 4 boys favoured ball courts and sports pitches and activities involving balls; they also mentioned chasing games and pretend play. Year 4 girls' favourite places and activities

were slightly more varied. They often used and favoured built elements and areas beside their classrooms as the tree circle, the sheltered corridor and the shrubbery by the building, as well as the sports pitches and ball courts. Around half of their favourite places were located close to vegetation. Common were activities with balls and chasing, and they also favoured socialising. Year 6 girls favoured basketball, football and other ball games and also favoured benches and socialising. Favourite areas were outside their classroom, ball courts and the container area. Year 6 boys favoured sports, including football and basketball, as well as ball games and the container area.

It was previously reported (Mårtensson et al., 2014) at the green school that girls tended to stay closer to the buildings whilst boys made more use of the whole schoolyard and sports pitches. The older boys tended to use the green edges more. Year 4 girls were very active in the middle yard and reported green elements and ball courts as favourites. The green periphery of the schoolyard accounted for one third of their favourite places, but were not used often. They also enjoyed pretend play and sports. Year 4 boys favoured sports and areas they could play sports or with balls. They also had favourite places in the schoolyard's green periphery, but were more present in the greenery located in the middle yard. The same routes across the school ground were used repeatedly. They also liked to socialise. Year 6 girls favoured socialising, sports and sports fields. The area outside their classroom was also a favourite, where they spent a lot of time, although they reported using the whole of the schoolyard. Year 6 boys enjoyed sports, ball games and chasing games the most. They favoured sports pitches and the area outside their classroom, but were also found in the green edges of the school ground. Locomotor play, rough and tumble play and green places were also mentioned in questionnaires.

Discussion

This study highlights the complexity of schoolyards' qualities in relation to children's play and activity at a school ground. It also raises important questions concerning the desired functions of schoolyards and children's activities and the ability of vegetation

and small interventions to reprogram school yards for their intended use and different target groups. A strength with the study has been the ability to compare, contrast and combine many different factors. Different layers of data tell different stories. When one layer of data doesn't appear to reveal much, another layer can be added or peeled back in order to gain a more complete picture of the changes that have occurred and the reasons for these changes. We have learned that we need to learn more about the *how* and *where* of school ground greening.

We know since before that proximity to greenery can be used to enhance the children's executive powers, mood and capability to negotiate with each other at a school ground. We also know that the social climate can benefit from greening and be more strategically used to prevent situations of conflict and bullying. Another important role for the school ground is to allow space for children´s vigorous activity: This, as other studies, show that children get 30-40 % of their daily need of physical activity during the breaks in school! However after the greening overall physical activity levels dropped. This puts attention to the limits of what a particular space can house of activity and benefits to the children. To some extent more functions at a school ground also need more space!

To get the benefits of greening a school ground without spoiling the cues of physical activity is one of the big challenges. We need to improve our understanding of how the green structure and other spatial elements structuring the space, feed into the social life of children. The effort to make more efficient use of the sport fields could very well have been a mistake. On the other hand the results show how greenery can boost children´s relationship to a school ground in a way that make space more attractive and their play more dynamic and varied. Such open and flexible play sequences in which children´s play evolve in relation to the particularities of space are known benefit their overall health (Mårtensson, 2009; Wells et al. 2018)

The case of the Year 6 children at the green school losing ground with the greening, illustrates how a change can benefit some group at the expense of others. It also highlights how different children - somewhat related to age and gender - can benefit

from different proportion of grey and green space. Schoolyard discussions often speak of m^2/child, but there need also to be attention to what size in total is needed to be able house the many different play types which attract different categories of children. Space requirements for younger children have been investigated (Mårtensson, 2013, Wells et al. 2018), but we know less about how space can house the dynamics of play and socializing for older school children. Perhaps also there is a need to speak of the share in between green/soft and grey/hard surfaces. Are older children served by a higher proportion of grey to green than younger children? It could be noted here that each of the schools caters for different age groups, the grey school Years 3-9 and the green school Years 1-6 and that grey school provided in large 13 500 m^2 and 30m^2/child, whilst the green school offered 15 000 m^2 and 50m^2/child.

The study showed how the introduction of a more complex green environment can make school ground life more inclusive. Generally girls and boys played more together in the green settings, and the greening made such sequences even more common. The study also shows us – once again - how play equipment and sport facilities can benefit from additions of greenery by adding some loose and malleable space to more distinct functions. Further, green sites affording a large range of different activities - as the woodland and the green hills at the grey school – are to recommend, rather than creating a green site for a particular use (as a maze).

A major factor in the development or redevelopment of schoolyards is the issue of time (see also Jansson and Mårtensson, 2012). It takes time for new green elements to establish themselves and fulfil their intended function. Schools, teachers, children and parents can want finished products to get about a change more quickly. Working with natural elements implies a slower process which stretch out into the management phase. However, as we have seen, activity related to the maintenance of the grounds can easily be made attractive to children if they get involved wisely.

One final important note is to be said about the overall results. The green additions to the school grounds were very much in the early phase of their development when the effects of the greening was to be documented. This have implications for the number

of affordances and the overall attractiveness of the area at the time for investigatation. The documentation of diminishing levels of physical activity two years after the green intervention should therefore be taken with some caution. Required is a follow-up study as the greenery has reached a more substantial height and volume. A common notion of space requirements being possible to replace by attention to the quality of details in the planning and design, is dubious based on the present study, but also needs further testing. To what extent the documented importance of vegetation for younger children´s more vigorous activity (Mårtensson, 2012; Wells, Jiminez and Mårtensson, 2018) extend to older school children, also needs to be further explored.

Conclusions

The role of school ground in children´s lives

- Remember that the breaks in school are most important opportunities to play and independent interaction with peers in children´s everyday life. Enter with respect for this and do any changes with this in mind.
- Any planned changes to a school ground needs to take into account the present use of the site. A good starting point is to document which places are used by children of different age groups and gender, and to document the overall play flows across the site.

Why additions of greenery

- Additions of greenery at playgrounds and open spaces, increase the activity and the variety of play types at the sites.
- Greenery nurtures children´s fantasy. With a green intervention pretend play and role play move into the school ground.

- Green elements at a site support activity which is open-ended and evolves in the playful interaction between peers and place. Such play restores children´s attention in ways that benefit their overall executive functions and well-being.

- Greenery can be strategically used to improve the social climate and to prevent conflicts and bullying. Additions of green elements serve the children well at meeting points – for example by the entrances to classrooms and the cantina.

- Children´s favourite places at a school ground often contain green elements and make the school ground attractive, especially if the elements form a piece of nature - like woodland for example.

The interplay between place and play

- Children tend to seek out places with a good mix of vegetation, open space and built elements - places which can offer good overviews as well as seclusion. At such places, children can switch between vigorous games and more open-ended social interaction and relaxation.

- Children staying in the fringe of the school are more happy and alert. The surroundings – if so woodland or a neighbourhood street-scape – can be very attractive and contribute to an "outward pull" away from the building.

- One might need to examine how the timing, rules and regulations around breaks can help to encourage children to actually use their favourite places and move into the more adventurous fringe. One example: Make sure that children (often girls) do not remain (sedentary) by the classroom just to be sure they do not come late to class!

An inclusive school ground

- If larger sports fields are divided into smaller fields there is a risk that the intensity and speed of the games in the area drop. This can contribute to a reduction of physical activity in some categories of children.

- An intervention directed towards younger schoolchildren can to a large extent rely on green additions, while an intervention directed towards older schoolchildren need to figure out how to bring in nature where these children like to hang out. Play and socializing goes hand in hand.

How to manage and develop with a child-perspective

- Do consider children´s perspective, not only on the design, but related to the ongoing management of the school ground. There is a fine balance between children´s interest of continuity in their relationship to place, and the protection of plants: Maybe one does not need to make a definite stop to children´s use of a newly planted area, but instead can make use a little more difficult and less frequent?

Litterature

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