

MASTER

Architecture as education for sustainable happiness a framework and a roadmap regarding physical learning environments

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Architecture as Education for Sustainable Happiness: a Framework and a Roadmap regarding Physical Learning Environments

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Architecture as Educator for Sustainable Happiness: a Framework and a Roadmap regarding Physical Learning Environments

ANNA W. VANDERVEEN

Abstract

We shape our buildings, and afterwards our buildings shape us. Hence, the architecture of the physical environment has an educational character. Increasing numbers of both educators and building design professionals are becoming aware of this important role of physical space, especially in educational settings. Yet, the physical learning environment is hardly gaining attention in global research on transformative sustainability learning (TSL). TSL is a type of learning that aims at sustainable development in harmony with human happiness. Previous research has shown that this requires intrinsic strategies to change behaviour. Currently, researchers, schools and designers lack insight into how physical settings contribute to this. Therefore, this study presents a framework which reveals the design characteristics of physical learning environments which support TSL and provides insight into how individual design characteristics relate to each other. The framework is built on the heart, head and hands model, which has been found to be a suitable organizing principle for TSL. The framework comprises three focus areas for building performance: (1) engage the heart (to foster motivation), (2), exemplify to the head (to foster understanding) and (3) enable the hands (to foster behaviour). Within each focus area, three design characteristics are distinguished. The framework is developed through an inductive study of literature and case study research with data collected by means of interviews and on-site observations. Deductive research is required to confirm and quantify the qualitative relationships hypothesised. In order to inform and assist schools and designers, this study presents a practical roadmap for building transformation, in which the developed framework plays a central role. The framework provides a basis for the evaluation of occupied built environments. This is illustrated by means of a post-occupancy evaluation (POE) of a case study school. The instrument developed for the analysis simultaneously provides a frame to clarify the school's request and to generate ideas for building transformation.

Key words

physical learning environment, transformative sustainability learning (TSL), sustainable happiness, performance based building, post-occupancy evaluation (POE).

INTRODUCTION

It requires no introduction that a building can contribute to one's sense of happiness through the provision of a safe and comfortable shelter. Yet, the impact of the physical environment on happiness goes far beyond this. The way we shape the physical interface between individuals within their communities and the natural environment is a reflection of larger cultural values and holds a close relationship with our attitude towards the non-human world (Upitis, 2015; Hertzberger, 2008). We shape our buildings based on these values, and afterwards this influences how we develop and internalize values ourselves (Upitis, 2015). Therefore, the physical environment not only influences human behaviour, well-being, cognition and emotion in that particular setting, it just as well influences the outcomes after leaving the setting (Gifford, et al., 2011). Hence, the physical environment plays a teaching role.

Although valid for every building typology, this is particularly important for school habitats. Here the primary target group, namely pupils, is in a phase of life in which norms and values are being internalized intensely. Pupils' localized places of study are the centres of their experiences that help to teach them how the world works and how they fit into that world (Gruenewald, 2003). Also, habits are being formed in early years. As a result, education and educational settings do not only prepare children for the future, they just as well create the future. This stresses the need to contemplate on which lessons we want pupils to learn from education and physical educational settings. As Taylor (1995) wrote:

'We expect schools to prepare children for living in a democratic society, yet we provide a learning environment that resembles a police state — hard, overly durable architecture, giant chain-link fences, locked gates, guards, and even guard dogs. Such architecture fails to encourage the sense of ownership, participation, or responsibility required for a democracy.'

Orr (1997) describes this architecture as the 'hidden curriculum' of the building, which powerfully influences the learning process. According to Orr, educational buildings are typically approached as structures that quietly serve the educational process, but require no care and interaction of those who use it. The lesson learned is mindlessness: these buildings teach that disconnectedness is normal and we learn passivity and disengagement from our surroundings. Orr even states that, as commonly practiced, educational buildings could easily be converted to use as a factory or prison. Similarly, Upitis (2015) observed that schools have been built largely as a reflection of the 'factory model' for learning, meaning that pupils are 'processed' until they are deemed ready to leave school as if they were products to be fabricated.

It can be argued that it is not too strange that schools reflect this factory model for learning. Many of our educational buildings originate from times when the factory model dominated the development of the world. Through industrialization and efficiency gains our (relative) negative environmental impact decreased and, in most nations, the resulting rise in wealth accompanied a rise in average (subjective) well-being (Veenhoven, 2004). Nonetheless, since the 1960s there has been growing concern about our natural environment. In combination with emerging social challenges around the world, this has given rise to a call for more 'sustainable' development. Since then, enormous efforts have led to remarkable efficiency gains in many fields (Veenhoven, 2004).

However, there is more to sustainability than efficiency advances. Wals and Rodela (2014) wrote:

‘Popularly stated, sustainability is not only about doing the things we do better (i.e. more efficiently) but also about doing things differently (i.e. developing new routines) and, perhaps foremost, about doing better things (i.e. developing new principles, vantage points and values).’

Developing new routines and values is not an easy undertaking, especially since *changing* routines is harder than *developing* routines (Geisen, 2013). Therefore, sustainability requires an early start, education thus being one instrument that can be used to move towards a more sustainable world (Wals & Jickling, 2002; Buckler & Creech, 2014). However, in a survey of current practice, a UN report concluded that ‘at current levels of unsustainable practice and overconsumption it could be concluded that education is part of the problem’ (UNESCO, 2005), since current educational systems still largely build on the paradigm which has caused the social, ecological and economic problems currently leading. As Orr (1991) said, we must not assume that it is education that will save us, or advance us; rather it is education of a certain kind. Hence, in this post-industrial era we need to rethink our approach towards education and the physical environments in which education takes place. This study explores the influence of the latter on ‘transformative sustainability learning’.

Transformative sustainability learning

Several approaches exist to integrate sustainability into education. Wals and Jickling (2002) explored possible ways of designing education for sustainable development in relation to human well-being and attitudes. Figure 1 represents their attempt to conceptualize learning processes. On the left side, ‘instrumental views’ of education for sustainability are presented, juxtaposed with more ‘emancipatory views’ on the right side. The instrumental approach is described as resulting in an ‘eco-totalitarian regime’, where rewards, punishments and conditioning of behaviour forcefully create a sustainable society from the perspective of the natural environment.

Since this society will almost certainly lack ‘justice’ and ‘happiness’, the emancipatory view is proposed, representing ‘a very transparent society, with action competent citizens, who actively and critically participate in problem solving and decision making, and value and respect alternative ways of thinking, valuing and doing’.



Figure 1 Two conceptualizations of learning processes with regard to sustainability in education (Wals & Jickling, 2002) in relation to ‘transmissive’ and ‘transformative’ sustainability learning (Sterling, 2001)

The hierarchical approach (left) and the participatory approach (right) towards education closely relate to the different typologies of sustainability education identified by Sterling (2001). They range from ‘transmissive’ to ‘transformative’ in their pedagogical approach (Holdsworth & Sandri, 2014). The transmissive approach regards the transmission of current knowledge and facts about sustainability, which closely relates to the hierarchical, authoritative methods described by Wals and Jickling in the ‘eco-totalitarian regime’. On the other hand, transformative sustainability learning is a mere participatory and democratic approach, which closely relates to the emancipatory views presented by Wals and Jickling. It is argued by many that sustainability education requires a paradigm shift from transmissive to transformative learning. Transformative sustainability learning is a type of sustainability learning that facilitates personal experience for pupils, resulting in profound changes in knowledge, skills and attitudes related to enhancing ecological, social and economic justice (Sipos, et al., 2008).

This empowering approach contrasts sharply with the prevailing interpretation of sustainable development. ‘Sustainability’ is often experienced as a concept that comprises discomfort, as one is supposed to abandon certain behaviours or consumptions in order to leave a legacy to generations one will never even get to know. Correspondingly, Vugt, et al. (2014) argue that environmental problems are often caused or exacerbated by self-interest, amongst other things. Brown and Kasser (2005) therefore suggest that ‘as long as environmentally responsible behaviour is framed in self-sacrificial terms, individuals will be faced with tough choices about how to act’ because such behaviour is assumed to detract from their own happiness. This study therefore starts from the perspective of ‘sustainable happiness’.

Architecture and education for sustainable happiness

It can be argued that our unrestrained pursuit of happiness, especially in the last decades, is a major cause of environmental exploitation and degradation. However, it has been found that bringing ‘sustainability’ and ‘happiness’ together within the concept of ‘sustainable happiness’ actually holds significant possibilities for individual, community, and global well-being (O’Brien, 2008; Brown & Kasser, 2005). O’Brien (2005) defined it as follows:

‘Sustainable happiness is happiness that contributes to individual, community and/or global well-being without exploiting other people, the environment or future generations.’

The concept of sustainable happiness extends happiness research and reinforces the relationship to sustainability (O’Brien, 2010). For example, a mindful consideration of one’s inner states and behaviour along with a set of values oriented more towards intrinsic than extrinsic aims appear to simultaneously benefit both individual and ecological well-being (Brown & Kasser, 2005). These findings are hopeful, given that such supportive factors as intrinsic values can be cultivated (Brown & Kasser, 2005). This stresses the important role education plays in moving towards a sustainable world.

In order to scale-up global action in this field, an international ‘Global Action Programme on education for sustainable development’ has recently been launched (UNESCO, 2014). This Global Action Plan calls for ‘whole-institution approaches’ towards education for sustainable development. This entails that educational contents, pedagogies and physical environments (right in Figure 2) should be aligned towards education for sustainable development (Wals, et al., 2015). Although increasing numbers of both educators and design professionals are becoming aware of this important role physical space plays (Cleveland & Fisher, 2014), the physical learning environment is hardly gaining attention in global research on transformative sustainability learning.

Certainly, much research is being done on physical (learning) environments in relation to sustainable development. In order to clarify why the aims and outcomes of such studies do not contribute to sustainability learning, this study adopts a dichotomy set by Veenhoven (2004). Veenhoven explains that whether one will live a (sustainably) happy life highly depends on the life-chances one possesses. He divides life-chances into *external* and *internal* qualities. In the first case the quality is in the environment, in the latter it is in the individual. The first category is referred to as ‘the liveability of the environment’, covering good living conditions. This quality of life is central in the thinking of building professionals.

The second category regards ‘the life-ability’ of the person, concerning how well one is equipped to cope with the challenges of life and masters ‘the art of living and living well’ (Cruz, et al., 2009). This quality of life is central in the thinking of educators. Since it has been found that the physical environment plays a teaching role, this paper argues that building professionals should concern their influence on one’s ‘life-ability’ as well.

The division of life-chances into ‘liveability’ and ‘life-ability’ provides a categorization to position earlier work on architecture in the context of education; see Figure 2.

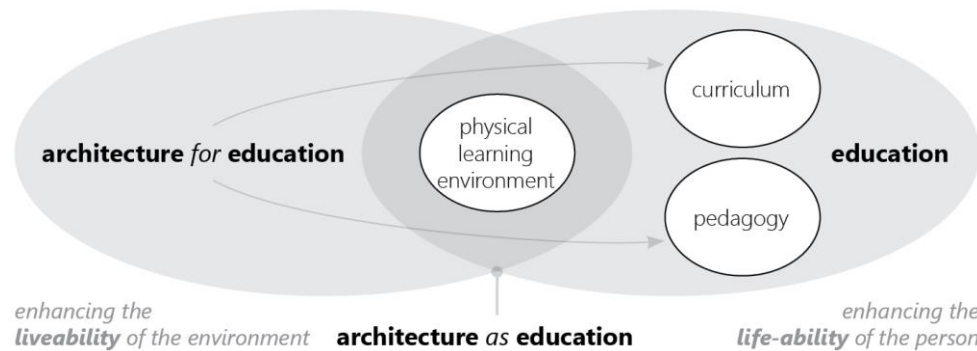


Figure 2 Architecture *for* education and architecture *as* education. Architecture *for* education influences the liveability of the environment at a global scale (this is unrelated to the education taking place in the building), the curriculum uptake and pedagogies. Architecture *as* education has an educational role of its own, on which this study elaborates in relation to transformative learning for sustainable happiness.

The liveability of the environment (left in Figure 2) is influenced by architecture *for* education. Research on ‘green’ or ‘sustainable’ architecture for education primarily focuses on the enhancement of the liveability of the environment. Much of the work focuses on energy-efficiency, aiming at the creation of a liveable environment at a global scale. Furthermore, research concentrates on liveable environments at a smaller scale, as vast research stresses the effects of the indoor environment on student and teacher outcomes, including health and productivity (Wargoocki & Wyon, 2007; Spengler, et al., 2001). Such measures have an influence on the extent to which the curriculum is learned, as reduced concentration will lead to a reduced knowledge uptake. Claims of improvements of pupils’ performance of up to 14% are made if building conditions are improved compared to common practice (Fisher, 2005; Wargoocki & Wyon, 2007). Also, the physical environment has an influence on how learning processes and pedagogies are shaped. Similar to how open space plans in office environments are penetrating common practice, insight into the influence of physical space on learning processes is now leading to the transformation of educational buildings. Hence, the influence of architecture *for* education is three-fold: it influences the liveability of the environment at a global scale (this is unrelated to the education taking place in the building), influences the curriculum uptake and influences learning processes; see Figure 2.

Meanwhile, architecture *as* education (central in Figure 2) has an educational role of its own. Based on a critical review of the literature on the evaluation of physical learning environments, Upitis (2015) states that ‘there is very little research on how space dictates what is learned and how it is learned’. The gap in the literature thus regards the common space of architecture and education: architecture *as* an educator for sustainability learning. The research at hand elaborates on how the physical learning environment contributes to transformative learning for sustainable happiness.

Research goal and relevance

Currently, insight into how physical space contributes to transformative sustainability learning is lacking. Therefore, the first goal of this research is to reveal the design characteristics of physical learning environments which support transformative learning for sustainable happiness and capture them in an appropriate framework.

The second aim of this study is to provide insight into how individual design characteristics relate to each other in order to ‘get the balance right’ between the application of diverse design characteristics.

Getting the balance right between measures is of great importance, since research shows that any approach to influence behaviour must incorporate interventions focusing both on the internal and external causes of behaviour (Defra, 2008; Jackson, 2005). This is due to the fact that people's reasons for doing what they do are multiple and complex. Moreover, it has been discussed that sustainable happiness requires intrinsic strategies. The framework gives insight into how the design characteristics of the physical learning environment distinguished provide either internal or external stimuli for behaviour (change) in order to facilitate this balance.

Hence, the framework provides theoretical understanding with regard to how physical space contributes to transformative sustainability learning. In order to foster the application of this theoretical understanding in practice, the section 'From theory to practice: a roadmap' aims to provide guidance to decision-makers in the process of building transformation. A roadmap is presented to inform and assist schools and designers with regard to the use of the framework in the process of building transformation.

RESEARCH METHODOLOGY

In the initial stage of this study, no hypothesis was present with regard to the design characteristics of physical learning environments which support transformative learning for sustainable happiness. Therefore, an 'inductive' research approach is taken. With an inductive stance, theory is the outcome of research (Bryman, 2012). In other words, the process of induction involves drawing generalizations and ideas out of observations.

In order to arrive at an applicable hypothesis, the study began with unstructured literature and case study research, which are used instrumentally to distinguish design characteristics. The case study is thus used to accomplish something other than understanding this particular school environment, so the inquiry regards an 'instrumental case study', as opposed to an 'intrinsic case study' (Stake, 1995). The school selected as a case is 'de Sokkerwei', an elementary school in Castricum, the Netherlands. The school is considered the first 'sustainable school' in the Netherlands and was built in the year 2001. It has been selected primarily for its famous national reputation of being a built environment that contributes to sustainability learning.

The case school has been used by means of on-site observations and unstructured interviews with pupils and staff (see Appendix C). The literature study is used complementarily to the case study research, to gather relevant theories and knowledge both in and outside the domain of building, in order to apply this understanding in the field of physical learning environments. The inductive search for an applicable model in this context has been influenced thoroughly by the extent to which it can be understood easily (see Appendix A for an overview of the inductive process). For input and quality control during this process, a meeting with a group of experts and multiple meetings with individuals have been held. The interviewees regarded people from both the demand and the supply side.

The results of the meetings primarily regarded the coherency in the categories which constitute the framework and the extent to which the experts were able to comprehend these categories within limited time (see Appendix A and B). The attendees of the expert meetings were professionals from various disciplines, including building technology, architecture, architectural philosophy, philosophy, anthropology, environmental policy and management, sociology and pedagogy.

Through an iterative, qualitative process nourished by literature inquiry and case study research, a coherent framework has been developed. The inductive character of this study entails that further, deductive research is required to verify and quantify the hypothesized relationships.

THEORETICAL UNDERSTANDING: THE FRAMEWORK

This section presents the framework developed in this study; see Figure 3. It holds the theoretical understanding gained in this inductive inquiry, which regards the design characteristics of physical learning environments considered successful in the context of transformative learning for sustainable happiness.

The framework developed is composed of three domains: demand, supply and the bridge between them. These three domains are adopted from the ‘performance concept’ for building (Szigeti & Davis, 2005). Performance-based building is an approach to the design, construction and evaluation of buildings to meet certain performance requirements. The concept can be illustrated by means of two halves of a hamburger bun, which represent the demand and supply side of building (Gielingh, 1988). The established performance criteria compose the bridge between demand and supply. The framework developed in this study builds on this ‘Hamburger Model’. In the context of physical learning environments, education is the demanding discipline and building is the supplying discipline. This study bridges gap between these domains by means of nine design characteristics constituting this gap.

The following sections discuss the framework; the demand and the supply side are explored in the context of physical learning environments for transformative sustainability learning and the gap between demand and supply is bridged by means of the nine design characteristics A1 to C3 which are distinguished in this study.

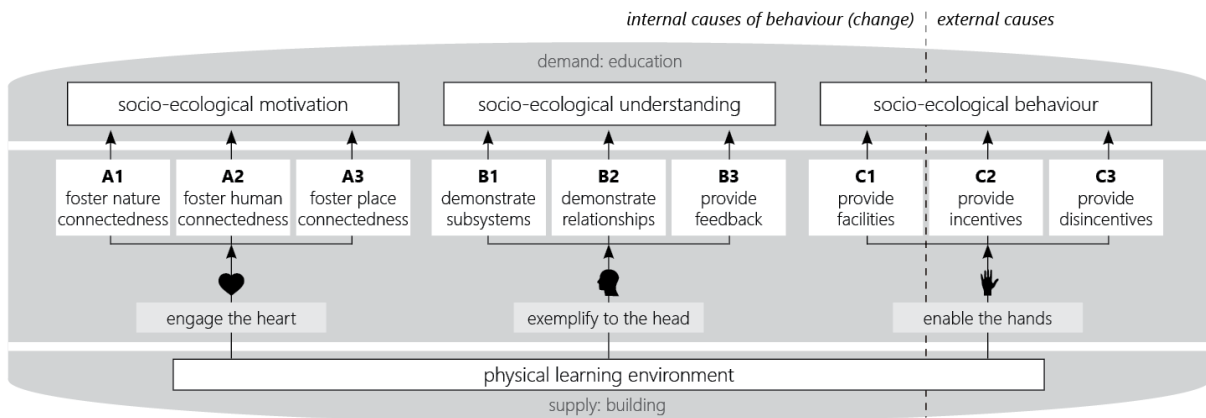


Figure 3 The framework developed in this study, presented by means of the ‘Hamburger Model’ (Gielingh, 1988)

An exploration of demands

Since school habitat transformation is often an once-in-a-lifetime job for decision-makers, such as school staff and employees at local governments, it is often hard for them to express an adequate demand towards supplying parties. Their set of demands consequently often results from ‘common’ practice and habits. Hence, the wants they express are not necessarily a manifestation of their underlying demand. Therefore, rather than asking clients about their wants, this section explores demands for transformative learning for sustainable happiness based on literature research.

Previous research has found that the organizing principle of ‘the head, the heart and the hands’ is useful to involve the whole person in transformative learning (Sipos, et al., 2008). Heart, head and hands is essentially shorthand for engaging affective, cognitive and psychomotor learning domains (Bloom, et al., 1964). What are the life-abilities, or sustain’abilities’ (Wals, 2015), the individual needs to develop in these domains when one aims to contribute to a sustainably happy planet?

Using the heart, head and hands model, three related competences have been determined: socio-ecological *motivation*, socio-ecological *understanding* and socio-ecological *behaviour* (see Figure 3). Singleton (2015) applied the head, heart and hands model to the physical environment and concludes that the context of place provides a framework of authentic experience for deeper reflection, sense of belonging and body/sensory stimulation that acts as a catalyst for deep engagement, which is required for transformation. When aiming to contribute to transformative learning for sustainable happiness, the demand on physical learning environments thus comprises a positive influence of the physical learning environment on the individual for the three life-abilities distinguished, on which the following subsections elaborate.

Socio-ecological motivation

Socio-ecological motivation covers the domain of affection. This regards the existential and normative dimension of sustainability (Wals, 2015), including passion, values, ethics and concerns. Affection and empathy with human others and the non-human world lead to an attitude that stimulates plans, goals and intentions to behave in a certain manner in certain settings (Gifford, et al., 2011). Motivation alone, though, will not succeed in realizing such socio-ecological behaviour. It is well reported that for many people there is a gap between their high level of concern about the environment and their actions (Defra, 2008). Many people are willing to do a bit more to limit their environmental impact, yet people have a much lower level of understanding about what they can do and what will make a difference. The second competence distinguished therefore covers 'socio-ecological understanding'.

Socio-ecological understanding

Socio-ecological understanding covers the domain of cognition and critique. This regards the contents of sustainability and the ability to reflect on issues accordingly (Wals, 2015). Such understanding requires one to adopt an integral, holistic view, in which relationships are understood and connections are seen. Thus, as well as thinking within a cell of specialized knowledge, we have to think outside that cell (Graham, 2003). This is often referred to as 'systems thinking', which is the process of understanding how those things which may be regarded as systems, influence one another within a larger system. Systems thinking focuses on the study of patterns, connections and relationships between such (sub)systems. Alongside specialized knowledge, systems thinking is one of the core competences for socio-ecological understanding.

Socio-ecological behaviour

Socio-ecological behaviour regards the actual behaviour exhibited. People's reasons for doing what they do are multiple and complex. Motivation and understanding will result in intention and cognition to behave in a certain manner, but whether one acts accordingly depends on many more things, such as habits, routines and external causes of behaviour change. Existing habits and routines are beyond the scope of this research.

In all cases, it should be noted that categories can be distinguished, but not separated. Rather, the distinctions can be used to map different dimensions of the performance of physical learning environments, in order to clarify discussions and position earlier research regarding it. For example, the phenomenon of 'learning by doing' entails that through 'doing', socio-ecological understanding and motivation can be enhanced. Reciprocal relationships exist between behaviour, understanding and motivation.

An exploration of supplies

The 'supply' side of the Hamburger Model (lower part of Figure 3) regards the actual physical environment designed or constructed. Several examples exist of schools that have developed their physical environment as 'architecture as education'. For example, the Italian 'Reggio Emilia' pre-primary schools, the 'Green School' in Bali and 'de Sokkerwei' in the Netherlands are often referred to in (scientific) literature. What is the special 'performance' that these physical learning environments deliver? In order to answer this question, Kong, et al. (2014) studied the special design elements and features present in the famous 'Green School' in Bali, which give the school the character of a 'three-dimensional textbook' for environmental education. In a similar manner, Dutt (2013) explored how physical learning environments play a role in mediating students' relationships to the natural world.

Both Kong, et al. and Dutt studied a school environment and demonstrate the special design elements and features present in that particular environment. Yet, since the design of physical environments is highly contextual and dependent on the specific function and location, such design elements cannot simply be copied to other settings. For example, Kong, et al. studied a school in a rural part of Indonesia, which setting requires a wholly different approach than, for example, western European cities. Similarly, in the case Dutt selected for her inquiry, a forest and two gardens were present on school property. Dutt stresses that this is unusual and that further research is required in less rural settings. These studies are typical for much of the work done regarding the impact of the physical environment on pro-environmental behaviour. Such research has been conducted primarily in relation to case studies where natural and outdoor environments dominate the built ones.

Both Kong, et al. and Dutt aimed to draw lessons from these specific, yet valuable cases. Based on an analysis of the design elements present, they formulated generalised design models, aspects, themes or principles. Those comprise the performance characteristics which lead to the cases studied being considered successful with regard to sustainability learning. Here, the results transcend the domain of supply and enter the third domain distinguished: the gap between demand and supply.

The gap between demand and supply

In order to provide insight into the influence of physical settings on student learning, all references discussed above aimed to conceptualize their results and capture them in design models, aspects, themes or principles. As discussed above, their inquiries are however limited in scope, primarily due to the strong focus on nature connectedness only. This study responds to that by a broader scope, applicable for both natural and built environments in both rural and urban settings.

The categorization of design characteristics, which constitute the gap between demand and supply, is based on the three competences elaborated on earlier (socio-ecological motivation, socio-ecological understanding and socio-ecological behaviour). As a result, three focus areas are defined to study the underlying design characteristics of physical learning environments which support transformative learning for sustainable happiness: 'engage the heart', 'exemplify to the head' and 'enable the hands'. The following sections elaborate on the three focus areas distinguished and the design characteristics that constitute these categories.

Engage the heart

Attachment theory, the joint work of John Bowlby (1969) and Mary Ainsworth (1973), argues that the type of attachment a child develops with his or her caregiver will influence, or even determine, how the child develops (Bretherton, 1992). The image of self and hedonistic, anti-social, selfish or empathic behaviour towards others in adult life: it can to a large extent be explained through the attachment developed in early years. The influence of the physical environment on such attachment is two-fold. Firstly, the physical setting influences attachment with nature and (other) people. Secondly, attachment with place is a category on its own. Hence, the focus area 'engage the heart' regards the influence of the physical learning environment on the type of attachment one develops with (1) *nature*, (2) *people* and (3) *place*. This categorization is based on the common distinction of three hierarchically situated and dynamically interrelated dimensions of sustainability, namely (1) the biological, geological and climatological substrate and its planetary boundaries, (2) the social relationships between humans and (3) the human-made structures (Wals, 2015).

The design characteristic 'foster nature connectedness' (A1 in Figure 3) regards the physical learning environment's influence on non-human concerns, comprising flora and fauna. Theory and correlational research suggest that exposure to nature may increase cooperation, and, when considering environmental problems as social dilemmas, sustainable intentions and behaviour (Zelenski, et al., 2015).

Fostering nature connectedness comprises different levels of contact. While some found that even exposure to nature videos has an effect (Zelenski, et al., 2015), others found that not only the presence of nature, but the experiential interaction with the natural world, including animals, is of great importance for nature connectedness (Dutt, 2013).

Moreover, exposure to nature may contribute to the second design characteristic distinguished, 'foster human connectedness', since theory and correlational research suggest that exposure to nature may increase cooperation, and, when considering environmental problems as social dilemmas, sustainable intentions and behaviour (Zelenski, et al., 2015). The design characteristic 'foster human connectedness' (A2 in Figure 3) regards the physical learning environment's influence on human concerns, comprising egoistic and social-altruistic concerns (Snelgar, 2006). Pupils' image of self and degree of otherness are influenced by their localized places of study, as those places are the centres of their experiences that help teach them how the world works and how they fit into that world (Gruenewald, 2003). As a result, their image of self and degree of otherness are influenced by that place.

Finally, the design characteristic 'foster place connectedness' (A3 in Figure 3) regards the physical learning environment's influence on the psychological bond with the particular place. Place attachment, also discussed under the terms 'rootedness' and 'sense of place' (Chawla, 1992), is often understood by environmental psychologists as the bonding between individuals and places (Ramkissoon, et al., 2012). Critical ecological educators have claimed that such love of place is the key to fostering sustainability behaviours (Mayer & McPherson Frantz, 2004), as research results indicate that individuals are more likely to show pro-environmental behaviour when positively attached to a place. Ramkissoon, et al. (2012) provide an extensive overview of existing literature. For example, research has shown that place attachment through participation in maintenance and operation of school habitats can generate a sense of commitment and responsibility, resulting in positive behaviour towards that place. This is not to say that international and domestic issues are peripheral to place-based education, but that students should first have a grounding in the history, culture and ecology of their surrounding environment before moving on to broader subjects.

Exemplify to the head

The school habitat can serve as a 'three-dimensional textbook' for teaching environmental science (Spengler, et al., 2001). The influence of the physical environment on socio-ecological understanding can be structured by means of a metaphor regarding a system of gear wheels. By means of this metaphor, three design characteristics can be explained.

Firstly, in order to function well, each gear of the system needs to be in order. Hence, one needs to understand the 'subsystems' within the larger system (B1 in Figure 3). Yet, in a world of increasing complexity, specialised knowledge on the individual gear wheels is not sufficient. The interaction and relationships between the wheels (B2 in Figure 3) are of importance. As discussed previously, systems thinking is required to understand how those things which may be regarded as systems, influence one another within a larger system. Finally, understanding subsystems and relationships is not sufficient for an adequate socio-ecological understanding about what one can do to make a difference. For example, one can be motivated to contribute to the prevention of further climate change and understand that one's energy use is relevant to this end, but if one is not acquainted with one's own energy use, it will be hard to make effective changes. The last design characteristic distinguished in this respect therefore is 'provide feedback' (B3 in Figure 3).

Kong, et al. (2014) concluded that through the exposure of materials, technologies and processes, buildings in Green School Bali had been transformed into powerful teaching tools. Moreover, in-depth interviews resulted in suppositions that students' enhanced understanding led to socio-ecological motivation. This stresses the notion that the three distinguished focus areas ('engage the heart', 'exemplify to the head' and 'enable the hands') have strong mutual interactions.

With regard to all three design characteristics in this area, an important note should be made. The rise of 'sustainable' efforts in the building industry is leading to many product developments to improve building performance. For example, measures are being taken to decrease energy use. Simple examples regard heating and lighting systems which turn off and on automatically, based on schedules or sensors. If working well, these kind of systems should be able to enhance the *liveability* of the environment (see Figure 2). However, from an educational perspective such measures may be considered undesirable, as the awareness regarding certain themes (energy use, in this case) may decrease. Also, people may become 'lazy' when used to the idea that everything is taken care of without their efforts and disconnectedness is enhanced. The focus area 'exemplify to the head' therefore calls for communication regarding such (sub)systems.

Fortunately, many developments provide excellent possibilities to integrate measures in the physical environment with educational strategies. For example, building automation often allows for (real-time) digital communication about how the building performs or how it is used. Important to consider with regard to such 'communicating buildings' is that building occupants use their (school) habitat for a variety of purposes. Domination of communication over other activities should be prevented. According to their preferences, occupants should be able to move the information between the *centre* and the *periphery* of their attention. Weiser & Brown (1996) refer to this kind of technology as 'calm technology'. This way, the school habitat can be both a liveable environment and a 'three-dimensional textbook' to enhance one's life-abilities (see Figure 2).

Enable the hands

In order to discuss the influence of the physical environment on socio-ecological behaviour, another metaphor is introduced. Imagine a sheep, who is standing by the riverside. Let's say we believe that, for some reason, the other side of the river is a better place to be. If our sheep is motivated to get to that place or understands that for one purpose or another it is better to be there, chances are that he will find ways to get to the other side of the river. In that case, internal causes of behaviour (change) prevail. Internal causes of behaviour (change) regard prevalent perceptions, cognitions and norms (Steg & Vlek, 2009). Socio-ecological motivation and understanding as discussed above are such internal causes of behaviour (change).

Now image our sheep again. As sheep cannot swim, the odds are that the sheep will not get to the place we want him to be. Let's help him. We can help the sheep by providing the facility 'bridge', giving him the opportunity to move. When opportunities are created and behaviour is 'tolerated' (C1 in Figure 3), one could see the physical environment as a relatively neutral factor. It will depend on internal causes of behaviour (change) whether one will use the facilities provided. If, on the other hand, internal causes are absent or insufficient, we can choose to induce behaviour. This can be done by changing the circumstances under which behavioural choices are made, by, rather than tolerating, stimulating or repressing certain opportunities (Max-Neef, 1991). This boundary between internal and external causes is indicated in the framework, as presented in Figure 3.

With regard to stimulating and repressing behaviour through incentives and disincentives respectively (C2 and C3 in Figure 3), the well-known 'carrot and stick' idiom is applicable to our metaphor. If our sheep does not use the bridge provided based on internal causes of behaviour, we can entice him with a carrot or we can force him by striking him with a stick. The sheep will move towards the carrot because it wants the reward of food, while also moving away from the stick behind him, since it does not want the punishment of pain.

Important to consider with regard to (dis)incentives is the distinction of 'known, unknown and unknowable sustainability' (Wals, 2015). Moving people away from a place or lure them there holds the notion that we have knowledge on what is desired and undesired. Certainly, there is a lot we *do* know about sustainability, yet we should immediately add that there are still uncertainties, no matter how robust the knowledge appears. One should thus be careful when influencing particular behaviours.

Moreover, an important note should be made with regard to (dis)incentives. The following section elaborates on this.

Getting the balance right

The (categories of) nine design characteristics constituting the framework have been discussed above. In the discussion, a categorization of characteristics is made into *internal* and *external* causes of behaviour or behaviour change. This is presented graphically with the dashed line in Figure 3.

Strategies which provide internal causes of behaviour (change) are called *informational* strategies. Informational strategies aim at changing prevalent motivations, perceptions, cognitions and norms (Steg & Vlek, 2009). As elaborated on earlier, informational strategies play an important role in transformative learning for sustainable happiness, since they result in profound changes in knowledge, skills and attitudes related to enhancing ecological, social and economic justice. Therewith, informational strategies are highly educational. Contrarily, one could argue that *structural* strategies do not contribute to sustainability learning. Structural strategies provide external causes of behaviour (change) and aim at changing the circumstances under which behavioural choices are made (Steg & Vlek, 2009).

For example, ‘nudge theory’ and ‘fun theory’ describe concepts of positive reinforcement without limiting people in their freedom of choice (Thaler & Sunstein, 2008). Thaler and Sunstein explain that putting fruit at eye level counts as a nudge, while banning junk food does not.

The critique on such structural theories and approaches, comprising external causes of behaviour (change), primarily regards their focus on the short-term: when successful, (dis)incentives have an influence on choices made at the moment of exposure to the (dis)incentive. For example, putting fruit at eye level (an incentive, as discussed in the previous section) may lead to an increased purchase of fruit. However, if this is only due to convenience, the altered behaviour will not maintain over time since the behaviour is conditioned, rather than internalized. Chances are that as soon as the customer visits another market or if the market reverses her policy, the customer will fall back into old habits.

One could therefore argue that they do not belong in a framework aiming at a positive contribution to transformative sustainability learning, as they can be regarded ‘conditioning of behaviour’ and considered part of the ‘eco-totalitarian regime’ presented in Figure 1. On the other hand, external stimuli can support internal causes of behaviour. For example, if the customer already had the intention to buy fruit, (dis)incentives may help to realize his intentions. In that case, external stimuli *do* have an educational character, as they can help to escape old behaviour patterns or to develop new habits and routines, due to which those behaviours can be maintained and reinforced over time (Defra, 2008). Since (dis)incentives can also be experienced as supportive with regard to internal causes of behaviour, these external stimuli are included in the framework.

In the context of transformative sustainability learning, it is thus important to never apply external stimuli in isolation. Rather, external strategies should always be combined with internal stimuli for behaviour (change). The framework gives insight into how the design characteristics distinguished provide either internal or external stimuli in the physical learning environment in order to facilitate this balance.

FROM THEORY TO PRACTICE: A ROADMAP

As discussed extensively, the current research departs from the aim to contribute to transformative sustainability learning with ‘sustainable happiness’ as the ultimate goal. In current practice, many developments are taking place which contribute to sustainable happiness without aiming for this specifically, as financial motivations very often dominate. Perhaps the most common measure which simultaneously contributes to sustainable happiness and increases financial profit, is decreasing energy use, which is important from both an economic perspective as well as from the perspective of the natural environment. Other examples regard decreasing operational costs by reducing sick-leave (Veenhoven, 2012) or by increasing the productivity of employees by improving comfort and health (Vanderveen, et al., 2015b).

As opposed to this chrematistic, market-centred dimension of the current economic process (Cruz, et al., 2009), the current research places *people* and the *planet* at the core of the ‘development’ discussion. This does not at all undermine the importance of the economy, but treats it rather as a servant than as something we should serve. It means that our goal-setting focuses on human and non-human life, while the economy receives attention in order to realize the goals set. In the framework, demands are dealt with from a purely idealistic perspective. Practical implications and limitations, for example related to time, space and money, are not taken into account.

Yet, practice proves that this is insufficient for change to arise. For example, Huckle and Wals (2015) argue that the worldwide UN Decade of Education for Sustainable Development (which ran from 2005

to 2014) represents ‘business as usual in the end’, since current global realities are not faced up. According to them, one of the reasons for this is inadequate guidance.

Similarly, no operational assistance is available to schools to transform their physical learning environment to support transformative sustainability learning. Therefore, this section aims to bridge the gap between theory and practice. To this end, a roadmap is presented in which the potential of the framework for practice is illustrated. The roadmap concentrates on the situation of educational real estate for primary and secondary education in the Netherlands.

Through application in practice, conflicts between the idealistic perspective and practice can be found. For example, products to arrive at the admired performance may be lacking or policy may hinder or prevent certain developments to take place. Hence, the application of the framework and roadmap may serve as a research and development agenda or as a basis for policy development.

A roadmap in the life cycle of buildings

The life cycle of building covers six stages, namely planning, programming, design, construction, occupancy and adaptive reuse/recycling (Preiser, et al., 1988); see Figure 4. The goal of the roadmap presented in this section is to provide guidance in this life cycle in order to arrive at suitable and sustainable school habitats in the context of transformative sustainability learning.

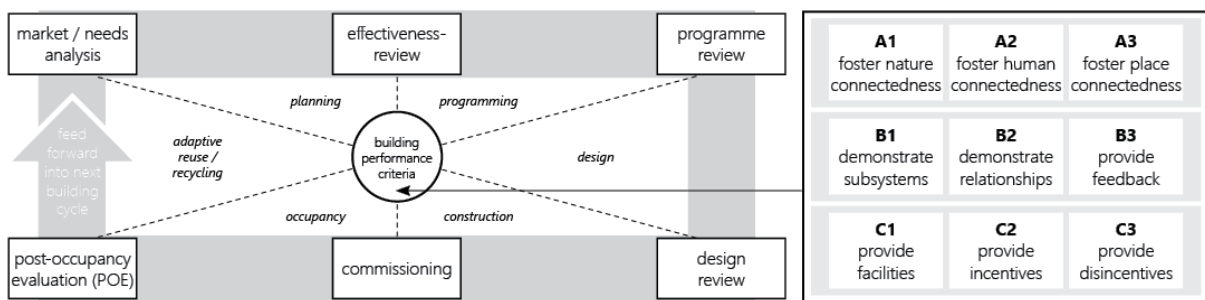


Figure 4 Building performance evaluation (BPE) cycle (Preiser, et al., 1988). The nine design characteristics A1 to C3 constituting the framework presented in this study (see Figure 3) can serve as building performance criteria.

In order to evaluate to what extent the desired building performance is planned or realized in diverse stages of the life cycle of buildings, one has to have criteria for evaluation. As presented in Figure 4, building performance criteria therefore play a central role in building performance evaluation. The nine design characteristics constituting the framework can serve as such criteria. The framework thus provides a basis for building performance evaluation.

To guide various actors in these phases, the developed roadmap comprises a step-by-step approach. It is presented graphically in Figure 5. The following sections elaborate on this roadmap, on the actors involved and on how the developed framework plays a role in the roadmap.

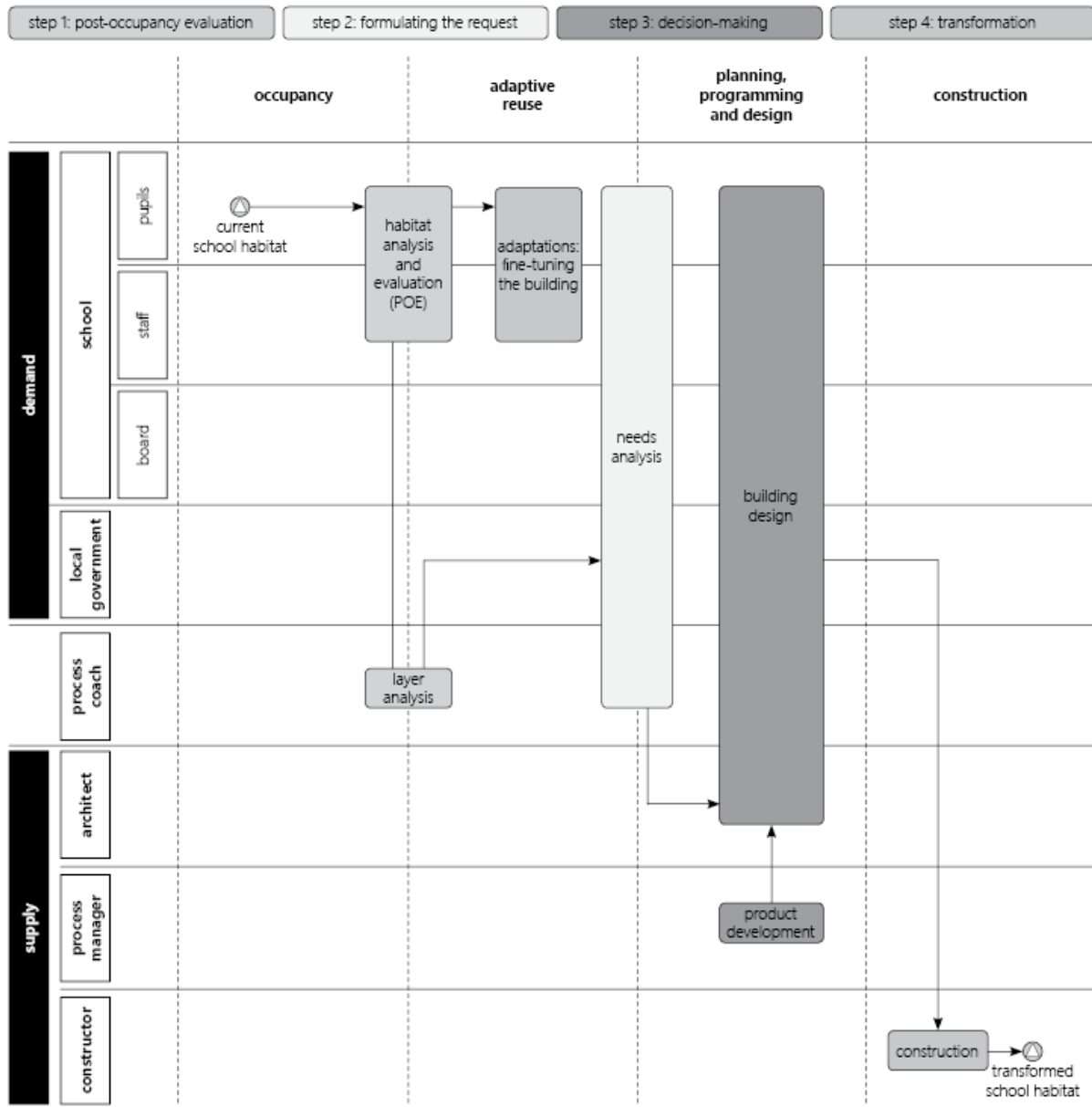


Figure 5 Roadmap presenting the role of diverse actors in various life cycle stages of buildings in order to arrive at physical learning environments which contribute to transformative learning for sustainable happiness

Step 1: post-occupancy evaluation

Building performance evaluation regards evaluation in the complete life cycle of buildings, as presented in Figure 4. In order to be able to develop appropriate plans for transformation, insight into the current situation is required. The roadmap therefore starts with a 'post-occupancy evaluation' (bottom left in Figure 4) of a current school habitat. Post-occupancy evaluation (POE) takes place after or during the 'occupancy' stage of the building life cycle. It is the process of evaluating buildings in a systematic manner after they have been built and occupied for some time (Preiser, et al., 1988).

Through an analysis of a current school habitat and a comparison with the established performance criteria, insight can be gained into the discrepancy between the present and the desired situation. As presented in the roadmap (Figure 5), this paper argues that pupils should be engaged in the evaluation of their school habitat. Many researchers and practitioners, including the Australian and European Performance Based Building (PeBBu) Networks, found that in order to enhance the adoption and implementation of performance based building, stakeholders from especially the demand side should actively be engaged (Foliente, 2004). In the case of school design, pupils are the primary occupant group, which makes their opinion on the building performance important to incorporate. Moreover, it is in line with transformative sustainability learning to involve pupils in the process rather than outsourcing the task of POE. This way, the physical learning environment can serve as an instrument for education not only after it is completed, but also in the process of building transformation.

The next section elaborates on such an evaluation of a case study school. Data gathering is done through unstructured interviews and structured on-site observations with pupils (age 10 to 11) and teachers. The observations and interviews with the pupils are structured by the adoption of 'BREEAM Junior', which served as a data gathering instrument (see Appendix D). BREEAM Junior is a for education adapted version of BREEAM, which is the most widely used sustainability assessment code for buildings in Europe. The quick scan tool BREEAM Junior can be used by pupils and includes behavioural assessment criteria. This allows for the evaluation of the influence of built structures on behaviour. Moreover, pupils' answers on the questions with regard to the school building provide insight into their socio-ecological understanding. Insight into motivation is gained primarily through unstructured interviews (see Appendix C).

Performance criteria alone, however, do not provide a structure to systematically analyze built structures. To this end, a building decomposition method is required. Throughout history many decomposition methods have been developed. Schmidt, et al. (2011) provide a structured comparison of decomposition systems which are most often used. This research adopts the decomposition method developed by Brand (1994). His decomposition constitutes six layers; site, structure, skin, services, space plan and stuff. The main difference between the decomposition of Brand and many others regards its range; while many methods regard the 'building' only, Brand takes into account other built, or physical structures as well, such as the exterior 'site', and 'stuff' inside the building. These layers are important to incorporate when the wide-ranging 'physical learning environment' is studied.

Adopting the six layers distinguished by Brand and combining them with the nine design characteristics distinguished in this study, an instrument for analysis can be constituted; see Table 1. This instrument facilitates an analysis of diverse layers of a specific physical learning environment with regard to the distinguished design characteristics. The instrument provides a structure to study all elements present in the physical environment with regard to their role in transformative sustainability learning.

The layer analysis regards the interpretation and explanation of the data collected by pupils by means of Table 1. The section 'A post-occupancy evaluation using the framework' presents such an analysis of the case study school in order to provide insight into the functioning of this instrument.

Table 1 The instrument for analysis is based on the nine design characteristics A1 to C3 constituting the framework developed in this study (see Figure 3) and the decomposition method set by Brand (1994)

	Engage the heart			Exemplify to the head			Enable the hands		
	A1	A2	A3	B1	B2	B3	C1	C2	C3
Site									
Structure									
Skin									
Services									
Space plan									
Stuff									

The analysis of the design characteristics with regard to the building layers (see Table 1) is considered a task too specialized for pupils and school staff. It is therefore suggested that a ‘process coach’ fulfils the role of building analyst (see the roadmap in Figure 5). In some cases, the architect (supply side) or a skilled school board member, parent or municipality employee (demand side) might be competent to conduct this analysis. However, it is valuable if this understanding is gained before selecting an architect. Moreover, previous research has shown that school building processes are often harsh due to inadequate communication and collaboration between demanders and suppliers and that a process coach could solve this problem (KIEN, 2015). Therefore, it is suggested to appoint a process coach who can fulfil these tasks simultaneously and acts as the bridge between demanders and suppliers in the diverse necessary fields.

Step 2: problem structuring and formulating the request

The analysis by means of Table 1 indicates how the present school habitat performs. Simultaneously, it shows the gaps in its current performance. The analysis and evaluation therewith provide a basis for the dialogue with regard to the school’s ‘needs analysis’ (see Figure 4), which captures the school’s request and constitutes the premises for the design of the physical environment.

This study specifically focuses on application in the Netherlands. In the Dutch situation, local governments are the owner of educational real estate. School boards are responsible for maintenance and operation. This means that in substantial transformations, both parties are involved. Yet, the task of building transformation is often a once-in-a-lifetime job for these decision-makers. Therefore, it is typically hard for them to express an appropriate demand towards supplying parties. As discussed previously, their set of demands consequently often results from ‘common’ practice and habits and represents the culture they are in, rather than the actual needs they have. This study responds to that situation by providing guidance to these non-professional clients, which include both users (pupils and staff) and other stakeholders (school boards and municipalities); see Figure 5.

The dialogue with regard to the school’s needs analysis is closely related to the school’s vision on sustainability and education. The insight gained by means of the post-occupancy evaluation provides a basis for this dialogue, in which all actors at the demand side should be engaged. It is important that the process coach is involved in this dialogue in order to inform and assist schools and municipalities, since it has often been concluded that one of the core issues in building transformation processes regards the inadequate request schools and municipalities formulate.

Step 3: idea generation and decision-making

In the analysis and evaluation of the case study, as presented in the following section, the evaluation by pupils and staff directly led to minor modifications in the physical environment. Even during the evaluation, they started moving furniture based on insights gained with regard to the influence of the

physical learning environment on their behaviour. Such adaptations to fine-tune the building lead to ‘adaptive reuse’ of the building; see the roadmap in Figure 5. They regard minor or small-scale transformations of the physical environment. POEs may thus be used for a variety of purposes, such as trouble-shooting shortly after moving in, fine-tuning the building during the occupancy stage, providing feedback for problem solving or assessing the need for new construction (Preiser, et al., 1988). Whether this transformation will regard only minor modifications, large-scale renovation or even a new building, depends on the performances of the current school habitat and its discrepancy with the admired situation on the one hand and the availability of resources on the other hand.

Larger transformations will require a more extensive process and the involvement of other actors. The needs analysis, accomplished in step 2, provides a basis for this process. In the planning, programming and design phases (see Figure 4) plans for transformation are made based on the request of demanding parties (step 2).

This request consists of the performances called for by demanders, which capture the requested performance-in-use. Such performance requirements thus regard ‘end result’ specifications. Such end result specifications contrast with ‘recipe’ specifications, in which the provider is instructed with solutions for *how* to respond to the client’s demand (Gibson, 1982). Since these instructions are absent in the performance concept for building, it is up to the supplier to invent ways to supply the performance desired.

This applies to diverse system levels; product developers provide specific solutions at a small scale, while the architect is responsible for the ensemble of products at a building level. Both parties may benefit from the nine design characteristics distinguished, when they use them in combination with ‘morphological analysis’ (Zwicky, 1969). An example of a ‘morphological box’ used in such an analysis is presented in Table 2. This box, which may be extended to a multidimensional matrix, captures possible solutions for each of the performance requirements set. This method can be used in the planning, programming and design phases as an aid for the generation of ideas, as it fosters creative thinking and facilitates discovery. Through an evaluation of the possible solutions, solutions can be selected and combined, as presented in red in Table 2.

Table 2 The nine design characteristics A1 to C3 constituting the framework developed in this study (see Figure 3) provide a basis for a ‘morphological analysis’, e.g. with regard to the building ‘skin’.

Idea generation and decision-making for the ‘skin’								
Engage the heart			Exemplify to the head			Enable the hands		
A1	A2	A3	B1	B2	B3	C1	C2	C3
solution 11	solution 21	solution 31	solution 41	solution 51	solution 61	solution 71	solution 81	solution 91
solution 12	solution 22	solution 32	solution 42	solution 52	solution 62	solution 72	solution 82	solution 92
solution 13	solution 23	solution 33	solution 43	solution 53	solution 63	solution 73	solution 83	solution 93
solution 14	solution 24	solution 34	solution 44	solution 54	solution 64	solution 74	solution 84	solution 94

Step 4: transformation

The actual transformation of the school habitat takes place after and based on the decision-making phases (step 3). This phase is beyond the scope of this research.

Continue the cycle

Demands constantly change and without interventions, the school habitat will not keep meeting them. It is therefore of great importance to continue the cycle; keep evaluating the performances and keep adjusting when necessary. For example, practice shows that BREEAM Junior, as elaborated on in step 1, is a suitable evaluation tool to use on a yearly basis.

A POST-OCCUPANCY EVALUATION USING THE FRAMEWORK

This section discusses the results of the evaluation of the case school by means of the framework presented in Figure 3. It regards the first step of the roadmap presented in Figure 5. This evaluation provides insight into how the physical learning environment of 'de Sokkerwei' provides input for socio-ecological understanding, motivation and behaviour. The design elements and principles noticed are discussed in relation to the 3x3 design characteristics captured in the framework. Subsequently, conclusions are drawn from the evaluation of this school.

An evaluation of design elements and principles

Engaging the heart

Table 3 presents the results of the analysis of the case school with regard to the first focus area: engage the heart. The following sections discuss this analysis and evaluate the discovered design elements and features.

Table 3 Analysis of design elements and principles contributing to socio-ecological motivation (① building shape and materials; ② the presence of nearby nature and natural school grounds; ③ climatic and seasonal exposure; ④ personalization; ⑤ place identity; ⑥ building condition; ⑦ scale; ⑧ inclusive design; ⑨ engaging routing)

	Socio-ecological motivation		
	Foster nature connectedness	Foster human connectedness	Foster place connectedness
Site	② ③ ⑤	② ⑦ ⑨	⑤ ⑦ ⑨
Structure	①	④	④
Skin	① ② ③	⑦	⑦
Services			④
Space plan	③	① ⑦ ⑧ ⑨	① ⑦ ③
Stuff	③	④	③ ④

Building shape and materials ①

The perhaps most remarkable thing about the school studied is its circular shape. Orientation visits and interviews quickly led to the conclusion that both pupils and staff very much appreciate this form. The building shape and materials can be seen as an expression of 'organic architecture' (Ree, 2000), or more specifically, of the organic school architecture of Rudolf Steiner. Steiner (1927) maintained that designs should be 'living forms' that also speak to the emotional, psychological, mental, moral, and spiritual natures of human users (Adams, 2005). He argues that architectural forms and spaces should arise organically from such 'inner functions' as well as from outer functions, such as structural and physical functions, in order to build in harmony with the spirit of people and nature in order to arrive at spiritual life within society.

The design measures noticed in this respect are various; see Table 3. The circular shape and the resulting place of togetherness in the centre of the building (which manifest themselves in the space plan) are believed to foster human connectedness. Moreover, the non-rectangular interior and exterior spaces characterise the experience of being at this school and contrast severely with the static or geometrical forms of most architecture and design. As a result, for many of the pupils this school is a very special place in their neighbourhood and is expected to foster place connectedness.

Several natural building materials are applied, which are expected to foster nature connectedness. The structural elements in the circular theatre of the school are made of local wood and can be considered representing a tree, covering this central place of togetherness. Moreover, a vegetated, green roof (part of the building skin) is present.

The presence of nearby nature and natural school grounds ②

The green roof (part of the skin) discussed under ① is the most noticeable form of nature in the school building. By all pupils, it is directly referred to when asked about the sustainable characteristics of their school habitat. Moreover, on the school grounds many trees are present and part of the facilities and finishings are made of natural building materials. Altogether, the appearance of the school is quite 'green'. Research shows that such 'green' school grounds foster human connectedness, as exposure to nature lessens bullying behaviour and often increases cooperation (Zelenski, et al., 2015).

Also, the natural school grounds are expected to foster nature connectedness. However, it seems that the full potential is not realised. Dutt (2013) explored how school design mediates students' relationships with the natural world. She found that not only the presence of nature, but the experiential interaction with the natural world is of great importance for nature connectedness. She provides an example of a pupil for who the design of the building and school grounds is not enough; daily interactions with the natural world inside schools, including animals, are an important element in having an attentive relationship to the earth. Similar results have been found in the case school. Although the school building and site possess quite some natural elements, interaction with nature is scarce. For example, no animals are present at the school and natural elements are limited to the exterior. Also, classes with regard to nature are never held in nature. Rather, pupils learn about nature via the books and lectures provided. No nature interaction is provided inside the school; the design elements noticed are restricted to the school 'site' (see Table 3) (the roof is also only visible from the site).

As a result, pupils from the student council are now lobbying for a school garden. In between the school grounds and the building skin, each classroom has its own little green space. These spaces could be used for gardening, as they used to in the past. Currently, the state of the greenery in these spaces is poor. This is discussed further under 'Enabling the hands'. Moreover, pupils mentioned that one of the reasons that even when initiatives are taken to enhance the state of this greenery, they sometimes negatively affect the greenery when they play hide and seek. This calls for natural school grounds with facilities for both play and gardening in order to foster nature interaction in diverse manners. Currently, the protection of the gardens would mean that pupils are not allowed to play with nature, since no other facilities are provided. As a result, the pupils regularly argue with regard to the use of the soccer field, since it is not large enough for all pupils at the same time and hardly any other opportunities for the larger children exist to entertain themselves on the school grounds.

Climatic and seasonal exposure ③

Whereas 'The presence of nearby nature and natural school grounds ②' can be considered a relatively static aspect, climatic and seasonal exposure goes a step further and concerns the visualisation of natural cycles and events. Affection with the regional climate, the seasons and the weather are important with regard to many forms of consumption and behaviour, such as food selection. The physical environment can strengthen this affection with nature and place through climatic and seasonal exposure.

On the school site, this is done through the presence of deciduous trees. As a result of these trees, in the autumn the school grounds are covered with leaves. Almost all toddlers were playing with these leaves, rather than with the facilities provided for play. They specifically mentioned that the leaves were one of the reasons they so much appreciated the fall season, strengthening their nature connectedness.

Moreover, Dutt (2013) found skylights to invite the weather to come to school as they were used explicitly in lessons about weather. They highlighted or celebrated natural weather events, which became meaningful experiences for the students. Similar feedback was given by pupils in de Sokkerwei with regard to their skylights (part of the skin).

Finally, climatic and seasonal exposure may regard the celebration of traditions related to the seasons and the climate. The space plan must facilitate this and stuff can make it come true. For example, a Christmas tree and other seasonal decorations are observed during the Christmas period and pupils mentioned that during other seasons, similar efforts are made with regard to the decoration of the school. The central theatre of the school provides a perfect space for this. The pupils are actively engaged in this, fostering their relationship with place and nature.

Moreover, the window sills and diverse furniture following the circular shape of the building are used to exhibit the creations of pupils. This is related to the extent to which the physical environment enables 'personalization', on which the following section elaborates.

Personalization ④

Through the personalization of place, the psychological bonding with that place can be enhanced. Building elements which contribute to this thus foster 'place connectedness'. Moreover, personalization may enhance human connectedness if it regards not only 'me', but also 'we'. A lot of 'stuff' is given a place in de Sokkerwei which foster human and place connectedness, such as drawings, pupils' creations and self-made birthday calendars. The structure, primarily its beams, are used to this end. The beams have the same height as regular sheets of paper, which make these beams an ideal exhibiting space for the drawings of pupils. In the classrooms of the toddlers, the ceilings are intensively used. Although the drop ceilings are not experienced as visually attractive, they do facilitate this because the panels can easily be lifted, due to which the ceiling's profiles can serve as anchorages. Also, the chairs and the coast racks are personalized, by means of the children their names and a different drawing for each pupil.

Moreover, personalization takes place with regard to the services; several pupils mentioned that they preferably work on the mezzanine floor, because there they can adjust the local climate based on their preferences.

Place identity ⑤

Important contributions to the understanding of 'place' have been made by Relph (1976). By the identity of a place, Relph refers to its "persistent sameness and unity which allows that [place] to be differentiated from others". Relph describes this persistent identity in terms of three components: (1) the place's physical setting; (2) its activities, situations, and events; and (3) the individual and group

meanings created through people's experiences and intentions with regard to that place. Place identity defined in this threefold way may foster place connectedness. Moreover, the physical setting may comprise natural elements which foster nature connectedness. Finally, collective experiences may foster human connectedness. Finally, collective experiences may foster human connectedness.

The distinctive atmosphere of a place is often referred to as the place's 'genius loci'. The place's physical setting can express and strengthen this uniqueness. In de Sokkerwei, such site specific features are found in the natural setting of the school, including several trees and a pond on the site. During the design process of this school, several stakeholders have stood out to maintain these elements. The pond provides the opportunity to learn about the exceptional water situation of the village, which is situated very near to the sea.

Building condition ⑥

The condition of buildings is an expression of status; similar to how slums express the position of their inhabitants in society, the condition of educational real estate gives an impression of the value attributed to education, pupils and teachers. This influences one's attachment with place and one's image of self and others (human connectedness). In de Sokkerwei, the pupils considered their school well-maintained. Some pupils mentioned plastic litter on the school grounds (see the section 'Enabling the hands'), but they consider this something they should work on themselves, rather than an expression of their status in society as determined or understood by others.

The decomposition method for built structures (see Table 3) is considered unsuitable to assess building condition, since it regards all aspects of physical environments. This is discussed further in the section 'Discussion and conclusions'.

Scale ⑦

The issue of 'scale' is widely discussed in the field of architecture. New technologies have given rise to modern aesthetics, which have drastically changed architectural expressions. New technologies have enabled the production of large parts and spans, and over time the relatively low costs of industrial fabrication have eradicated many forms of human crafts. As a result, the 'human scale' in the built environment is often being threatened. The Roman author, architect, civil engineer and military engineer Vitruvius is famous for his work in this field of human proportions and scale, among other things. He defined the 'Vitruvian Man', as drawn later by Leonardo da Vinci: the human body inscribed in the circle and the square. He argued that physical environments should be based on this human scale. This is essentially related to the 'organic architecture' elaborated on under 'Building shape and materials' ①; according to Vitruvius, architecture is an imitation of nature and as birds and bees built their nests, so humans constructed housing from natural materials and in proportion to its users.

Especially in school environments, the issue of scale even goes beyond one single 'human scale', since humans with all kinds of sizes use the building. The user group ranges from toddlers, to young teenagers, to school staff. In order to engage all of their hearts and to enable autonomous use to all, a variety of scales is thus required.

In de Sokkerwei several building elements are noticed in this respect. For example, the height of the railings on the school site differ between the entrance of the toddlers and the entrance of the larger children. Moreover, windows in both the skin and interior walls are specifically designed for children, as the height is adjusted to them. This is expected to foster connectedness with place and to enhance the image of self, since it expresses that everyone is thought of and welcome to participate.

Moreover, the issue of scale and autonomous use goes beyond different user ages and lengths. The following section elaborates on 'inclusive design'.

Inclusive design 8

International efforts have increased and are still contributing to an increase of awareness regarding the fact that many people do not have the 'ideal' proportions and size of the man described by Vitruvius as discussed under 7. In many studies, the physical environment has been identified as a dominant factor for a more just and inclusive society in which all needs are understood as integral to society's order and not identified as 'special' (Farrington & Farrington, 2005; Woodcraft, 2012; Sherlaw & Hudebineb, 2015). Accessibility is a key issue towards the freedom of many people to autonomously participate in social life. Historically, improving accessibility began with building special facilities for people with all kinds of 'special' needs, such as chronically handicapped.¹ Unfortunately, this approach did not lead to inclusion at all, since grouping people together resulted in separation, or integration at best (see Figure 6).

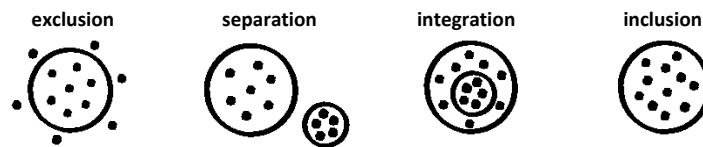


Figure 6 Graphical representation of exclusion, separation, integration and inclusion

In the case studied, special chairs (stuff) for two pupils with a muscle disease are present. Moreover, the stairs and steps are not accompanied by ramps or elevators. The steps, the stairs and the chairs therewith embody 'categorical solutions' for accessibility. Categorical solutions are intended for an exclusive target group (Vanderveen, et al., 2015a). In this case, the chairs are designed for use by handicapped, facilitating 'integration'; see Figure 6, while the stairs and steps can only be used by people who have no mobility constraints.

Therewith, categorical solutions characterize 'discriminating' built environments. However, hearing the pupils, the situation in this school is not experienced as a discriminating environment. As discussed further under 'Enabling the hands', the pupils in this school even considered the barriers in the environment (such as the steps) as a stimulus for human connectedness. Unfortunately, no conversations with the pupils with a muscle disease were possible in order to hear their story with regard to this situation.

Engaging routing 9

The routing in the case school is aligned with its circular shape. In the morning, right before the lessons start, two pupils perambulate this circular route through the building with a bell to inform everybody about the current time. Rather than a reprimanding message of an automated system, the ringing bell therewith becomes a gentle reminder of peers to start your activities. This type of engagement fosters connectedness among pupils, as well as between pupils and other occupants. The same counts for the 'waste service'; twice a week, two to three pupils collect the trash from all classrooms through this route. Most other route designs would not make it impossible for such activities to take place, but this setting is expected to foster such doings as it is beautifully aligned with them. For the pupils, their participation in both duties feels as an honour.

Of course, this is not only due to the architectural form. It is essentially related to the school ethos. If such duties are seen as tedious tasks, the routing may have the opposite effect, as the pupils who collect the trash could be regarded the 'losers' of the week. The section 'Discussion and conclusions' elaborates on this.

¹ See Vanderveen, et al. (2015) for a historical overview of social inclusion and accessibility in the (public) built environment.

Moreover, routing plays a role at different scales, as it does not only concern the routing *in* the school, but also *to* the school. The section ‘Enabling the hands’ elaborates on the extent to which the location of the school fosters active lifestyles. This is related to the extent to which the routing to the school engages the heart, since a pleasing route may serve as an *incentive* (see the section ‘Enabling the hands’) to walk or cycle, rather than to come by car.

This is a general comment with regard to this section concerning the heart, which is now coming to an end. The framework (see Figure 3) defines a relationship between the engagement of the heart and socio-ecological motivation. However, clearly, engagement of the heart is not always related to socio-ecological issues. We can experience pleasure from all sorts of things. The wide variety of sources of experiences we call ‘pleasurable’ and sizes and shapes of these experiences, is opposed by the simplicity of the thing they have in common: they feel good (Smuts, 2010). Pleasurable experiences are not (necessarily) pleasurable because we prefer them based on an intrinsic motivation for socio-ecological welfare, but because they feel good.

‘Pleasure’, as an engagement of the heart, can therewith be deployed as a stimulus for socio-ecological behaviour without being related to socio-ecological motivation. Such an incentive, which engages the heart, thus regards *extrinsic* motivation for socio-ecological sustainability.

Exemplifying to the head

Table 4 presents the results of the analysis of the case school with regard to the second focus area: exemplify to the head.

A structure to analyze the influence of the physical learning environment on socio-ecological understanding has been found in the concept of ‘metabolism’. Metabolism is a word used in several contexts. As used in its original biological context, the word connotes the internal processes of a living organism (Ayres & Simonis, 1994). In a broader sense, it regards the throughput of resources through a system and thus comprises the inputs, processing, outputs and impacts of a process. Examining the metabolism of a system thus allows to gain insights into resource utilization and waste production (Kibert, et al., 2002). Physical environments (such as buildings, urban areas and cities) also have such a metabolism which can be mapped and measured (Graham, 2003). This section distinguishes five flows with regard to the metabolism of physical learning environments: air, water, energy, materials and food. The scope of the evaluation is limited to these five flows.

Table 4 Analysis of design elements and principles contributing to socio-ecological understanding, clustered per flow (1 air, 2 water, 3 energy, 4 materials, 5 food)

	Socio-ecological understanding		
	Demonstrate subsystems	Demonstrate relationships	Provide feedback
Site	1	1	
Structure			
Skin			
Services	1 2 3	1	
Space plan			
Stuff	5		

Air 1

Air handling

An air handling unit is placed on top of the roof and demonstrated, as it is visible from the school grounds. However, neither teachers nor pupils seem to be aware of the function of this unit. By one of the toddlers, it was referred to as a ‘radio’.

Supply: exposed HVAC system

Air supply is provided by air ducts, attached to the ceilings of the classrooms and in the sight of users. Some teachers pay attention to these services in their classes. However, as most of the teachers who participated in the building process resulting in this building have now left the school, the number of educators who actively use this feature of the school habitat in their lessons is decreasing.

One pupil elaborated further on the HVAC system than the exposed air ducts in the classroom. He knew where the air comes from before entering the classroom and showed me the inlet in the building façade. These are positioned above the exit of the car park, which is situated underneath the school. As a result, the air entering the classrooms sometimes smells like exhaust air, due to which the understanding of the pupils in that class with regard to the functioning of the HVAC system within the larger system was enhanced. Although they considered this undesirable, it illustrates the variety of ways to demonstrate subsystems and relationships between systems.

Indoor climate

No insight is provided into the state of the indoor climate on the one hand and the relationships between the subsystems present, the presence of people and their settings with regard to the HVAC system on the other. Many pupils complained with regard to the indoor climate; they considered it either too cold, too warm or not fresh. No insight is provided with regard to the factual situation.

Outdoor climate

With regard to the climate outdoors, one element is noticed which elaborates on the relationship between air quality and elements and features present in the physical environment. On the school site, a 'climate grove' is present. Several trees are planted as part of a project aiming to decrease climate change and this is explained on a sign board in front of the trees.

Water ②*Rainwater drainage*

The drainage of rainwater is visible in the central hall of the building; rainwater drainage is aligned with the structural elements present. It is however not demonstrated where the water goes subsequently and if it is used in the school, for example to flush the toilets.

Sanitary

Most of the water used by the pupils is used in the bathrooms. Pupils are, however, unaware of the amounts and type of water (black, grey or white) used. The physical environment does not contribute to an enhanced understanding, since no insight is provided into the water flows through the school. Neither subsystems, nor relationships are demonstrated and feedback is not provided.

Energy ③*Generation: solar panels*

The roof of the school is covered with about sixty solar panels. Due to the slope of the roof, these panels are clearly visible from the school grounds. Hence, these subsystems are demonstrated; see Table 4. However, the extent to which understanding is provided with regard to the functioning of these subsystems is limited. For example, the data gathering with pupils and the interviews show that most pupils are not aware of the amount of energy provided by the photovoltaics. Moreover, insight into the relationship between the solar panels and the larger system is lacking. No insight is provided into what the energy is used for and if the amounts generated cover the amounts of energy consumed in the school.

Generation: windmill farm

Besides the energy generation by means of photovoltaic panels on the school building, the school has invested in a windmill farm. Unfortunately, no educational aspect of this farm is found, since nothing with regard to the windmills is demonstrated towards pupils.

Usage: lighting and computers

The lighting in diverse rooms is automated; the lights turn on automatically when people enter the room. As discussed in the section 'Exemplify to the head', such automated systems hold a risk of disengagement of users. Some of the teachers pay attention to this, by actively discussing such features of the building. The physical environment itself does not communicate regarding it. Neither with regard to the automated, nor to the unautomated lighting systems, insight is provided concerning the energy utilisation of these systems or the relationships with, for example, the energy generated on the roof of the school. The same is true with regard to other equipment, such as the computers. During the evaluation, pupils concluded that thirty computers were turned on without being used, while they were previously unaware of this.

Materials 4*Building materials*

During the building process, building materials have gained special attention and many materials have been selected which could be considered sustainable. In order to answer the questions in the quick scan tool with regard to building materials, pupils asked the director and the teacher whether their school has been built in an environmentally friendly manner. They answered 'Yes', while these teachers were actually unaware of the measures taken and materials applied. The story goes that the school is 'sustainable', but insight is often lacking *why* one could consider the school sustainable.

Contrarily, the materials used for the skin and structure used to be 'labelled', so that pupils could read about the origin of the building materials. The labels were made by pupils themselves and they organised tours for external parties, such as teachers from other schools or teachers in training. Nowadays, these labels are not present anymore and most school staff is not aware of the building materials chosen. As a result, no educational aspects with regard to them are identified.

Waste

During their evaluation, pupils concluded that they often misuse the waste bins provided, because they do not have proper understanding with regard to the different waste flows. Therefore, they proposed to illustrate on the bins which kind of products they can throw in that bin in order to enhance their understanding.

Processing and impacts

Due to their participation in the 'waste service' (see 'Engaging routing 9' in the section 'Engaging the heart') the pupils know what happens with the waste after they throw it away. However, they do not know what happens with the materials after they leave the school and no insight is provided into the impacts of waste through the design of the physical environment.

Food 5*Inputs*

The food consumed in the school is exposed in front of each classroom; a table is positioned next to each classroom door, where the pupils set out their consumptions. This provides insight into the consumptions of peers, but lacks information or feedback with regard to their origin, production methods and impacts. The effects of this 'food exposure' are discussed further in the section 'Enabling the hands'.

Waste

The waste materials used to pack food are already discussed under ④. The human waste resulting from food and food waste are not given any educational attention in the case studied, although after the evaluation several pupils started advocating to build a compost heap, which could address this issue. Currently, organic waste is not collected separately.

Processing and impacts

The impact of food, for example related to the health effects of food consumption and the environmental impact of food generation, are not given any role in de Sokkerwei’s physical environment. Demonstrating the impacts of the processing of food could regard, for example, insight into the digestion of food as a result of climbing the stairs as opposed to taking the escalator.

Enabling the hands

School habitats may provide hands-on examples of technologies and practices for resource conservation, recycling, energy use, air quality, and the like (Spengler, et al., 2001). In order to enable such practices, it is important that the physical learning environment supports this. Table 5 presents the results of the analysis of the case school with regard to this third focus area: enable the hands. The findings are clustered by the themes used in the quick scan tool BREEAM Junior (see Appendix D).

Table 5 Analysis of design elements and principles contributing to socio-ecological behaviour, clustered per theme (① litter and waste, ② food, ③ greenery, ④ safety, ⑤ mobility, ⑥ air quality, ⑦ hygiene, ⑧ water, ⑨ energy)

	Socio-ecological behaviour		
	Provide facilities (tolerate behaviour)	Provide incentives (stimulate behaviour)	Provide disincentives (repress behaviour)
Site	③ ⑤	⑤	⑤
Structure			
Skin			
Services	⑥ ⑧ ⑨	⑨	⑨
Space plan	① ③ ⑤	① ② ③ ④ ⑤	① ② ⑤
Stuff	① ⑦	① ②	① ②

Litter and waste ①

In and outside de Sokkerwei, only little litter is present. This is worth a compliment for pupils and staff, especially since the amount of bins present on the school grounds is not large. Yet, a few pupils complained regarding litter on the school grounds. They call for more ‘facilities’ for waste collection outside. Although this could indeed enhance the waste situation, space for improvement with regard to users’ behaviour concerning waste primarily regards the *separation* of waste, rather than the *collection* of waste. Each classroom has its own facilities for separated collection of plastic, paper and residual waste. Nevertheless, several pupils concluded that they hardly used the plastic bin and threw their plastic waste in the residual waste bin instead, because they had to walk too far to the first-mentioned. The evaluation of these facilities by pupils directly led to minor modifications in the physical environment; in order to eliminate such disincentives, they started moving stuff (e.g. the plastic bin) based on insights gained even during the evaluation. Moreover, they concluded that enhanced ‘understanding’ would in this case serve as an incentive. Several pupils mentioned they did not know which products should be thrown in which bin. They proposed to illustrate this on the bins. This issue is further discussed previously, in the section ‘Exemplifying to the head’. Furthermore, they found that facilities for organic waste are absent.

In the heart of the school under study, an 'Eco-place' is arranged. Here, used batteries, clothing and markers are collected, either for recycling or donation purposes. The special thing about this place is its place; although not particularly mentioned with regard to this 'Eco-place', pupils did mention the location of facilities in the school in relation to the actual use of them. The school possesses a large, touch-screen game computer, which is situated in one of the entrances of the building. It is however hardly used by the 5th and 6th graders, "because we are all the way over there": they are situated on the other side of the building and therefore do not encounter it, especially since they use another entrance. By contrast, the Eco-place is situated in the centre of the building. This entails that, contrarily to the game computer mentioned, it is more or less on the route of all pupils. All pupils regularly visit the central space in the school for a variety of purposes, so they encounter the Eco-place on a regular basis. Yet, whether this place concerns either an incentive or disincentive with regard to the actual use of it, depends on the user one observes. Some pupils experience this special place (which manifests itself in the space plan) given to these facilities as an incentive, as it makes it feel as something of importance. They even bring the markers they use at home to the school to make optimal use of these facilities. Yet, the evaluation has shown that other pupils do not even know of the existence of this place, let alone they will use it. Since all pupils do encounter it, it is believed that the design of the Eco-place is inadequate to draw the attention of certain pupils. In their case, a lack of incentives seems to be the reason they do not use the facilities provided.

The pupils are actively engaged in waste collection on the school level. Twice a week, two to three pupils are the 'waste service'. They perambulate the circular route through the school and collect the trash from all classrooms. This is discussed previously under 'Engaging routing 9' in the section 'Engaging the heart'.

Finally, rather than reusing and recycling waste, the school is also concerned with reducing the amounts of waste generated. More and more pupils carry their food and beverages in reusable packings. Although lunch boxes and reusable bottles require no facilities from the physical environment, physical space may stimulate certain behaviours. It is observed that in most classes, the children's consumptions for the day are exposed in front of the classroom. Through this combination of space plan and stuff, it is directly visible whether pupils bring either reusable or non-reusable packings. If social control based on this exposure will take place, is dependent on the prevailing norms of other pupils, staff and parents. Dependent on this milieu, the exposure can be either an incentive or a disincentive to exhibit socio-ecological responsible behaviour. This counts not only for the packings of consumptions, also for the food and beverages themselves, on which the following section elaborates.

Food 2

The same combination of space plan and stuff as discussed above, regards either incentives or disincentives for socio-ecological responsible food selection. If the school ethos is such that consumptions which could be considered unsustainable (either because of the ecological environmental impact or for health reasons) are considered 'cool', the food exposure might repress socio-ecological behaviour. If, on the other hand, socio-ecological motivation and understanding prevail (internal causes of behaviour change), food exposure may lead to a stimulation of socio-ecological responsible behaviour.

In relation to food, another potential lies in the physical learning environment. As discussed in the section 'Engaging the heart', pupils are now lobbying for a school garden on the site to grow their own food in a garden on school property. This is further discussed below.

Greenery ③

'Learning by doing' requires active learning. Greenery can contribute to this in diverse fields. For example, several attempts have been made to foster gardening at school. As discussed in the section 'Engaging the heart', each classroom has its own little garden (which manifests itself in the space plan and the site). For several reasons, one could argue that the use of these facilities is stimulated. Firstly, the gardens are positioned in front of each classroom in order to foster ownership and a sense of responsibility ('motivation' as an incentive). Moreover, this location means that a visually unattractive garden is in the sight of the ones who are responsible for it. As a result, pupils now complain about the poor state of the greenery, which they are overlooking from their classroom. Several attempts have been made by different classes to maintain the gardens, in cooperation with parents. Yet, these attempts have stranded over and over. With regard to this aspect, we could conclude that the physical setting is adequate and that the fact that the possibilities offered are hardly used, is due to external factors.

Moreover, a potential for interaction with greenery regards growing food, as discussed above under ②. The reason that the school staff is not (yet) granting the pupils' request for a school garden primarily regards safety and security issues, on which the following section elaborates.

Safety ④

The request of the pupils to develop a school garden is not (yet) granted by the school management due to fear of vandalism. The evaluation by pupils and diverse interviews with pupils and staff have led to the conclusion that the safety in the school is very good, but that outsiders sometimes misuse the school grounds after school hours. No threat is experienced due to this; they regard teenagers who have other interests than the pupils and staff at the school. The school decided not to place gates and fences which can obstruct this, because they very much appreciate the appearance of the school, as discussed extensively in the section 'Engaging the heart' and contrast the citation of Taylor (1995) on page 2. Therefore, no disincentives to repress the behaviour of the teenagers mentioned have been put in place. Now, pupils mooted to accommodate the yard in a greenhouse which can be closed.

The contact among pupils is very good. A few years ago, the school has started to put effort into being a 'peaceful school'. This certification mark puts emphasis on social safety and security in schools. Hearing the pupils, this is really working for them. An interesting, related finding of the pupils' evaluation regards the extent to which the physical learning environment represents 'inclusive design', as discussed in the section 'Engaging the heart'. Pupils found that the school is not very accessible in an inclusive way. Some pupils experienced that themselves, when they had temporary handicaps, for example a broken leg. While some pupils concluded that the accessibility of the school environment should be enhanced, others thought this was not necessary, because they are very willing to help peer students when they are in need. Taking that perspective, one could argue that an *inaccessible* environment is in fact an *incentive* to foster social behaviour, if the school ethos is such as the aforementioned pupils sketched.

Mobility: active design ⑤

The routing to and in schools is principally related to the extent to which the physical environment fosters physical activity. Despite the health disadvantages of limited physical activity and abundant sitting, physical activity levels in children are typically low and sitting times high. By means of 'active design', the physical environment can serve as a catalyst for physical activity, since building layout and furniture may influence children's physical activity and therewith stimulate more active lifestyles (Ucci, et al., 2015; Aminian, et al., 2015). With regard to the furniture in the case studied, no measures have been found which stimulate physically active behaviour (such as standing-height desks) and no alternative pedagogical approaches were observed which foster physical activity. It could also be

argued that this is not facilitated by the classroom environments, which are relatively small and already quite full with pupils and their desks. It was observed that in one class dances were performed by pupils and there was not much space for this to take place. One could even see this as a disincentive towards physical activity in the classroom environment.

Contrarily, in the heart of the school a theatre is arranged, where the entire school can meet. Each month, during the month closing, all the classes gather here and two to three classes perform. There is sufficient space for this to occur and the large, open space fosters the use of the entire space available.

The case studied regards a (dominantly) one-storey building. Therefore, the positioning of stairs to foster physical activity (as opposed to using escalators) is not relevant. A more interesting facet, which is related to the school site, regards the mode of transportation pupils use. Firstly, the school's location has been found to influence the choice of transportation (McDonald, 2008). The school studied is positioned in the heart of a neighbourhood and as a result, most children come to school by bike and some walk. There were even some parents seen who came to the school jogging.

The norm of bicycles as a mode of transportation is stressed by the integration of bike racks in the architectural design of the school site, as opposed to the tucked away parking lot for cars. The bike racks follow the circular shape of the building and are divided along the diverse entrances, due to which all pupils can easily enter their classroom after parking their bikes.

The parking lot is not as easily accessible as the bicycle racks, which could be considered a disincentive for the use of cars. On the other hand, it results in the phenomenon that the children who do get to the school by car are dropped off alongside the road (a bus stop provides space for this to occur), due to which the parents of these children do not enter the school and social interaction does not take place.

Air quality ⑥

Neither inside nor outside incentives or disincentives are present to enhance the air quality. As discussed in the focus area 'Exemplifying to the head', no understanding is fostered with regard to this issue and to a large extent, the regulation of the air quality in the school is automated. Therefore, human behaviour is eliminated. Only on the mezzanine floors above the classrooms facilities are provided to users to regulate the indoor environmental climate (as discussed in section 'Engaging the heart' under the design feature 'Personalization ④'). The often poor air quality is related to the 'hygiene' of and health in the school, as elaborated on in the following section.

Hygiene ⑦

With regard to hygiene in their school, the pupils are not very satisfied. They do not consider the school in general to be very clean and recognise that this is to a large extent due to their own behaviour.

For example, many pupils do not take off their shoes before entering the gym. A sign is present on the door, saying 'please take off your shoes', but this is ignored by most pupils. Facilities and incentives in the physical environment to foster the desired behaviour are lacking, as well as disincentives to prevent the undesired behaviour. For example, no shoe rack is present to stimulate pupils to take off their shoes. A designated space, which could even be personalised (as with the chairs and coat racks, see 'Personalization ④' in the section 'Engaging the heart') could stimulate this.

Pupils also mentioned they often lack to wash their hands after using the bathrooms. Yet, facilities for this are provided and easily accessible.

The poor hygiene of the air, as discussed under 'Air quality ⑥', is not due to the behaviour of pupils and teachers. No facilities are provided to them to adjust it, rather than opening the windows, which they regularly do if the outdoor weather allows it.

Water ⑧

Water is used for a wide variety of purposes. During the evaluation, pupils mainly focussed on the bathrooms, where they assessed the toilets and the water taps. During the evaluation, several pupils found out that the toilets have buttons to save water for flushing. These facilities were never observed by them before, although many others do use them on a regular basis. It is expected that an enhanced understanding could serve as an incentive to foster the use of water-saving facilities, as most pupils sounded motivated to limit their negative impact.

Energy ⑨

As water, energy is used for a wide variety of purposes. Among other things, pupils assessed the use of energy for lighting and computers. They counted that no less than thirty computers were turned on without being used. Besides a lack of insight provided regarding this situation and its effects (see the section 'Exemplifying to the head'), pupils are not fostered to adjust their behaviour. With regard to the lighting, most pupils and teachers turn off the lights when leaving the room. As a results, the lights are mostly off when the classes are empty. Yet, in the room for staff, the lights are on surprisingly often. This can be explained through the position of the light switch in the room: it is positioned on the other side of the room than the door through which people enter and leave. Hence, turning off the lights is repressed through the design of the physical environment. This stresses the importance of (dis)incentives for behaviour in the physical environment. In all other rooms, such incentives are present.

Conclusions of the evaluation

The evaluation matrices (Table 3, Table 4 and Table 5) allow to draw conclusions on both the nine design characteristics, as well as the six layers of built structures.

The design characteristics educating for sustainable happiness

The results of the evaluation of the case study show a clear dispersion of building elements and features with regard to the categories of design characteristics. Concerning the focus area 'Engaging the heart', many design features and elements have been identified, which regard all three characteristics distinguished within this focus area. The physical environment brings people closer to each other and to nature, although nature connectedness could be enhanced through the fostering of experimental interaction with nature. Site specific features, which express the genius loci of the particular place, are limited, but connectedness with place is realised through various design measures which make the habitat an engaging environment.

The second focus area ('Exemplifying to the head') is strongly under-represented in comparison to the other two focus areas. Several subsystems are demonstrated, but their relationship with the larger system is not clarified and feedback towards the users is not provided. Therewith, the function of the physical environment as a 'three-dimensional textbook' is limited.

Several facilities have been identified which enable socio-ecological behaviour, although the lack of other facilities makes certain behaviours impossible. This is discussed further in the section 'Discussion and conclusions' under 'The post-occupancy evaluation'. The (dis)incentives distinguished primarily regard the location of facilities and their design, which have both been found to contribute to the actual use of the facilities provided. Moreover, it has been found that motivation, understanding and the social climate in the school may serve as (dis)incentives.

The layers of built structures

With regard to the first focus area, all six layers of built structures are of significance, although the contribution of 'services' towards socio-ecological motivation in this school is limited. Contrarily, the design features and elements fostering socio-ecological understanding are strongly clustered around the services. These have some influence in the third focus area, although most facilities and (dis)incentives for socio-ecological behaviour regard the space plan and the stuff inside the building. The evaluation shows how the diverse layers of built structures currently play a role in the educating character of the physical environment of the school studied. Besides, it shows where performances are lacking. The evaluation therewith also provides a basis for product development and applications in transformations (this regards step 3; see Table 2).

DISCUSSION AND CONCLUSIONS

By means of the framework and roadmap developed, this research makes a contribution to the evaluation of physical learning environments as a basis for transformations towards suitable and sustainable school habitats. A categorization of performances of the physical learning environment is developed which is useful both for professionals in the field, as well as for unexperienced school staff and other stakeholders. This facilitates and fosters whole-school approaches towards transformative sustainability learning in the years to come and provides a framework for future product developments. Further deductive research is still required to verify the hypothesised relationships (see the section 'Research methodology').

The post-occupancy evaluation

In their book 'Post-Occupancy Evaluation', Preiser, et al. (1988) argue that POEs should consider both the positive and negative aspects of building performance. The framework and roadmap developed in this study currently have a strong focus on the 'DOs' in comparison to the 'DONTs'. Further research could advance this. Deductive research to test the relationships hypothesized in the framework is likely to have a quantitative character. Quantifying the relationships between physical space and human motivation, understanding and behaviour, could comprise a measurement system including both negative and positive outcomes. This way, the value of the POE with regard to transformation plans could increase, because the evaluation will not only show what to maintain, but also what to definitely address.

Applicability of Brand's decomposition method

The choice for the decomposition method of Brand is explained in the section 'Research methodology' and is based on the broad scope of this method compared to others. During the evaluation of the case study school, the layers 'site' and 'stuff' have indeed been found to be very useful in this context. Yet, this method also has its limitations, which have highly influenced the analysis results. For example, it was hard to position 'door steps', 'window sills' and 'interior windows' in this decomposition. Also, the evaluation of the 'Building condition ⑥' (section 'Engaging the heart') using these layers was unsuccessful.

Therefore, other decomposition methods may be more suitable. For example, the SfB elements method (as described by Vanderveen, et al. (2015a)) could provide a solution, as building elements such as 'openings' and 'finishings' are distinguished in this method. Moreover, the distinction between 'fixed facilities' and 'fittings and furniture' could be useful to gain insight into the magnitude of the building transformation required.

Towards construction and occupancy

The roadmap presented in this paper regards the evaluation of occupied learning environments and the process of the transformation of these environments. However, the actual construction is not taken into account. Moreover, the subsequent occupancy stage requires attention. As mentioned in section the 'Continue the cycle', demands constantly change and without interventions, the school habitat will not keep to meet them. Current practice shows that the flexibility and adaptability of physical environments are therefore of great importance. Flexibility and adaptability in the context of architecture as education for sustainable happiness still requires research with regard to both the construction and the occupancy stage.

A whole-school approach

The physical learning environment has an educational role on its own, but much of the possibilities present will only be seized if a 'whole-school approach' is taken. As presented in Figure 2, this entails that curricula and pedagogies should develop simultaneously with physical environments. The findings

of this study primarily stress the importance of pedagogies and pedagogues. Educators have the important task to serve as role-models for their pupils and to make use of the possibilities provided in their classes. The case study has shown that without the commitment of teachers, a large discrepancy will exist between the actual and the intended use of buildings. This is strongly related to the findings of Martin (2008) and Cutter-Mackenzie and Smith (2003), among others, who found that teacher literacy is the 'missing paradigm' in environmental education.

Moreover, with regard to several design elements and features evaluated of the case studied, it is concluded that the school ethos has a crucial role in the functioning of the physical environment. As Gislason (2010), based on the school climate model adapted from Owens and Valesky (2007), concludes: physical design, school organisation, staff culture and student milieu are vital aspects of the learning environment and their combined role should be addressed. As discussed with regard to the case studied, the school ethos can determine whether certain design elements and features will serve as an incentive, or rather as a disincentive.

One way to foster whole-school approaches could include an, for example, annual evaluation of the physical environment and user behaviour, as mentioned in the section 'Continue the cycle'. By carrying out a yearly evaluation with pupils and staff, the attention for certain issues is assured and new pupils and staff will, within limited time, be actively involved in these issues.

The framework for physical learning environments

As discussed extensively, the framework is built on the 'heart, head and hands'-model, which has been found to be a suitable organizing principle in the context of transformative sustainability learning (Sipos, et al., 2008). Yet, several aspects have been found which could not be placed in this model. This primarily concerns the extent to which the environment fosters inventiveness, creativity and discovery. In his theory 'Human Scale Development', Max-Neef (1991) even distinguishes 'idleness' and 'creativity' as two of the nine universal, fundamental human needs. Idleness is understood as 'the state of mind and spirit that is inviting to the muses' and as such idleness and creation are seen as two inseparable aspects.

Traditionally, invention has been explained as an individual or psychological phenomenon involving an exceptional talent of intuition of the inventor (Miettinen, 1996). This 'Genius Theory of Invention' has however been criticized widely, as it has been found that in addition to the individual, the sociocultural surroundings must be taken into consideration. Accordingly, inventiveness is social or collective in nature. Moreover, many of the important things and knowledge in our daily lives are discovered by accident. The invention theory explaining such 'accidental discoveries in science' is named 'serendipity' (Roberts, 1989). These alternatives to the Genius Theory raise a question: what is the impact of events and processes in both the social and physical environment that cannot be anticipated? As mentioned above, Max-Neef documented that this regards the human 'spirit'. Similarly, one reference (Unknown, 2016) has been found which complements the heart, head and hands-model with the 'spirit'. This dimension could be added to the framework presented in this study, see Figure 7, but requires further research.

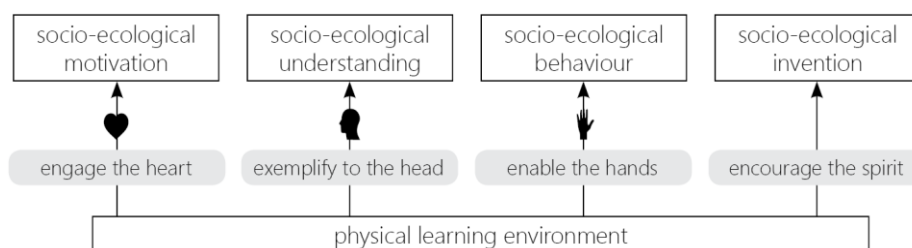


Figure 7 A possible complementation on the framework presented in Figure 3 could regard the 'spirit'.

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APPENDIX A: INSIGHT INTO THE INDUCTIVE PROCESS

The framework presented in this paper has emerged from an iterative, inductive study. Finally, it builds on the ‘heart, head and hands’ model. This was not always the case. This Appendix elaborates on the inductive study and the main paths which have been followed. Interviews and conversations with many experts (see Appendix B) have highly influenced this process.

The search for a model capturing ‘whole-school approaches’

A design’s success rests largely on how well it supports a given educational program and only if there is a good program-design fit, a design will tend to facilitate and reinforce educational practice (Gislason, 2010). Based on a critical review of the literature on the evaluation of physical learning environments, Cleveland & Fisher (2014) conclude that approaches to evaluations that attempt to assess the effectiveness of PLE’s in supporting pedagogical activities are in their infancy and require further development. Correspondingly, Uptis (2015) states that “there is very little research on how space dictates what is learned and how it is learned”. Higgins et al. (2005, p. 3) cite that “the science of designing learning environments is currently remarkably under-developed”. Gislason (2010) argues that the underlying problem in this regard is that researchers generally consider teaching and learning apart from their architectural setting, or study the built environment separately from educational practice: the *habitats* versus the *habits* of schools.

The learning ‘environment’ comprises a complex set of aspects of which the physical learning environment is part. Geisen (2013) describes five ‘architectures’ of the educational system which should be changed in order to arrive at sustainable, meaningful education: the architecture of (1) the building, (2) the learning process, (3) the curriculum, (4) the leadership and (5) the community. Another model for school climate and learning environments regards the model from Owens & Valesky, as presented in Figure 8. In addition to the categories of learning environments Owens & Valesky distinguish, the virtual environment is becoming more and more dominant in both our personal and professional lives.

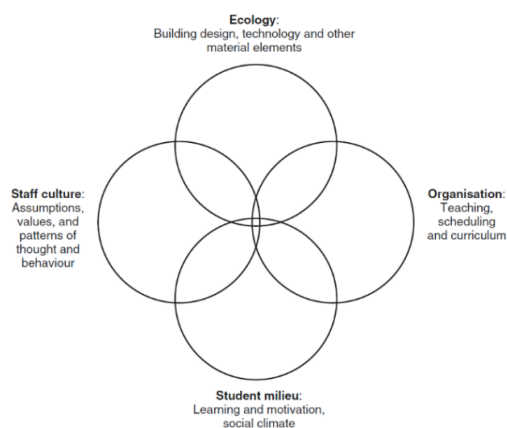


Figure 8 School climate model adapted from Owens and Valesky (2007)

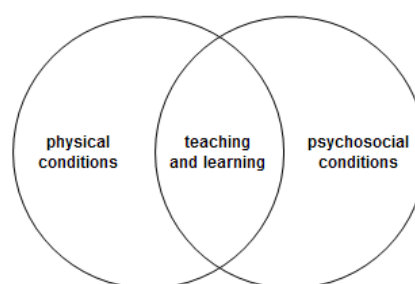


Figure 9 Major categories of learning conditions from a holistic perspective, adapted from Bernard (2012)

These models and diverse other models have been studied in order to define the place of the physical learning environment in relation to other facets of the ‘learning environment’. Finally, the model as presented in Figure 2 (comprising the curriculum, pedagogy/learning processes and the physical learning environment) is adopted to represent ‘whole-school approaches’. Student milieu and staff culture are discussed in the discussion of this paper.

A conceptual framework

Two major categories of the performance of the PLE can be distinguished. Cleveland & Fisher (2014) describe them as “learning environments as containers within which learning activities occur” versus “built pedagogies that influence teaching and learning practices, activities and behaviours”. The current research positions PLE’s in these two force-fields, schematically presented in Figure 10. The ‘learning containers’ have a *servicing performance* and the ‘built pedagogies’ have a *pedagogic performance*. The latter characteristic of a school *habitat* holds a close relation with a school’s *habits*.

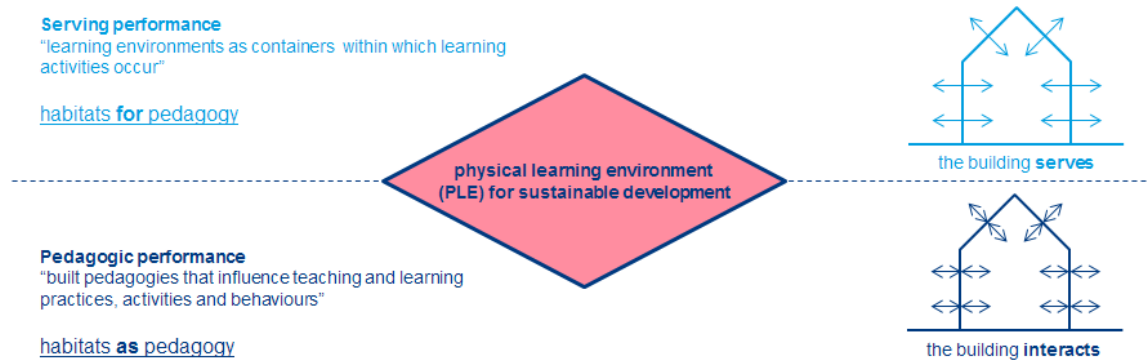


Figure 10 Two major categories of the performance of PLE’s with citations from Cleveland & Fisher (2014)

Roughly, the pedagogic performance regards the aspects of the PLE which relate to a school’s vision on education, while the servicing performance regards the building as a serving ‘container’ for educational processes to take place, therewith concerning a PLE as real estate independent of its pedagogic characteristics. Concluding, the research context regards the servicing performance (SP) and the pedagogic performance (PP) of schools habitats in relation to education for sustainable development (ESD) and sustainable building (SB); see Figure 11.

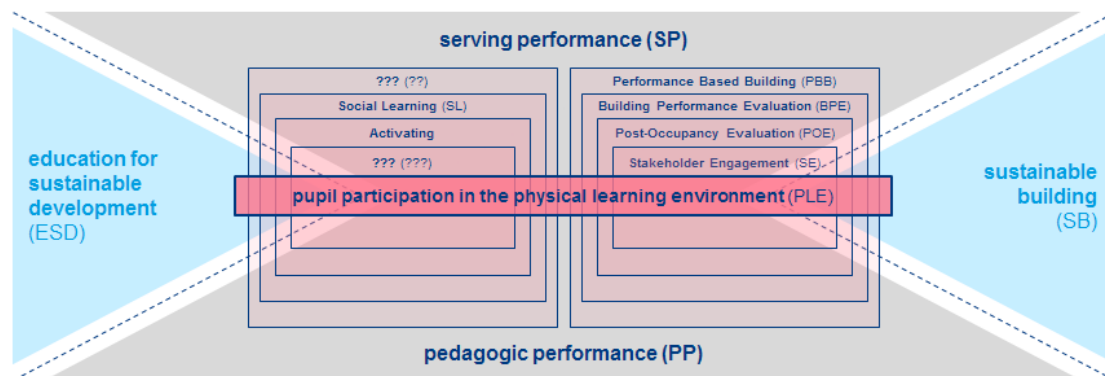


Figure 11 The conceptual framework positioned in the work field of the current research: aiming at enhancing the SP and the PP to foster ESD and SB

Building on the background of education for sustainable development, the current research focuses on ‘social learning’ (SL). SL is group-oriented learning, focusing on the context in which the learning takes place. It strengthens the functioning of groups, organizations and communities in new, uncertain and difficult to predict conditions that require a reorientation of existing routines, assumptions, principles and values. It is aimed at solving unforeseen, authentic problems or accepting new challenges and is characterized by an optimal use of the capacities of the participants in the process (Hoeven, Wals, & Blanken, 2007). Although there is no ‘recipe’ for social learning, several phases of SL cycles can be distinguished (see Figure 12a).

Moreover, in order to enhance building performance in the context of sustainable development, the ‘performance concept’ is applied, in which stakeholder engagement is gaining attention. The process of evaluating the performance of a building is commonly known as ‘Building Performance Evaluation’ (BPE) and regards the complete life cycle of buildings (see Figure 12b).

As the transformation process of PLEs is by schools often experienced as a burden, a strong opportunity for improvement lies in the simultaneous use of this process for educational purposes. The current research combines these two concepts. The two cycles mentioned above are presented in Figure 12. Combining the concepts of social learning and building performance evaluation, pupil participation is found to be useful both as a form of education as well as to improve building performance. Thus, pupil participation may serve as a magnet between the fields of education and building for sustainable development. This research focus is indicated in pink in Figure 12.

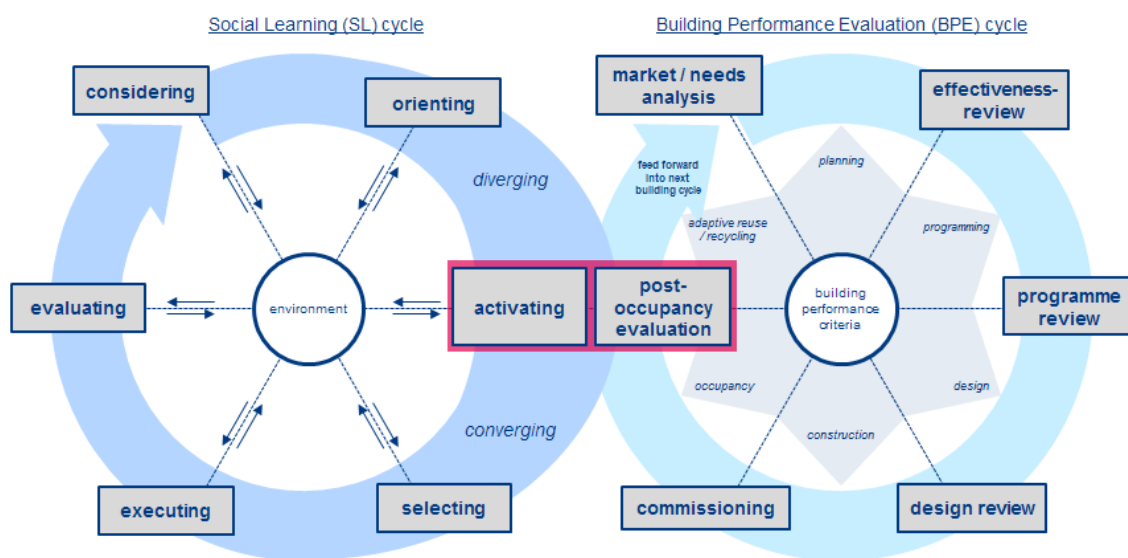


Figure 12 Process cycles for (a) Social Learning (Hoeven, Wals, & Blanken, 2007, p. 16) and (b) Building Performance Evaluation (Preiser & Vischer, 2005, p. 17) with the research focus in pink

A framework based on the Hamburger Model

As soon as the ‘Hamburger Model’ had been found to be a suitable model to explore the design characteristics of physical learning environments which support transformative sustainability learning, the search to bridge the gap started. The explorations of demand, supply and the bridge between them have had many forms. Some of them are:

Demands

- Triple bottom line: this categorisation has been found to be too broad to be useful.
- Stakeholders / value domains: see next section.

Supply

- Building / scale levels: too much focused on the supply side to be useful to determine evaluation parameters, but the decomposition set by Brand (see section ‘From theory to practice: a roadmap’) is used for the supply side.

The bridge

- Theme’s: as set by Eco-Schools or BREEAM or many other categorisations (water, energy, light, etc.). Such themes have been found to be too specific to be able to study the ‘pedagogic performance’

A framework based on value domains

In order to arrive at valuable physical learning environments, one has to clearly establish whose values are involved. Mallory-Hill (2004) states that the overall value of a building can be derived from its relationship with its human environment, thus it derives from how well it performs at all of the various human perspectives from which it is viewed. The current research adds the perspective of the non-human world to this description.

Although not necessarily mutually exclusive, the interests of different “users” of a building can be quite varied, thus defining total building quality requires that the needs of all potential stakeholders are considered. (Mallory-Hill, 2004). Mallory-Hill defines six categories of stakeholders or ‘Human System Levels’ (HSL): individual occupants, organization & groups, owners, community, global community and future users & contexts. Each stakeholder category is coupled to a value domain, which represents the interests and demands of a certain group of stakeholders (see Figure 13). The architectural toolkit provides the supplies to meet these demands. Relating this to the two major categories of the performance of physical learning environments as discussed in the previous section results in the schema presented below. While all six HSL’s are identified as ‘stakeholders’, only the middle four are recognized as ‘users’ who interact with the pedagogic performance of a PLE.

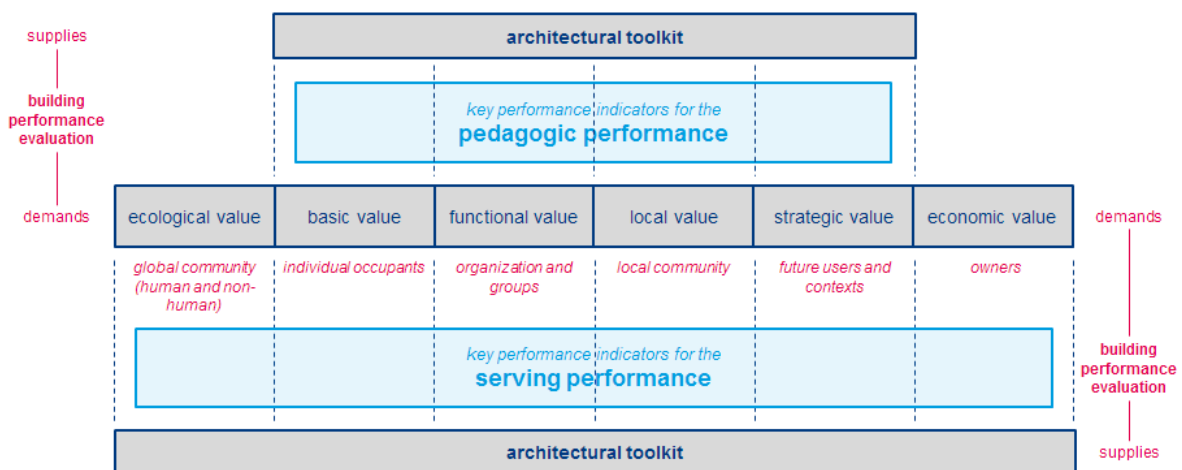


Figure 13 Six value domains and corresponding Human System Levels (Mallory-Hill, 2004), related to the two major categories of school building performance as distinguished in the current research

In order to evaluate the PLE’s performances, one has to have criteria for evaluation. Therefore, key performance indicators (KPI’s) must be defined. By using these KPI’s for measurement, comparison, evaluation and feedback and integrating this into the design and management of built environments, better decision-making is supported and building performance may be enhanced (Mallory-Hill, Preiser, & Watson, 2012). This process is known as ‘building performance evaluation’ (BPE). BPE focuses on the relationship between design and technical performance of buildings in relation to human behaviour, needs and desires: that is, BPE determines whether facilities will work for the people that will use, occupy, or otherwise be impacted by them (Mallory-Hill, Preiser, & Watson, 2012). Shortly, BPE aims at bridging the gap between *actors* and *factors*.

The main reason not to continue with this categorisation was the non-mutually exclusiveness of these value domains in the context of transformative learning for sustainable happiness. Too much overlap between categories was found, for example since the pedagogic performance of physical learning environments is quite similar to users, as to the local community. Also, the categorization did not provide a structure to study the pedagogic performance in more detail: what kind of lessons can be learned from physical environments in relation to (sustainable) happiness?

A framework based on human needs

Since the framework aims at sustainable 'happiness', the search for suitable categories has long been built on the nine 'fundamental human needs' distinguished in Human-Scale Development (Max-Neef, 1991) in order to arrive at a suitable school evaluation domain model.

An exploration of demands

It has often been concluded that consumer 'wants' do not reflect real 'needs', since consumers do not know what they really need. Several reasons exist for this phenomenon. For example, consumers are seen to be misled by the advertisement industry (Veenhoven, 2004). Moreover, consumer wants are highly related to time, place and culture, since they often emanate from habits.

The same is true for many decision-makers in the transformation process of school habitats. This task is often an once-in-a-lifetime job for decision-makers, such as school staff and employees at local governments. Therefore, it is often hard for them to express an appropriate demand towards supplying parties. Their set of demands consequently often results from 'common' practice and habits.

It is therefore argued that a direct relation between needs and supplies, which is often assumed, is incorrect, as it implies that needs manifest themselves through demand (Max-Neef, 1991). In order to establish a valid set of demands, we thus need to explore 'needs' in more detail first.

Fundamental human needs

"Happiness is a shared desire of every human being. It is possibly the ultimate thing we want while other things are wanted only as a means to its increase." (Thinley, 1998)

When used in a broad sense, the word happiness is synonymous with 'quality of life' or 'well-being'. In this meaning it denotes that life is good, but does not specify what is good about life. Therefore, Veenhoven (2004) distinguishes four qualities of life, as presented in Table 6.

Table 6 Four qualities of human life (Veenhoven, 2004). The current research focuses on life-chances only.

	Outer qualities	Inner qualities
Life-chances	Liveability of the environment	Life-ability of the person
Life-results	Utility of life	Satisfaction

Veenhoven explains his classification as follows. The classification depends on two distinctions. Vertically there is a difference between chances for a good life and actual outcomes of life. Horizontally there is a distinction between 'external' and 'internal' qualities. In the first case the quality is in the environment, in the latter it is in the individual.

Together, these two dichotomies mark four qualities of life. These fundamental types of happiness can however be reached in many different ways. Max-Neef claims that it is traditionally believed that human needs tend to be infinite, that they change all the time, that they are different in each culture or environment and that they are different in each historical period. In line with Aristotle's idea, he also argues that these assumptions are inaccurate, since the fundamental difference between *needs* and *satisfiers* of those needs is not taken into account. He suggests that what changes, both over time and through cultures, are not the needs themselves but the ways or the means by which needs are satisfied. It should be pointed out, however, that satisfiers do not include objects: they are non-material. This means that while in conventional economics there is a dual relationship between wants and material goods, in H-SD there is a triple relationship between needs, satisfiers and material goods.

Max-Neef (1991) provides an overview of fundamental human needs according to axiological characteristics and distinguishes nine fundamental human needs: subsistence, protection, affection,

understanding, participation, idleness, creation, identity and freedom. He adds to his discussion on fundamental human needs that each need can be satisfied within three contexts: (a) with regard to oneself (Eigenwelt); (b) with regard to the social group (Mitwelt); and (c) with regard to the environment (Umwelt). Adding to this list the 'future' (Zukunftswelt), covers the full scope of sustainable development.

The physical environment in relation to sustainable happiness

A lot has been written about the impact of physical space on people. Aiming at a positive influence of physical space on sustainable happiness however requires a framework to systematically study the full spectrum of influence. Combining Max-Neef (1991), Veenhoven (2004) and Owens & Valesky (2007) their work as discussed in the previous sections provides such a framework. The framework is presented graphically in Figure 14. Following Veenhoven (2004) his division of life-chances into outer qualities and inner qualities allows for a clear distinction of two major categories of the influence of the physical learning environment on human happiness, namely the 'serving performance' and the 'pedagogic performance'. The serving performance is defined as the PLE's influence on the liveability of the environment, while the pedagogic performance is defined as the PLE's influence on the life-ability of the person. The 'learning containers' can be seen as 'habitats for pedagogy', while the 'built pedagogies' can be regarded 'habitats as pedagogy'.

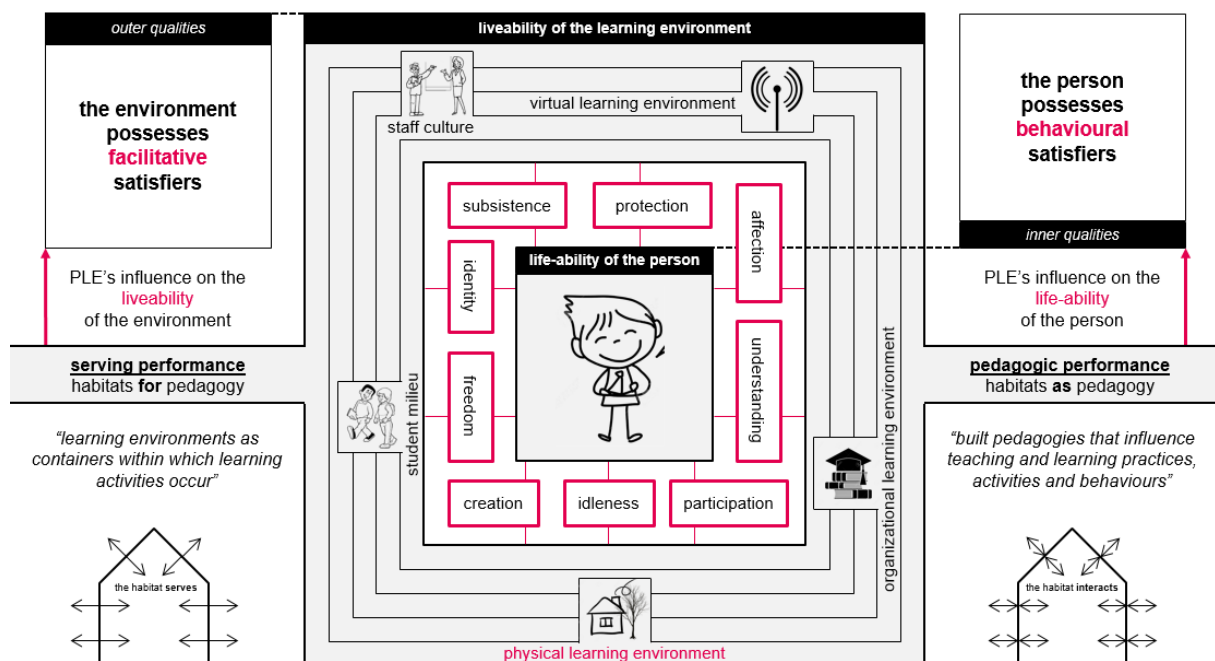


Figure 14 A framework (based on Max-Neef (1991), Veenhoven (2004) and Owens & Valesky (2007)) to systematically study the influence of the physical learning environment on sustainable happiness, including two major performance categories of PLE's with citations from Cleveland & Fisher (2014)

It should be noted that a strict distinction between the two performance categories is in fact undesirable to define, as an integral approach lies on the basis of a successful design. Thus, the distinction should be seen rather as a useful mapping of different dimensions of PLE performance in order to clarify discussions and position earlier research regarding it. The latter is needed since the two main categories require fundamentally different specializations, typically leading to isolated publications traceable through different key words and published in different research domains.

A School Evaluation Domain Model

Using the framework presented in Figure 14 regarding the physical learning environment in relation to sustainable happiness, a school evaluation domain model has been developed. Through an iterative

	metabolism	inclusion	attachment	pleasure	invention	
the individual						levels of human-environment interaction
the school						
the community						
performance categories						

Figure 16 School evaluation domain model based on the nine fundamental human needs (black bold) distinguished in Human-Scale Development (**Max-Neef, 1991**)

For each category, a definition is developed; see Figure 17.

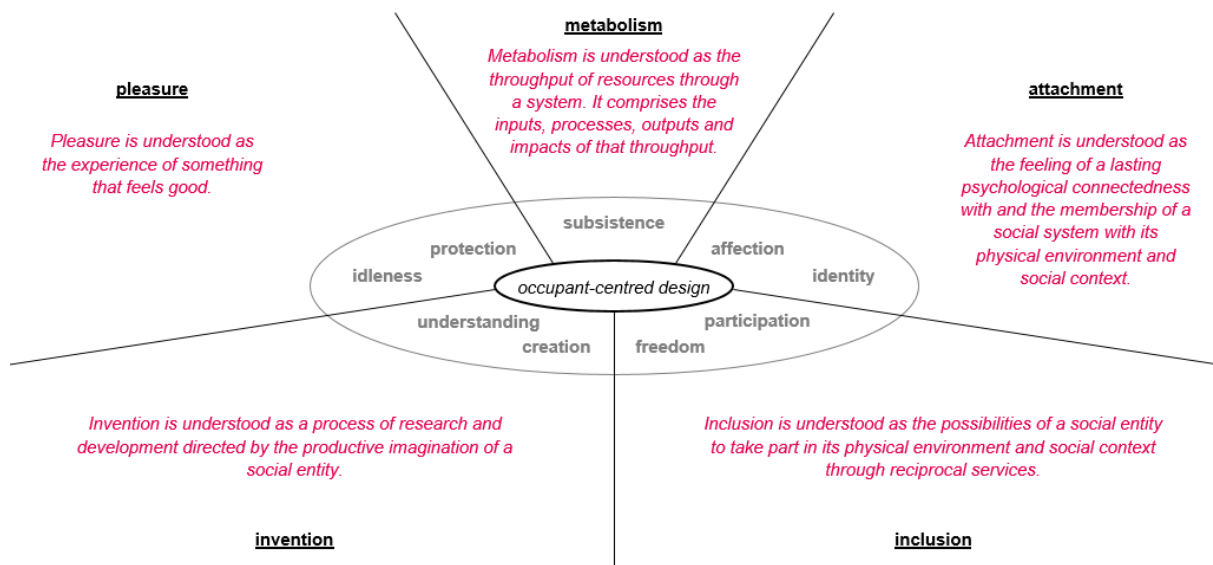


Figure 17 Definitions for the various performance categories

Within each category, evaluation parameters were to be developed to be able to evaluate school buildings by means of this evaluation domain model. Then, the model started to become so difficult to understand, that an alternative approach towards this model was considered required (especially since the aim of the model was to facilitate post-occupancy evaluations by pupils and school staff).

From then, the heart, head and hands model has dominated the framework development. This model was considered a suitable starting point, since the categories can easily be understood by non-experts. Moreover, many of the aspects studied in light of the school evaluation domain model presented above could very easily be placed in the heart, head, hands-model.

APPENDIX B: GESPREKKEN MET EXPERTS

Hieronder vindt u een overzicht van een groot deel van de gesprekken die ik in de loop van dit onderzoek heb gevoerd. De gesprekken zijn chronologisch weergegeven. Globaal kan het totale proces worden ingedeeld in vier fasen, zie Tabel 7. In deze Appendix zijn niet de gesprekken met begeleiders opgenomen. Zowel de interne begeleiders van de Technische Universiteit Eindhoven als de externe begeleider bij het gastbedrijf SME Advies (Hak van Nispen tot Pannerden) waren in het begin (nagenoeg) wekelijks betrokken. In fase 2 en 4 is die frequentie aanzienlijk verlaagd, tot circa één keer per maand.

Tabel 7 Globale indeling van het totale proces in vier fasen

<i>Periode</i>	<i>Werkzaamheden</i>	<i>Afsluiting fase</i>	<i>Resultaat</i>
<i>April – mei</i>	Oriëntatie duurzame scholen	2 juni: begincolloquium	Sectie 'Introduction'
<i>Juni – december</i>	Raamwerkontwikkeling en feedback	18 december: tussencolloquium	Sectie 'Theoretical understanding: the framework'
<i>Januari – februari</i>	Oriëntatie voor toepassing in de praktijk en ontwikkeling roadmap		Sectie 'From theory to practice: a roadmap'
<i>Maart</i>	Afronding	1 april: eindcolloquium	Paper met bijlagen, boekje (zie Appendix E) en presentatie

De belangrijke conclusie uit de oriëntatiefase betreffen het inzicht te komen dat educatie in relatie tot gebouwen momenteel (vrijwel) uitsluitend plaatsvindt in relatie tot bouwprocessen. De lessen hebben nauwelijks betrekking op het gebouw als product, maar worden met name ingezet *in* het gebouw, in plaats van *met* het gebouw. Ik besloot het raamwerk toe te spitsen op het gebouw als *product* voor duurzaamheidseducatie. De processen, die bovendien een heel belangrijke rol kunnen spelen, hebben een rol in het hoofdstuk 'From theory to practice: a roadmap'.

Wanneer het in de praktijk over het *product* 'schoolgebouw' gaat, is er in de meeste gevallen geen sprake van een educatieve component, zoals bij veel verduurzaming van onderwijsvastgoed. Dit is tot uitdrukking gebracht in dit paper in Figure 2: architectuur *voor* onderwijs versus architectuur *als* onderwijs. Ik besloot mij louter te richten op de laatste categorie, aangezien de eerste categorie reeds door velen onderzocht en uitgevoerd wordt. Deze twee tweedelingen (*product* versus *proces* en gebouwen *voor* onderwijs versus gebouwen *als* onderwijs) vormen de basis van dit onderzoek. De oriënterende gesprekken daaromtrent vonden vooral plaats in april en mei.

Van juni tot en met november stond de ontwikkeling van het raamwerk centraal, waarop Appendix A reeds toelichting heeft gegeven. In die maanden zijn er relatief weinig gesprekken gevoerd, omdat het raamwerk is gebaseerd op literatuuronderzoek (zie Appendix A) en case study onderzoek (zie Appendix C). In december zijn de tussenresultaten omtrent het raamwerk met diverse mensen besproken. Die gesprekken betroffen met name de categorisering van het raamwerk, zoals u hieronder zult lezen.

Eke Schins, Arthur Hilgersom en Wouter Deen - 2 april 2015

Eke Schins is werkzaam bij Grontmij. Een groot aantal scholen in Nederland heeft beheertaken aan Grontmij uitbesteed. Arthur Hilgersom en Wouter Deen zijn zelfstandige architecten. In samenwerking met het gastbedrijf, dat met name op educatie concentreert, hebben zij het concept E³ ontwikkeld. E³ staat voor energieopwekking, energiebesparing en energie-educatie. In dit gesprek werd door het team geëxploreerd hoe de rol van educatie kan worden ingevuld. Ik heb aangehoord wat er reeds gedaan wordt en meegedacht over hoe dit in de toekomst kan worden ingevuld. Dit gesprek heeft bijgedragen aan het inzicht in beide tweedelingen die in de oriëntatiefase zijn gemaakt (*product* versus *proces* en gebouwen *voor* onderwijs versus gebouwen *als* onderwijs).

José Hendriksen - dinsdag 28 april 2015

José Hendriksen was ten tijde van ons gesprek bestuurslid van de Foundation for Environmental Education (FEE). FEE is wereldwijd de grootste milieu-educatieve organisatie. FEE is actief in meer dan 65 landen. FEE-International is de internationaal eigenaar van de vijf programma's, waaronder Eco-Schools. Eco-Schools is het internationale keurmerk voor duurzame scholen. In dat kader sprak ik met José. Ze vertelde me diverse verhalen over Eco-Scholen wereldwijd en enkele voorbeelden waar het gebouw is benut als hulpmiddel om invulling te geven aan duurzaamheid in het onderwijs, waaronder [dit inspirerende voorbeeld](#) van hoe andere manieren van 'bouwen' of 'gebouwen' een enorm belangrijke hulpmiddel kunnen zijn om maatschappelijke uitdagingen het hoofd te bieden.

Wietse Walinga - donderdag 30 april 2015

Wietse Walinga is directeur van het Kennisplatform Duurzaam Gebouwd en betrokken bij de stichting Duurzame Scholen. Ik sprak hem persoonlijk en bezocht een bijeenkomst van de stichting Duurzame Scholen ("Van goede klasse, 20 mei 2015, Amersfoort), om inzicht te krijgen in wat er reeds gebeurt in dit veld.

Het gesprek en de bijeenkomst maakten duidelijk dat de kant van architectuur *als* onderwijs nog erg onderbelicht is, maar het kwam wel ter sprake. In de presentaties kwamen diverse interessante referenties aan bod, die aanknopingspunten hebben gevormd voor mijn begincolloquium, zoals [dit filmpje](#) over 'the positive classroom environment', dat gaat over de 'habits' en 'habitats' van scholen.

Ellen Leussink - donderdag 7 mei 2015

Ellen Leussink is werkzaam bij RVO (Rijksdienst voor Ondernemend Nederland) en speelt al jaren een belangrijke rol in het programma 'DuurzaamDoor', een kennisprogramma voor sociale innovatie dat de ontwikkeling naar een groene, duurzame economie wil versnellen en doorbraken helpt realiseren. Het programma organiseert samenhang tussen landelijke, regionale en lokale initiatieven via 'sociaal instrumentarium' en het leren van elkaars ervaringen. Ellen is zelf pedagoge en is binnen DuurzaamDoor voornamelijk bezig met educatieve aspecten.

Het gesprek met Ellen, evenals diverse gesprekken met mijn begeleider bij het gastbedrijf, hebben tot veel inzicht geleid in de Nederlandse situatie omtrent onderwijsvastgoed en de rol van diverse partijen daarin. Dit heeft een bijdrage geleverd aan de ontwikkeling van de roadmap, die in dit paper is gepresenteerd.

Arjen Wals - woensdag 13 mei 2015

Arjen Wals is hoogleraar Transformatief Leren voor Sociaal-Ecologische duurzaamheid aan de Wageningen Universiteit binnen de leerstoelgroep educatie- en competentiestudies. De richting van dit onderzoek is dan ook zeer nauw verwant aan Arjen zijn werkveld. Alhoewel Arjen met name focust op leerprocessen (zie Figure 2, 'pedagogy') is ook het werkveld van de fysieke leeromgeving hem niet vreemd. Dit komt onder andere door zijn samenwerking met David Orr (die in dit onderzoek diverse keren is aangehaald).

Op woensdag 13 mei heb ik persoonlijk kennis met hem gemaakt. Verder is hij in het proces op diverse momenten schriftelijk betrokken geweest. Hij zou aanwezig zijn op de expert meeting (woensdag 9 december 2016), maar was op het laatste moment helaas verhinderd. Arjen zijn werk en feedback is op veel niveaus in dit onderzoek verweven, zoals in de referenties duidelijk zichtbaar is. Tijdens ons gesprek sprak Arjen onder andere over de relatie tussen gedragsverandering en persoonlijke leefstijlen en de gemeenschap. Deze relaties zijn nader toegelicht in Appendix A, bij het zoeken naar een model voor een 'whole-school approach'.

Eric Slaats en Annemarie van den Broek - vrijdag 22 mei 2015

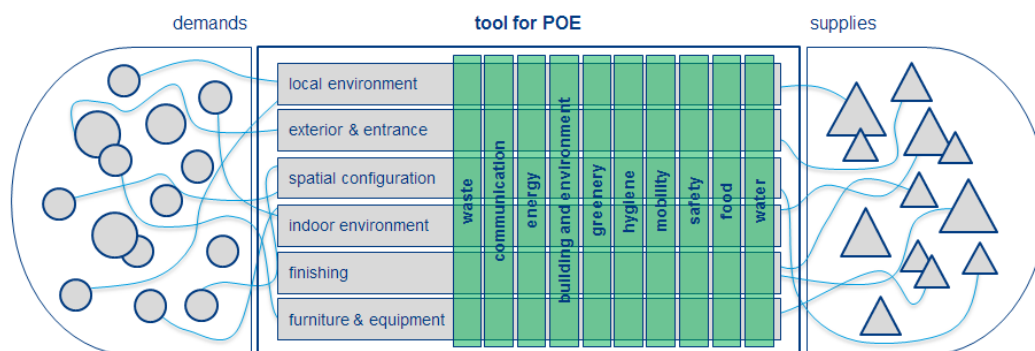
Eric Slaats en Annemarie van den Broek zijn werkzaam bij Fontys Hogescholen. Zij zijn initiatiefnemer van 'Schoollab'. Schoollab is een iFontys- project met als doel het ontwikkelen van living labs rondom educatie. De focus is initieel gericht op basisonderwijs. Het Schoollab moet een platform worden voor onderzoek en exploratie met alle mogelijke zaken die het leren beïnvloeden. Educatieve studenten zullen in het gebouw van Schoollab lesgeven aan uitgenodigde basisschoolklassen, met alle nieuwe mogelijkheden, tools, middelen en inzichten die ontwikkeld kunnen worden. Diverse bouwkundestudenten van de Technische Universiteit Eindhoven hebben gewerkt aan het ontwerp van het gebouw van Schoollab. Eric en Annemarie hebben die ontwerpen met me gedeeld en ze toegelicht.

Ferdie van de Winkel en Ad den Otter (OPTI-School) - dinsdag 9 juni 2015

Ferdie van de Winkel en Ad den Otter hebben het initiatief 'OPTI-School' opgezet. Het doel van OPTI-School als onafhankelijke Stichting is om goede, gezonde onderwijshuisvesting te realiseren en dit te borgen gedurende de gehele gebouwlevenscyclus. Ad den Otter is onder andere verbonden aan Ruimte-OK en was lange tijd directeur van ADMS (Architectural Design Management Systems) aan de Technische Universiteit Eindhoven. Hij heeft in beide kaders veel onderzoek en praktijkwerk gedaan omtrent scholenbouw. Hij heeft me onder andere diverse onderzoeken aangedragen die ze in dat kader hebben uitgevoerd. Dit heeft bijgedragen aan een beter inzicht in wat er al gedaan was en waar de 'gap' nog lag.

Marcel Loomans en Jan Hensen - juni tot en met september 2015

Toen ik aan dit afstudeeronderzoek begon, volgde ik nog een dubbele master. Naast de specialisatie 'Building Technology', waarvoor ik dit paper heb opgeleverd, volgde ik toen ook nog de mastertrack 'Building Physics and Services' (BPS). Daarvoor waren Marcel Loomans en Jan Hensen mijn begeleiders. Zoals in de sectie 'From theory to practice: a roadmap' en ook in Appendix A is toegelicht, speelt leerlingparticipatie in schoolevaluatie in dit onderzoek een belangrijke rol. Het was dan ook de bedoeling om een instrument te ontwikkelen waarmee leerlingen hun gebouw(de omgeving) kunnen analyseren en evalueren. Figuur 18 laat schetsmatig zien hoe dat destijds voor ogen was. Het binnenklimaat speelde daarin een redelijk belangrijke rol. Het onderzoek dat ik bij BPS zou uitvoeren, zou zich erop richten aan dat onderdeel invulling te geven en zou gaan over de nauwkeurigheid en geldigheid van (binnenklimaat)metingen door leerlingen, teneinde daarvoor passende richtlijnen te ontwikkelen die inspelen op de specifieke situatie van desbetreffende school omtrent klimaatsystemen, gebouwindeling, tijdstip in het jaar en op de dag, enzovoort.



Figuur 18 The (draft) set-up of the tool to be developed in the overarching research

Inhoudelijk kwam het echter steeds verder van de rest van het onderzoek af te staan, met name omdat het verschil in niveau van precisie erg groot werd. Bovendien werd steeds beter duidelijk dat mijn interessegebied daar niet lag. Eind september heb ik daarom besloten om deze richting niet te continueren.

Diverse scholenbezoeken - april 2015 tot maart 2016

In het kader van Eco-Schools, het internationale keurmerk voor duurzame scholen dat in Nederland door mijn gastbedrijf wordt beheerd, ben ik mee geweest naar diverse scholen die gaan verbouwen of net een bouwproces achter de rug hebben. Ook hebben er diverse scholenbezoeken plaatsgevonden in het kader van OPTI-School en de samenwerking met BPS (zie hierboven). Alle bezoeken gezamenlijk hebben geleid tot meer gevoel omtrent de vraagzijde en de issues die daar spelen.

De scholen waren: Markland College Zevenbergen; Citaverde College Heerlen; Citaverde College Roermond; Citaverde College Horst; De Klimboom Eindhoven; Brede School Casteren; D'n Opstap Lage Mierde; AOC Oost Doetinchem; De Regenboog Eindhoven; Dr. Nassau College Quintus Assen; CV Vincent van Gogh Lariks Assen; Brede School Nieuwstraat Rotterdam; Christelijk Lyceum Veenendaal. Daarnaast hebben vijf bezoeken aan de case study school plaatsgevonden (zie Appendix C). De bezoeken zijn gespreid over basisscholen, middelbare scholen en locaties van het MBO, om een breed beeld te krijgen.

Boekuitreiking Scholenbouwatlas - woensdag 10 juni 2015

De Scholenbouwatlas is dit jaar uitgekomen. De Scholenbouwatlas is een toegankelijk handboek voor het verbouwen van basisscholen en kindercentra. De komende jaren zullen in Nederland honderden basisscholen moeten worden verbouwd. De nood is hoog, want de visies en behoeftes veranderen voortdurend en er is veel achterstallig onderhoud. Voor de meeste schooldirecteuren, teamleden en schoolbesturen is dit een ingewikkelde opgave waarbij veel komt kijken. De scholenbouwatlas biedt hulp bij het aanpassen van basisscholen en kindercentra. Opdrachtgevers kunnen zich via De Scholenbouwatlas goed oriënteren en afvragen welke verbouwmogelijkheid het beste bij de ambitie past. Dit handboek geeft een overzicht van actuele verbouwopties en toont honderd inspirerende voorbeelden van verbouwingen in Nederland. Deze voorbeelden zijn aangedragen door het veld zelf: via een oproep aan scholen en gemeenten door nationale kenniscentra. De Scholenbouwatlas laat zien dat goed verbouwen, waarbij de opgave integraal wordt aangepakt, een slim alternatief is voor nieuwbouw. Tijdens de boekpresentatie kwamen diverse voorbeelden aan bod en sprekers aan het woord. De gesprekken met partijen als Duurzaam Gebouwd en Stichting Duurzame Scholen gingen met name om de aanbodzijde (zie het Hamburgermodel in Figure 3). Deze bijeenkomst betrof juist de vraagzijde, waaronder de PO-raad. Deze bijeenkomst, diverse andere gesprekken en de scholenbezoeken (zie hierboven) hebben ervoor gezorgd dat een goed begrip van zowel de aanbodzijde als de vraagzijde is verkregen.

Marco van Zandwijk - woensdag 16 september 2015

Marco van Zandwijk is werkzaam bij Ruimte-OK (stichting Ruimte voor Onderwijs en Kinderopvang). Hij heeft een bouwkundige achtergrond en studeerde aan de Academie voor de Bouwkunst. Marco is nauw betrokken geweest bij de ontwikkeling van de Scholenbouwatlas (zie hierboven). Zijn ervaring, zowel theoretisch als praktisch, is dat mensen erg veel belang hebben bij 'zelfbepaling' en zelf invloed hebben en dat dingen niet van buitenaf worden opgelegd.

Met Marco besprak ik het model uit Figure 17. Gedurende het gesprek werd duidelijk dat ik onder de categorieën allerlei dingen verstond, die ook wat hem betreft cruciaal zijn in dit veld. De indeling van de categorieën sprak echter niet voor zich. Naar aanleiding van onder andere dit gesprek werd steeds beter helder dat dit model niet de potentie in zich had om aan een breed publiek inzicht te verschaffen in de aspecten die het model behelsde. Marco adviseerde om op zoek te gaan naar een reeds bestaand model dat nuttige handvatten kan bieden en nuttig kan zijn voor de dagelijkse praktijk. Zoals reeds besproken heb ik dat uiteindelijk gevonden in het 'hart, hoofd, handen'-model.

SME Advies - dinsdag 29 september 2015

SME Advies is het gastbedrijf waar dit onderzoek heeft plaatsgevonden. Naast de regelmatige gesprekken die ik met mijn begeleider voerde, gaf ik op 29 september een tussenpresentatie aan het hele bedrijf. De opkomst was circa tien personen en de aanwezigen hebben zeer uiteenlopende achtergronden, waaronder milieuwetenschappen, sociologie, biologie, bedrijfskunde, sociale geografie, bestuurs- en organisatiewetenschappen en webdesign. De conclusies naar aanleiding van deze presentatie waren vergelijkbaar als die aan de hand van het gesprek met Marco van Zandwijk (zie hierboven). Vanaf oktober heb ik deze categorisering daarom laten varen.

Vanaf oktober ging de raamwerkontwikkeling verder aan de hand van het 'hart, hoofd, handen'-model. Appendix A heeft deze overgang reeds in meer detail toegelicht. Vanaf toen stond de combinatie van het hart, hoofd, handen-model en het hamburgermodel centraal.

Nienke Moor, Coosje Hammink, Kristel Hermans, Maurice Dominicus, Masi Mohammadi - woensdag 9 december 2015

Deze expert meeting was ver van te voren gepland, waardoor alle aanwezigen uitgebreid de tijd hebben gehad (en genomen) om het schriftelijke tussenresultaat tot zich te nemen. De feedback gedurende deze expert meeting was dan ook zeer uitgebreid en waardevol en betrof zeer veel aspecten van het onderzoek.

Het gebouw als onderwijzer: de relatie tot 'onderwijs'

Het was onder andere voor de aanwezigen nog niet precies duidelijk wat werd verstaan onder 'het gebouw als onderwijzer', doordat er zo veel verschillende typen aspecten aan bod kwamen. Deze typen zijn uiteindelijk begrijpelijk gevat in het hart, hoofd, handen-model, doordat het model duidelijk maakt dat de invloed zowel 'zacht' (hart) kan zijn, als heel specifiek in de lessen gebruikt kan worden door feedback en meetbare dingen, enzovoort (hoofd).

Ook was nog niet duidelijk wat precies de relatie was ten opzichte van leerprocessen/pedagogiek en curricula (zie Figure 2). Diverse aanwezigen hadden de indruk dat het ging om de invloed van het gebouw op leerprocessen. Middels Figure 2 is getracht duidelijk te maken dat dit niet het geval is, maar dat het gaat om de eigen rol die de fysieke leeromgeving speelt.

Bovendien waren er vraagtekens bij de grootte van het effect van het gebouw op het 'leren'. Om te benadrukken dat dit effect niet verwaarloosbaar is, zijn uiteindelijk de beschikbare, gemeten invloeden ten aanzien van de invloed van het binnenmilieu op het leren (zie Introduction) opgenomen in het paper, aangezien deze resultaten aanwijzingen geven dat het gebouw inderdaad niet verwaarloosbaar is.

Woordkeuzes

Diverse woorden leidden tot verwarring, door de uiteenlopende achtergronden van de aanwezigen. Het betrof termen als 'ecology' en 'environment'. Die zijn uiteindelijk beter toegelicht of anders gekozen.

Jozanneke Vanderveen - vrijdag 11 december 2015

Jozanneke Vanderveen is promovenda in de politieke filosofie. Haar expertise en interesse liggen op het gebied van (politieke) rechtvaardigheid. Het raakvlak tussen haar werk en dit onderzoek betreft de manier waarop mensen betrokken zijn bij en bijdragen aan een 'betere wereld' en de verhouding tussen interne en externe oorzaken van gedrag (zie Figure 3). Haar input voor dit onderzoek betrof daardoor met name de 'ingrediënten voor duurzaam geluk', zoals in appendix E toegelicht en in dit paper beschreven in de sectie 'An exploration of demands'.

Marianne Kolkena - donderdag 14 december 2015

Marianne Kolkena is lactatiekundige en in opleiding tot medisch cultureel antropoloog. Haar expertise en interesse liggen op het gebied van hechting, zoals in dit paper beschreven in de sectie 'Engage the heart'. Alhoewel Marianne primair focust op de hechting tussen kinderen en ouders in de eerste levensjaren, is het toepassingsgebied van hechtingstheorie veel breder en was haar expertise ook zinvol in de context van scholen(bouw).

Daarnaast heeft Marianne veel ervaring als boekvertaler. Ze heeft mij geholpen een aantal citaten uit het Engels naar het Nederlands te vertalen. Deze komen terug in Appendix E.

Tussencolloquium - vrijdag 18 december 2015

Bij het tussencolloquium was het definitieve raamwerk zoals in dit paper gepresenteerd zo goed als af. Wat echter nog miste, is de link naar de praktijk en een manier om op basis van dit raamwerk ook echt gebouwen te kunnen beoordelen en ontwerpen. Naar aanleiding van de feedback tijdens het tussencolloquium is een eerste aanzet gemaakt tot de sectie 'From theory to practice: a roadmap'. Met name het analyse-instrument zoals gepresenteerd in Table 1 is hieruit voortgevloeid.

Jacob Voorthuis - vrijdag 15 januari 2016

Jacob Voorthuis is architectuurfilosoof en werkzaam op de Technische Universiteit Eindhoven. Hij heeft meegedacht over de toepasbaarheid van het raamwerk voor de praktijk en dan met name voor architecten en andere ontwerpers van de fysieke ruimte. Zijn reacties waren positief en hij wil graag kijken of het raamwerk de basis zou kunnen dienen voor een master-architectuurproject.

Joost Bennekers - donderdag 4 februari 2016

Joost Bennekers werkt voor de Dutch Green Building Council aan het project 'Waardevolle Scholen'. Ik maakte voor het eerst kennis met dit initiatief tijdens een bijeenkomst van RVO gedurende de Dutch Green Building Week in september 2015. Partners van de Dutch Green Building Week (DGBW) hebben gezamenlijk afgesproken een concept te ontwikkelen voor het realiseren van een 'Waardevolle School'. Door de diverse partners wordt samengewerkt aan de ontwikkeling van een nieuw verduurzamingsconcept waarmee primair onderwijsgebouwen kosteneffectief kunnen worden verbeterd en verduurzaamd. Daarnaast moeten de gebouwen goed kunnen worden geëxploiteerd en aansluiten bij de behoefte van de leerlingen, leraren en schoolbesturen. Het concept van de waardevolle school omvat ook dat de school een functie heeft in de omgeving en 'waardevol' is voor omwonenden.

Als pilotschool hebben de partners een school in Zaanstad gekozen. De bedoeling is om op basis van deze case de geleerde lessen ook op andere scholen toe te kunnen passen. Daarvoor is Joost Bennekers nu onder andere bezig met een 'Gouden Route', een soort routekaart die scholen moet helpen in het proces naar een waardevolle school. Daarover sprak ik hem en we hebben het met name gehad over de diverse partijen die betrokken zijn in die processen. Dit heeft als input gediend voor het hoofdstuk 'From theory to practice: a roadmap', waarin dit onderzoek in feite ook zo'n routekaart presenteert, op een specifiek veld.

Ruud van Vliet - woensdag 24 februari 2016

Ruud van Vliet werkt samen met Marco van Zandwijk en Ellen Leussink (zie eerder) aan de landelijke GreenDeal Scholen, om gebouwen voor primair en voortgezet onderwijs te verduurzamen. Daarbij ligt de focus op energiebesparing, energieopwekking, het verbeteren van het binnenklimaat en het terugdringen van de levenscycluskosten voor schoolgebouwen. Er zal echter ook ruimte zijn voor een educatieve component. Met Ruud sprak ik met name over de partijen die betrokken zijn bij renovatie en hoe de processen daaromtrent eruit zien, teneinde het stappenplan meer te kunnen toespitsen op de praktijk.

Christelijk Lyceum Veenendaal - donderdag 3 maart 2016

Het Christelijk Lyceum Veenendaal heeft mij benaderd met de vraag of ik een inspiratiesessie zou willen verzorgen voor het docententeam. De school staat aan de vooravond van een nieuwbouwtraject en de directie is zich er zeer van bewust dat de grootste invloed die zij daarop hebben, in het begin van het proces is. Daarom heeft ze zich ten doel gesteld om rond de zomerperiode een nieuwe onderwijsvisie gereed te hebben, opdat daar in het najaar een degelijk programma van eisen uit kan voortvloeien en de architect daar vanaf december mee aan de slag kan. Karin Wouters, sectordirecteur havo-vwo, benaderde mij omdat ze merkte dat een rondgang onder docenten met betrekking tot hun wensen louter had geleid tot een versterking van oude patronen. Ze wilde de docenten daarom graag eens meenemen in andere manieren van denken over onderwijs en onderwijshuisvesting.

Het programma bestond uit drie parallelle workshops van circa een uur, die alle drie twee keer gegeven zijn. In beide rondes namen zo'n 40 docenten deel aan de workshop die ik heb verzorgd. In circa twintig minuten heb ik ze meegenomen in het raamwerk dat ik in dit paper heb gepresenteerd. Met diverse voorbeelden heb ik geïllustreerd hoe zaken een plek kunnen krijgen in schoolgebouwen. Na deze introductie zijn de docenten circa een half uur zelf aan de slag gegaan met de Duurzaamheidsscan van Eco-Schools (zie Appendix D), waarmee ook de leerlingen van de Sokkerwei (zie sectie 'Research methodology' en Appendix C) hun school en schoolgebouw hebben geëvalueerd. Men was geschokt van de huidige situatie en er waren veel onderwerpen waar ze nog nooit over hadden nagedacht. De school heeft diverse gebouwen; dat de staat van de oudste gebouwen slecht was, daarover waren ze niet verbaasd, maar dat ze na deze scan ook over de nieuwe gebouwen uiterst ontevreden bleken, ontstelde hen. Zowel over de staat van de gebouwen (op het gebied van gebouwen *voor* onderwijs, zie Figure 2), als de mate waarin zij bijdragen aan duurzaamheidsonderwijs (zoals in dit paper besproken) waren zij uiterst ontevreden. Het feit dat dit ook in de nieuwere gebouwen geldt, heeft heb doen beseffen dat ontwerpers van de fysieke ruimte niet automatisch aan hun onuitgesproken wensen tegemoet zullen komen en dat een goede uitvraag daarom ontzettend belangrijk is.

Na de scan hebben we de resultaten van de scan getracht een plek te geven binnen het raamwerk dat ik heb ontwikkeld. Daarmee is de toepasbaarheid ervan in de praktijk getest. Deze test heeft geleid tot het inzicht dat de negendeling voor leken goed te begrijpen is, maar dat de analyse niet door hen kan worden uitgevoerd. Vrijwel geen van de tachtig docenten slaagde erin om de resultaten van de scan in te delen binnen de categorieën van het raamwerk. Een docent zei: "Tja, ik ben maar een simpele docent Engels." Zoals in de toelichting op het stappenplan (zie sectie 'Step 1: post-occupancy evaluation') is toegelicht, wordt de analyse van het schoolgebouw daarom gezien als een taak die te gespecialiseerd is voor leerlingen en schoolpersoneel.

Daar staat tegenover dat wanneer de analyse eenmaal gedaan is, zij wel goed begrepen wat deze inhield. Reageren op de analyse (in dit geval betrof dat geen analyse van hun gebouw maar de voorbeelden die ik gegeven heb in de presentatie) was geen enkel probleem. In het gesprek dat we tot slot met z'n allen hebben gevoerd, kwamen de diverse aspecten van het raamwerk heel duidelijk terug. Met name de metafoer van het schaap (zie sectie 'Enable the hands') bleef erg goed hangen. De meeste moeite hadden ze met de middelste groep ontwerpkenmerken, waarop ik de benaming daarvan in het Nederlands nog wat heb aangepast. De reacties van de docenten op de inspiratiesessie waren erg positief. Diverse leerkrachten kwamen achteraf naar mij toe met de opmerking dat ze nu over allemaal dingen aan het nadenken waren, waar ze eerder nog nooit over hadden nagedacht. De komende weken en maanden houden we contact om te kijken hoe ik hen verder kan helpen bij het formuleren van de onderwijsvisie en het programma van eisen.

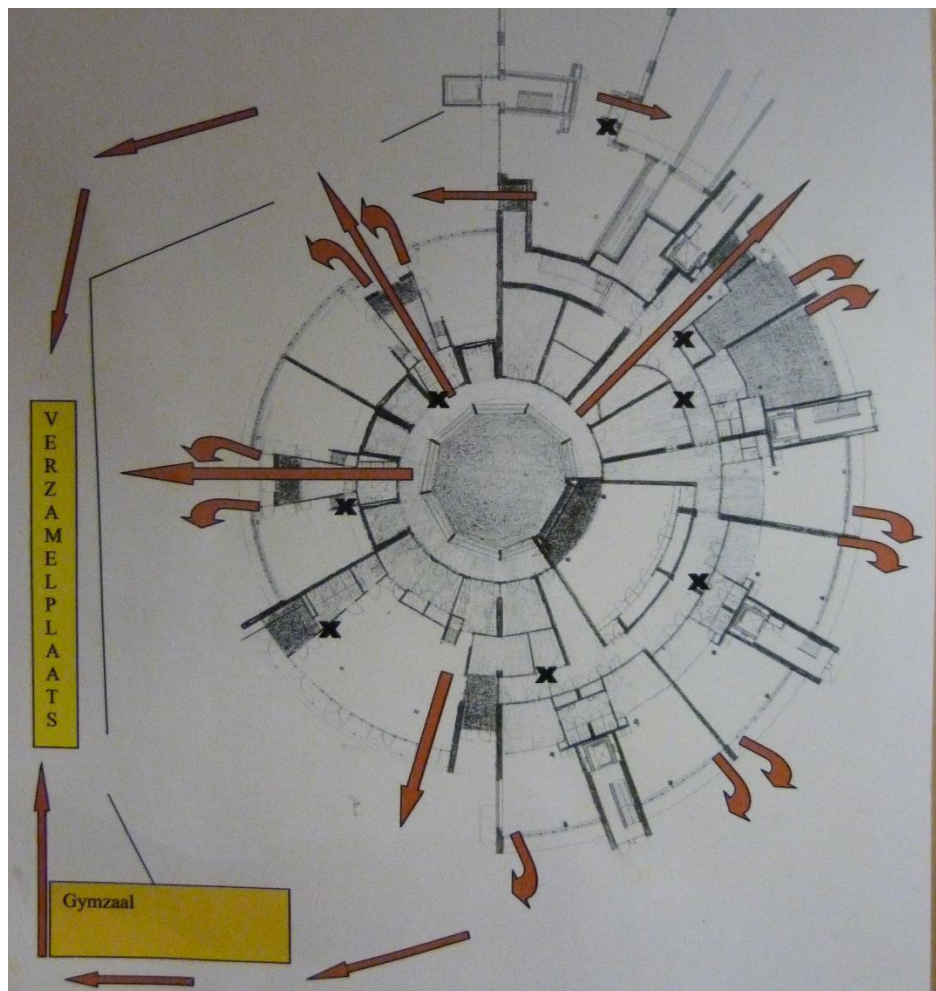
APPENDIX C: OBSERVATIES EN INTERVIEWS OP DE SOKKERWEI

In totaal heb ik vijf bezoeken gebracht aan de Sokkerwei. Hieronder lees je per bezoek wat het bezoek inhield en welke bevindingen er (globaal) zijn gedaan.

Donderdag 8 oktober 2015

Tijdens dit bezoek heb ik kennis gemaakt met de directeur van de school (Marja Verruijt) en het schoolgebouw zelf. Ik heb een uitvoerige rondleiding gekregen door het gebouw en over het terrein en Marja Verruijt heeft haar bereidheid geuit om mee te werken aan het onderzoek. De rondleiding vormden een goede achtergrond om de eerste interviews voor te bereiden.

De plattegrond van de school is weergegeven in Figuur 19. De centrale hal in dit gebouw dient als theater, plek voor de overblijf, samenwerken, enzovoort. Deze centrale hal wordt het 'Weitheater' genoemd. Daaromheen liggen alle lokalen. De lokalen rechts in Figuur 19 zijn van de onderbouw, de lokalen links van de bovenbouw. In Appendix E is veel fotomateriaal van dit gebouw opgenomen.



Figuur 19 Plattegrond van de Sokkerwei

Het nieuwe gebouw van de Sokkerwei is in 2001 opgeleverd. Destijds waren er veel docenten die daar nauw bij betrokken zijn geweest en de potentie van het gebouw gebruikten in hun lessen. Sindsdien zijn er echter veel docenten vertrokken en zijn veel nieuwe docenten niet op de hoogte gebracht van de potentie van het gebouw. De aandacht voor duurzaamheid in het onderwijs in relatie tot de gebouwde omgeving is daardoor in de loop der tijd verzwakt. Het komt nog wel terug in diverse opdrachten en projectweken, zoals nu in de 'Raar maar waar'-week.

Tegenwoordig profileert de school zich met name als 'Vreedzame School'. De Vreedzame School streeft er naar om kinderen te leren: op een positieve en zorgzame manier met elkaar om te gaan, op een democratische manier met elkaar beslissingen te nemen, constructief conflicten op te lossen, verantwoordelijkheid te nemen voor elkaar en voor de gemeenschap en open te staan voor verschillen tussen mensen. Het programma wil niet alleen kinderen bovenstaande sociale competenties leren, maar vooral ook een positief sociaal en moreel klimaat in de school creëren, waar een opvoedende en gedragsregulerende werking van uitgaat.

Woensdag 28 oktober

Tijdens dit bezoek heb ik een eerste interview met twee leerlingen uit groep 7/8 gehouden. Ook heeft er een kringgesprek met de peuterklas plaatsgevonden en sprak ik diverse leerkrachten.

Observaties binnen en buiten

Ik was vroeg op de school aanwezig, waardoor ik er reeds was toen alle leerlingen en ouders het schoolplein en de school betraden. Veel leerlingen gingen direct vanaf buiten hun lokaal in (zie ook de rode pijlen in Figuur 19) en kwamen daardoor bij binnenkomst niet in de centrale hal. Een grote groep verzamelde zich echter in de gangen rondom het Weitheater. Daar werden krukjes neergezet, waar de leerlingen van groep 5, 6, 7 en 8 door ouders werden gecontroleerd op luizen. Doordat de hal aan de lokalen van alle vier die jaren grenst, was er veel interactie tussen de leerlingen en ouders van de verschillende groepen. De lokalen hebben veel glas naar de hal toe, waardoor er ook met de leerlingen in de klas interactie plaatsvond. Er waren bovendien enkele ouders die hardlopend naar de school zijn gekomen: dit zegt iets over de positionering van de school in de wijk/het dorp en de toegangswegen er naartoe. Op het moment dat de lessen moesten beginnen, liepen twee leerlingen een rondje door het gebouw met een bel, in plaats van dat een geautomatiseerd systeem dit signaal afgeeft.

Alle lokalen hebben relatief lage ramen, waardoor ook de kleinere kinderen altijd contact hebben met buiten. De vensterbanken zijn gebruikt om de lokalen te personaliseren; eigen werkstukjes van de kinderen worden daar tentoongesteld. In de muren van de personeelskamer zijn zelf speciale ramen gemaakt op ooghoogte van de kleine kinderen. In het Weitheater is de houten constructie duidelijk aanwezig en is het regenwaterafvoersysteem tentoongesteld. In alle klassen zijn de luchtkanalen van het klimaatsysteem duidelijk aanwezig. Hout en baksteen zijn de dominante bouwmaterialen.

Het schoolterrein is omgrensd door een muurtje en hekjes, die de ronde vorm van het gebouw volgen. De fietsenrekken zijn in deze omheining geïntegreerd en volgen dus eveneens de ronde vorm. Per twee lokalen is er een entree (zie Figuur 19). De fietsenrekken zijn verspreid over die entrees, waardoor iedereen de fiets kwijt kan in de buurt van waar hij/zij moet zijn. De hekjes en muurtjes bij het deel waar voornamelijk de peuters komen, zijn op hun schaal afgestemd en daarom wat lager.

Opmerkingen van leerkrachten

Door de ronde vorm van het gebouw heeft elk lokaal de vorm van een 'pizzapunt', zoals leerlingen het verwoordden. Daardoor zijn de lokalen relatief diep en smal en maken de muren geen hoeken van 90 graden met elkaar. Volgens diverse leerkrachten nodigt dit uit tot creatief gebruik van de ruimte. Zo was er in de peuterklas een 'heksenhoek' gecreëerd die in eerste instantie buiten het blikveld van de docent valt, wanneer men in de kring zit of op het bord gericht is. Haar ervaring is dat dit het creatieve spel van kinderen bevordert, doordat ze niet steeds in de gaten gehouden worden. In de hogere groepen wordt deze ruimte ingenomen door computers. Ook daar kunnen leerlingen relatief uit het zicht van de docent zelfstandig werken.

Interview met twee leerlingen uit groep 7/8

Het interview was er met name op gericht om een beeld te krijgen van wat de leerlingen van hun schoolgebouw vinden en hoe het aansluit bij hun behoeften (op dat moment stonden 'menselijke

behoefte' nog zeer centraal in het raamwerk, zie Appendix A). We hebben diverse opmerkelijke dingen aan het gebouw besproken. Uit het gesprek kwam naar voren dat de algehele indruk van het gebouw positief is. Het centrale 'Weitheater' wordt gewaardeerd. De leerlingen werken het liefst boven (vide in de klas), onder andere omdat het daar rustiger is dan in de klas en in het Weitheater en er meer individueel regelbaar is (licht, temperatuur). De leerlingen vinden het fijn dat de school een kleinschalig karakter heeft.

Een van de eerste vragen betrof de mening van de leerlingen met betrekking tot het duurzame karakter van de school. De leerlingen vinden hun school duurzaam, omdat er zonnepanelen zijn, er gras op het dak ligt, er zonne-energie wordt opgewekt en ze de lichten altijd uit doen. Ook maken ze gebruik van de inzamelplek in het Weitheater voor stiften en batterijen.

Gesprek met de leerlingen van groep 1/2 en observaties buiten

Onder leiding van de juf van de groep is een kringgesprek gevoerd over de duurzame aspecten van het schoolgebouw van de Sokkerwei. Naar aanleiding van dit gesprek hebben de leerlingen een tekening gemaakt over wat ze zo bijzonder vinden aan hun school. In Figuur 20 zie je enkele van de 18 tekeningen die hiervan het resultaat zijn. Tijdens mijn volgende bezoek aan de school (woensdag 16 december) heb ik de tekeningen met de leerlingen besproken.



Figuur 20 Enkele tekeningen van de peuters

Het (digi)bord bij de peuters is in hoogte verstelbaar en daardoor goed te gebruiken door zowel de leerkracht, als zelfstandig door de kinderen.

Na dit kringgesprek was het tijd voor buitenspelen. Ik ben met de kinderen meegegaan om met een paar nog individueel of in kleine groepjes wat verder te kunnen praten, onder andere over wat ze van het schoolplein vonden. Ze waren vooral erg blij met alle boombladeren die op het plein lagen, nu in de herfst. Vrijwel alle leerlingen waren daar druk mee; ze schoven ze heen en weer met bezems, maakten er bulten van en gooiden de bladeren als regens over zichzelf heen. Vrijwel alle kinderen wisten van de zonnepanelen op het dak en waar die voor dienen. Van de klimaatinstallatie op het dak werd gedacht dat het een grote radio is. Als verzamelpunt werden de kolommen van het gebouw gebruikt (die staan buiten). Hier omheen werd druk gestoepkrijt, in ronde vormen rond de kolom, en ze werden gebruikt om rondjes omheen te draaien en elkaar te tikken.

Woensdag 16 december 2015

Tijdens dit bezoek heb ik wederom een interview met twee leerlingen uit groep 7/8 gehouden. Daarnaast was dit een interessante tijd voor observaties, omdat men midden in de feestdagen zat.

Observaties binnen en buiten

Het hele gebouw was versierd in kerstsferen. De gelegenheid die het gebouw bood om deze versieringen op een integrale manier vorm te geven, heeft mede geleid tot het besproken ontwerpprincipe 'Climatic and seasonal exposure', in de sectie 'A post-occupancy evaluation using the framework'.

Interview met twee leerlingen uit groep 7/8

Dit interview was vergelijkbaar met het eerste interview, maar dan met andere leerlingen. Aangezien de duurzaamheidsscan (zie Appendix D) met name focust op het 'hoofd' en de 'handen', zijn de interviews met name op het 'hart' gericht (inmiddels had het raamwerk deze structuur). De leerlingen vertelden onder andere dat ze de lichtstraat in het Weitheater zo leuk vinden door het contact met buiten dat het oplevert.

Bespreken van tekeningen met de peuters

In wederom een kringgesprek hebben we alle tekeningen van de leerlingen de revue laten passeren. Alle leerlingen hebben toegelicht wat ze getekend hadden. Een deel van de kinderen was dat helaas alweer een klein beetje vergeten, maar de juf wist ook nog het een en ander. Uiteindelijk heb ik besloten om de tekeningen geen plek te geven in het onderzoek. Het kringgesprek dat we hebben gevoerd voorafgaand aan het maken van de tekeningen lijken dusdanig sturend te zijn geweest voor wat de leerlingen hebben getekend, dat er weinig waarde in de tekeningen zelf lijkt te zitten. Zo is het tijdens het kringgesprek bijvoorbeeld uitvoerig gegaan over het groendak, over de ronde vorm van het gebouw en over de zonnepanelen op het dak. Dat zijn ook eigenlijk de enige elementen die in de tekeningen terugkomen.

De juf vertelde verder nog dat ze in de lessen regelmatig aandacht besteed aan de duurzame aspecten van het gebouw. Het feit dat er geen radiatoren aanwezig zijn, behandelt ze door het te hebben over wat je kunt doen met je natte handschoenen in de winter: op school kun je die niet op de radiator leggen, zoals je thuis vaak doet. Verder gaan de lichten in de wc's automatisch aan en uit op basis van sensoren. Ze legt dit uit aan de leerlingen en maakt er vaak een spelletje van, bijvoorbeeld dat ze moeten toveren om het licht aan te doen (hokus pocus!). Daardoor blijft het de leerlingen bij dat ze het erover gehad hebben.

Vrijdag 29 januari 2016

Tijdens dit bezoek heb ik wederom een interview met twee leerlingen uit groep 7/8 gehouden. Daarnaast sprak ik met Hans van Weenen, die nauw betrokken is geweest bij de ontwikkeling van het schoolgebouw.

Observaties binnen en buiten

Toen ik binnenkwam, was net de maandafsluiting gaande. Alle leerlingen van de school hadden zich in het Weitheater verzameld en een aantal klassen gaf een klein optreden. De hele school past in het Weitheater.

Wat me opviel, was dat steeds het licht in de personeelskamer aan was, terwijl er in de meeste lokalen goed gelet werd op het aan- en uitzetten van de lichten wanneer er niemand aanwezig was. Ik merkte op dat de lichtknop zich aan de andere kant van de ruimte bevond dan de deur en betrapte mezelf er ook op dat ik bij het verlaten van de ruimte bijna vergat het licht uit te doen. Het lijkt aannemelijk dat de plek van de knop de oorzaak is van dat het licht zo vaak aan staat.

Interview met twee leerlingen uit groep 8

Wederom was het gesprek gericht op het 'hart' (in tegenstelling tot het hoofd en de handen). De lievelingsplekken van de kinderen kwamen ter sprake. Ook liepen we weer samen een rondje door het gebouw, om zo veel mogelijk associaties de revue te laten passeren. De leerlingen gaven een kleine rondleiding door het gebouw en vertelden erover wat ze wisten. Zo werd bijvoorbeeld duidelijk dat ze het blootgestelde wateropvangsysteem nog nooit hadden opgemerkt, toen we erlangs liepen en ik vroeg wat het was. Evenals de leerlingen in het vorige gesprek vonden ze de lichtstraat in het Weitheater mooi en vonden ze het fijn en leuk om naar buiten te kunnen kijken en het weer te zien.

Beide leerlingen hebben sinds groep 1 op deze school gekregen. Ik vroeg ze wat ze in die acht jaren gemist hebben. Daarbij kwam al snel het schoolplein ter sprake. Deze oudere leerlingen zijn niet te spreken over de voetbaldoelen. Ook zouden ze graag wat meer diversiteit op het schoolplein hebben. Het schoolplein gebruiken ze met name om te voetballen. Andere faciliteiten (klimrekken, zandbakken, etc.) worden door deze, wat oudere leerlingen niet meer benut. De leerlingen gaan in de pauzes vrijwel altijd naar buiten; alleen als het regent, (mag dat) soms niet.

Ook vertelden de leerlingen over 'keuzekaarten'; dat zijn dingen die je kunt doen als je klaar bent met je andere, verplichte opdrachten. Ze vertelden dat er diverse keuzekaarten zijn die iets te maken hebben met duurzaamheid. Opvallend daaraan was dat ze de opdrachten op de keuzekaarten altijd in de klas uitvoeren, ookal gaat de opdracht over iets wat tastbaar is (zoals veel natuurgerelateerde zaken). Daar worden bijvoorbeeld geen excursies aan gekoppeld. Ook gaat de klas zelden naar buiten (behalve uiteraard voor de pauzes). Ik vroeg de leerlingen wat ze in de afgelopen acht jaren juist heel leuk vonden. Naast 'pauzes' en 'vakanties' kwamen daar de keuzekaarten weer aan de orde. Ze noemden diverse projecten waar ze uitgebreide, praktijkgerichte opdrachten hadden gedaan, zoals een 'kettingreactie' bouwen. Hier was het gebouw soms ontoereikend; dit soort ruimteverslindende opdrachten waren niet altijd mogelijk, omdat het gebouw daarvoor niet groot genoeg was. Vorig jaar stond er een lokaal leeg, waardoor ze langere tijd aan hetzelfde project konden werken zonder steeds weer te hoeven afbreken.

Verder vertelden de leerlingen weer over het grasdak en de zonnepanelen. Op een gegeven moment liep er een juf langs, die aanhaalde dat de manier waarop verwarmd wordt bijzonder is. De leerlingen hadden wel eens gehoord van het HVAC-systeem, maar het schoot ze niet direct weer te binnen.

De leerlingen gaven aan het fijn te vinden dat er zo'n groot raamoppervlak is in elke klas. Het 'tuintje' tussen de ramen en het schoolplein wordt niet echt gebruikt. Er worden wel steeds plannen voor gemaakt, maar ze worden (bijna) nooit ten uitvoer gebracht. De leerlingen vinden de tuintjes er daardoor 'ook echt niet uitzien'. Bovendien gebruiken ze de tuintjes om verstoppertje in te spelen en schoppen ze de bal er regelmatig in, dus ze gaven ook toe niet zo zuinig om te gaan met de tuintjes.

Deze leerlingen gaan binnenkort naar de middelbare school. Er zijn twee middelbare scholen in de omgeving. Ik vroeg ze maar welke ze zullen gaan en hoe ze de keuze daarvoor hebben gemaakt. Opvallend was dat daarbij onder andere de uitstraling van het schoolgebouw aan de orde kwam. Ze konden alleen niet echt omschrijven wat ze aan de ene prefereerden ten opzichte van de andere.

Zo'n afsluiting als vandaag plaatsvindt, is er elke maand. Daarnaast worden er zeer regelmatig musicals gegeven door de klassen. Met Sinterklaas, Kerst en Pasen wordt het Weitheater versierd, maar dan is er geen speciale uitvoering.

Als de leerlingen zelf mochten bepalen wat er met de fysieke leeromgeving zou gebeuren, zouden ze vooral het schoolplein groter maken en meer plek creëren om te sporten.

Gesprek met Hans van Weenen

Hans van Weenen was initiatiefnemer van de nieuwbouw van de Sokkerwei. Ik sprak hem op locatie om meer inzicht te krijgen in het proces dat destijds speelde, welke rollen diverse partijen daarin hebben vervuld, welke obstakels ze zijn tegengekomen, welke intenties er allemaal waren en wat daarvan terecht is gekomen. Hieronder leest u enkele van de aspecten die we besproken.

Het proces is gestart met de vraag vanuit het schoolbestuur aan Hans van Weenen om te kijken naar de mogelijkheden om een energiezuinig gebouw te realiseren (noot: dit vond bijna twintig jaar geleden plaats, toen 'duurzaamheid' nog maar weinig aandacht kreeg en er nog maar weinig voorbeelden waren van scholen en andere gebouwen van hoe dit te realiseren). Hans van Weenen en anderen hebben zich internationaal georiënteerd op het gebied van scholenbouw en ze formuleerden al snel een veel meer multi- en interdisciplinaire opdracht, waarin aandacht was voor veel meer dan energiebesparing en -opwekking. Het werd al snel als ambitie gesteld om educatie een prominente plek te geven. Het lukte snel om de schooldirectie, de gemeenteraad en diverse leerkrachten (unaniem) achter het plan te krijgen. Toch bleek scholing van leerkrachten op de lange termijn noodzakelijk: zodra er nieuwe leerkrachten kwamen, miste de benodigde achtergrond.

De volgende stap was het kiezen van de architect. Bij het uitzetten van de vraag is specifiek gevraagd om ervaring met duurzame scholenbouw, of sterke interne motivatie om samen een leerproces in te gaan. Ook bij de selectie van een projectontwikkelaar heeft een uitgebreide selectie plaatsgevonden. Een van de belangrijkste redenen om voor de uiteindelijke projectontwikkelaar te kiezen, betrof met name het stedenbouwkundige plan, waarin veel aandacht was voor het behoud en verdere ontwikkeling van de aanwezige groenstructuren op het terrein. Die ambities werden echter al heel snel losgelaten door de projectontwikkelaar, toen ze eenmaal geselecteerd waren. Hans van Weenen gaf aan in de loop van het proces enorm te hebben moeten vechten om gestelde ambities te realiseren. De unanieme uitspraak van de gemeenteraad met betrekking tot de ambities voor het nieuwe schoolgebouw was erg belangrijk in latere stadia, omdat Hans zijn ervaring is dat men toch op diverse momenten heeft geprobeerd zich enigszins terug te trekken.

Hans van Weenen heeft onder andere diverse workshops en symposia georganiseerd in het kader van de nieuwbouw. Diverse kennis kwam helaas echter te laat in het proces om nog verwerkt te kunnen worden. Dit benadrukt dat het heel belangrijk is om op tijd te beginnen oriënteren, alvorens de bouwprocessen in te gaan.

Toen de school opgeleverd werd, waren overal bordjes in de school waarop leerlingen toelichtten wat er op diverse plekken in het gebouw gebeurde en waarmee ze ook rondleidingen gaven. Die bordjes zijn nu niet meer aanwezig.

Donderdag 11 februari 2016

Tijdens dit bezoek heb ik met groep 8 de Duurzaamheidsscan (zie Appendix D) uitgevoerd. De klas bestond uit 30 leerlingen. De Duurzaamheidsscan beslaat tien thema's. In vijf groepen hebben de leerlingen hun school(gebouw) op alle tien de thema's beoordeeld. Per thema hebben de leerlingen ongeveer drie kwartier onderzoek gedaan. Na beide rondes hebben we de resultaten klassikaal besproken. De discussie van de resultaten is niet in deze Appendix opgenomen, maar uitvoerig besproken in het paper.

APPENDIX D: DUURZAAMHEIDSSCAN VOOR DATAVERZAMELING

De volgende pagina's bevatten de duurzaamheidsscan die is gebruikt om data te verzamelen samen met de leerlingen. Deze Duurzaamheidsscan van Eco-Schools Nederland is identiek aan 'BREEAM Junior', zoals het dataverzamelingsinstrument in dit paper is beschreven.

Opdracht 1. Afval

Hoe gaat jullie school om met afval?

Geef 2 voorbeelden.

Opdracht 2. Scorelijst

Hieronder staan 10 punten die bepalen hoe jullie school omgaat met afval. Missen jullie nog belangrijke onderwerpen waarvan jullie vinden dat ze in de scorelijst horen? Jullie mogen ze nog toevoegen!

1. slecht, er kan nog veel verbeterd worden
3. middelmatig, er is nog wel wat verbetering nodig
5. goed, de school kan trots zijn

Wat	1	2	3	4	5
1. In elke klas staat een papierbak.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Papieren handdoekjes en andere wegwerpproducten die wij gebruiken zijn van hergebruikt materiaal.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Onze school gebruikt gerecycled papier.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. We hoeven nooit ver te lopen naar een prullenbak. Er staan er genoeg.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Op het schoolplein en in de buurt van de school ligt geen afval.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. In de lerarenkamer drinken de juffen en meesters uit stenen of glazen bekertjes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Kinderen drinken melk of limonade uit een beker die je kan hergebruiken.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. Onze school heeft een aparte afvalbak voor GFT (Groente-, Fruit- en Tuinafval)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. Onze school heeft een aparte afvalbak voor plastic.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. Wij printen op school altijd dubbelzijdig.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Totaalscore					

Opdracht 3. Advies aan de directeur!

Kies twee onderwerpen van de scorelijst uit waarop jullie school slecht of middelmatig scoort. Schrijf hieronder een advies aan jullie directeur en vertel hem hoe hij het probleem kan oplossen. Bedenk ook wat jullie zelf kunnen doen om het probleem op te lossen.

Advies 1 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:

Advies 2 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:



Opdracht 1. Communicatie over duurzaamheid

Hoe communiceert jullie school over duurzaamheid?

Geef 2 voorbeelden.

Opdracht 2. Scorelijst

Hieronder staan 10 punten die bepalen hoe jullie school omgaat met communicatie. Missen jullie nog belangrijke onderwerpen waarvan jullie vinden dat ze in de scorelijst horen? Jullie mogen ze nog toevoegen!

1. slecht, er kan nog veel verbeterd worden
3. middelmatig, er is nog wel wat verbetering nodig
5. goed, de school kan trots zijn

Wat	1	2	3	4	5
1. Je kunt op onze school goed zien dat we meedoen aan Eco-Schools.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Alle kinderen weten dat onze school meedoet aan Eco-Schools.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Het logo van Eco-Schools staat op de website van onze school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Op de website van onze school staan foto's / filmpjes van Eco-Schools activiteiten.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Onze school wisselt ideeën uit met andere (Eco-)scholen in Nederland of andere landen.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. Er is een 'Eco-hoek' ingericht met nieuws over Eco-Schools (bijvoorbeeld meterstanden, activiteiten of namen van de werkgroepleden).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. In het beleid van onze school staan doelen op het gebied van duurzaamheid.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. Onze school heeft contact met (lokale) kranten over onze Eco-Schools activiteiten.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. Onze school gebruikt sociale media, zoals Hyves, Twitter of Facebook, om te vertellen over Eco-Schools.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. Onze school heeft een Eco-Code.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Totaalscore					

Opdracht 3. Advies aan de directeur!

Kies twee onderwerpen van de scorelijst uit waarop jullie school slecht of middelmatig scoort. Schrijf hieronder een advies aan jullie directeur en vertel hem hoe hij het probleem kan oplossen. Bedenk ook wat jullie zelf kunnen doen om het probleem op te lossen.

Advies 1 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:

Advies 2 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:



Opdracht 1. Omgaan met energie

Hoe zuinig gaat jullie school om met energie?

Geef 2 voorbeelden.

Opdracht 2. Scorelijst

Hieronder staan 10 punten die bepalen hoe jullie school omgaat met energie. Missen jullie nog belangrijke onderwerpen waarvan jullie vinden dat ze in de scorelijst horen? Jullie mogen ze nog toevoegen!

1. slecht, er kan nog veel verbeterd worden
3. middelmatig, er is nog wel wat verbetering nodig
5. goed, de school kan trots zijn

Wat	1	2	3	4	5
1. Als een lokaal leeg is, is het licht uit.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Apparaten zoals computer en digibord staan uit als ze niet worden gebruikt.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Als het raam openstaat is de kachel uit.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Alle ramen hebben dubbelglas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Na schooltijd en in de vakantie staat de kachel lager.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. De meeste klassen hebben spaarlampen of ledlampen.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Onze school heeft radiatorfolie en tochtstrips.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. Onze school neemt de meterstanden op van elektriciteit en gas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. Onze school wekt zelf duurzame energie op, bijvoorbeeld met zonnepanelen.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. Op onze school zijn afspraken gemaakt over het besparen van energie.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Totaalscore					

Opdracht 3. Advies aan de directeur!

Kies twee onderwerpen van de scorelijst uit waarop jullie school slecht of middelmatig scoort. Schrijf hieronder een advies aan jullie directeur en vertel hem hoe hij het probleem kan oplossen. Bedenk ook wat jullie zelf kunnen doen om het probleem op te lossen.

Advies 1 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:

Advies 2 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:



Opdracht 1. Het schoolgebouw

Hoe ziet jullie school eruit? Is er bijvoorbeeld veel groen of ruimte?

Geef 2 voorbeelden.

Opdracht 2. Scorelijst

Hieronder staan 10 punten die bepalen hoe jullie school omgaat met het gebouw en de omgeving. Missen jullie nog belangrijke onderwerpen waarvan jullie vinden dat ze in de scorelijst horen? Jullie mogen ze nog toevoegen!

1. slecht, er kan nog veel verbeterd worden
3. middelmatig, er is nog wel wat verbetering nodig
5. goed, de school kan trots zijn

Wat	1	2	3	4	5
1. Onze school is milieuvriendelijk gebouwd.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. In lokalen komt genoeg daglicht binnen.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. De temperatuur is goed geregeld. Het is niet te koud of te warm.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Het schoolgebouw is goed onderhouden.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. De schooldeur bij de ingang valt vanzelf achter je dicht.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. Het schoolgebouw wordt ook gebruikt voor of na schooltijd (bijvoorbeeld voor buitenschoolse opvang).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Er is op/rond het gebouw geen vandalisme (bijvoorbeeld graffiti).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. In de buurt van onze school is 'groen' aanwezig. Bijvoorbeeld bomen, gras, bloemen en dieren.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. We krijgen wel eens les buiten op het schoolplein of in de directe omgeving van de school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. Onze school ligt niet vlakbij een drukke (snel-) weg.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Totaalscore					

Opdracht 3. Advies aan de directeur!

Kies twee onderwerpen van de scorelijst uit waarop jullie school slecht of middelmatig scoort. Schrijf hieronder een advies aan jullie directeur en vertel hem hoe hij het probleem kan oplossen. Bedenk ook wat jullie zelf kunnen doen om het probleem op te lossen.

Advies 1 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:

Advies 2 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:



Opdracht 1. Een groene school

Hoe groen is jullie school?

Geef 2 voorbeelden.

Opdracht 2. Scorelijst

Hieronder staan 10 punten die bepalen hoe jullie school omgaat met groen. Missen jullie nog belangrijke onderwerpen waarvan jullie vinden dat ze in de scorelijst horen? Jullie mogen ze nog toevoegen!

1. slecht, er kan nog veel verbeterd worden
3. middelmatig, er is nog wel wat verbetering nodig
5. goed, de school kan trots zijn

Wat	1	2	3	4	5
1. Wij krijgen vaak buiten les. Bijvoorbeeld de natuur ontdekken op en rond de school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Op school leren we veel over de natuur.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Onze school organiseert groene excursies, bijvoorbeeld naar een boerderij, bos of een natuurgebied.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. In onze school is veel groen te vinden. Bijvoorbeeld planten in de klassen, een binnentuin of een aquarium in de school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Wij hebben een groen schoolplein. Bijvoorbeeld planten, bomen of een grasveld.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. Wij hebben een moestuin bij de school waarin wij zelf groente laten groeien.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Onze school heeft een eigen composthoop.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. Onze school gebruikt geen chemische bestrijdingsmiddelen tegen onkruid of insecten.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. Onze school heeft een groen dak (dat is een dak waar planten op groeien).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. Onze school helpt dieren uit de omgeving door bijvoorbeeld het ophangen van een vogelhuisje, een vleermuiskast of een bijenhotel.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Totaalscore					

Opdracht 3. Advies aan de directeur!

Kies twee onderwerpen van de scorelijst uit waarop jullie school slecht of middelmatig scoort. Schrijf hieronder een advies aan jullie directeur en vertel hem hoe hij het probleem kan oplossen. Bedenk ook wat jullie zelf kunnen doen om het probleem op te lossen.

Advies 1 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:

Advies 2 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:



Opdracht 1. Een schone school

Is jullie school schoon?

Geef 2 voorbeelden.

Opdracht 2. Scorelijst

Hieronder staan 10 punten die bepalen hoe jullie school omgaat met hygiëne. Missen jullie nog belangrijke onderwerpen waarvan jullie vinden dat ze in de scorelijst horen? Jullie mogen ze nog toevoegen!

1. slecht, er kan nog veel verbeterd worden
3. middelmatig, er is nog wel wat verbetering nodig
5. goed, de school kan trots zijn

Wat	1	2	3	4	5
1. Ons schoolgebouw is schoon.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Er ligt geen stof in het gebouw.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Er hangen geen vieze geurtjes in onze school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Bij de ingang van de school liggen deurmatten.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Onze school heeft een gladde vloer en geen vloerbedekking.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. De ramen in de klassen staan regelmatig open, zodat er voldoende frisse lucht is.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Onze school heeft een goed werkend ventilatiesysteem.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. De toiletten worden vaak schoongemaakt.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. Kinderen wassen hun handen nadat ze naar de wc zijn geweest.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. De schoonmakers gebruiken milieuvriendelijke schoonmaakmiddelen.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Totaalscore					

Opdracht 3. Advies aan de directeur!

Kies twee onderwerpen van de scorelijst uit waarop jullie school slecht of middelmatig scoort. Schrijf hieronder een advies aan jullie directeur en vertel hem hoe hij het probleem kan oplossen. Bedenk ook wat jullie zelf kunnen doen om het probleem op te lossen.

Advies 1 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:

Advies 2 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:



Opdracht 1. Een bereikbare school

Is jullie school goed bereikbaar?

Geef 2 voorbeelden.

Opdracht 2. Scorelijst

Hieronder staan 10 punten die bepalen hoe jullie school omgaat met mobiliteit. Missen jullie nog belangrijke onderwerpen waarvan jullie vinden dat ze in de scorelijst horen? Jullie mogen ze nog toevoegen!

1. slecht, er kan nog veel verbeterd worden
3. middelmatig, er is nog wel wat verbetering nodig
5. goed, de school kan trots zijn

Wat	1	2	3	4	5
1. Het verkeer rond onze school is veilig.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. De meeste kinderen komen lopend of met de fiets naar school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Weinig kinderen komen met de bus of de tram.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Weinig kinderen worden met de auto naar school gebracht.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Rondom de school zijn speciale of veilige routes aangegeven.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. We hebben wel eens fiets- of verkeersles op school gehad.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Onze school heeft een fietsenstalling.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. Onze school heeft klaar-overs.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. De meeste juffen of meesters komen met de fiets of lopend naar school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. Naar kamp of met schoolreisjes gaan we op de fiets.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Totaalscore					

Opdracht 3. Advies aan de directeur!

Kies twee onderwerpen van de scorelijst uit waarop jullie school slecht of middelmatig scoort. Schrijf hieronder een advies aan jullie directeur en vertel hem hoe hij het probleem kan oplossen. Bedenk ook wat jullie zelf kunnen doen om het probleem op te lossen.

Advies 1 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:

Advies 2 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:



Opdracht 1. Een veilige school

Is jullie school veilig?

Geef 2 voorbeelden.

Opdracht 2. Scorelijst

Hieronder staan 10 punten die bepalen hoe jullie school omgaat met veiligheid. Missen jullie nog belangrijke onderwerpen waarvan jullie vinden dat ze in de scorelijst horen? Jullie mogen ze nog toevoegen!

1. slecht, er kan nog veel verbeterd worden
3. middelmatig, er is nog wel wat verbetering nodig
5. goed, de school kan trots zijn

Wat	1	2	3	4	5
1. Kinderen voelen zich bij ons op school veilig.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. We hebben op onze school regels tegen pesten.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Kinderen met krukken of in een rolstoel kunnen makkelijk naar binnen en zich door school bewegen.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Op het schoolplein wordt gestrooid als het vriest in de winter.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. In het donker is er voldoende licht op het schoolplein en bij de ingang van onze school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. Op school is altijd iemand aanwezig met een EHBO-diploma.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Glazen deuren hebben veiligheidsglas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. Onze school heeft brandmelders, brandblussers en brandslangen.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. Nooduitgangen zijn duidelijk aangegeven.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. We weten wat we moeten doen in een noodgeval, bijvoorbeeld als het brandalarm afgaat.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Totaalscore					

Opdracht 3. Advies aan de directeur!

Kies twee onderwerpen van de scorelijst uit waarop jullie school slecht of middelmatig scoort. Schrijf hieronder een advies aan jullie directeur en vertel hem hoe hij het probleem kan oplossen. Bedenk ook wat jullie zelf kunnen doen om het probleem op te lossen.

Advies 1 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:

Advies 2 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:



Opdracht 1. Eten op school

Eten jullie op school fairtrade of biologisch, bijvoorbeeld met een kerstontbijt?

Geef 2 voorbeelden.

Opdracht 2. Scorelijst

Hieronder staan 10 punten die bepalen hoe jullie school omgaat met voedsel. Missen jullie nog belangrijke onderwerpen waarvan jullie vinden dat ze in de scorelijst horen? Jullie mogen ze nog toevoegen!

1. slecht, er kan nog veel verbeterd worden
3. middelmatig, er is nog wel wat verbetering nodig
5. goed, de school kan trots zijn

Wat	1	2	3	4	5
1. De kinderen die overblijven gebruiken een broodtrommel.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Onze schoolmelk is biologisch.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Kinderen drinken kraanwater, geen water uit flessen zoals Spa en Evian.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. De koffie en thee in de lerarenkamer is fairtrade en/of biologisch.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Kinderen en leraren gooien geen eten weg.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. Wij krijgen les over waar ons voedsel vandaan komt.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Op onze school leren we hoe we zelf groenten kunnen verbouwen.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. Het groente en fruit dat we verbouwen eten we zelf op.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. Wij weten wat de betekenis is van keurmerken voor duurzaam eten, zoals fairtrade, Max Havelaar, EKO of MSC.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. Wij leren over de eetgewoonten van mensen in andere delen van de wereld.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Totaalscore					

Opdracht 3. Advies aan de directeur!

Kies twee onderwerpen van de scorelijst uit waarop jullie school slecht of middelmatig scoort. Schrijf hieronder een advies aan jullie directeur en vertel hem hoe hij het probleem kan oplossen. Bedenk ook wat jullie zelf kunnen doen om het probleem op te lossen.

Advies 1 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:

Advies 2 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:



Opdracht 1. Een waterzuinige school

Gaat jullie school zuinig om met water?

Geef 2 voorbeelden.

Opdracht 2. Scorelijst

Hieronder staan 10 punten die bepalen hoe jullie school omgaat met water. Missen jullie nog belangrijke onderwerpen waarvan jullie vinden dat ze in de scorelijst horen? Jullie mogen ze nog toevoegen!

- 1. slecht, er kan nog veel verbeterd worden
- 3. middelmatig, er is nog wel wat verbetering nodig
- 5. goed, de school kan trots zijn

Wat	1	2	3	4	5
1. Alle wc's hebben een stopknop die iedereen ook gebruikt.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. De (meeste) kranen gaan automatisch aan als je je handen er voor houdt.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. In de kranen zitten waterbesparende dopjes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Er zijn geen kapotte of lekkende kranen.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Wij doen de kraan dicht als we klaar zijn met handen wassen of water drinken.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. Regenwater dat op ons dak valt gaat niet gelijk naar het riool maar wordt opgevangen in een regenton of gaat de grond in.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Regenwater dat op het dak valt wordt hergebruikt. Bijvoorbeeld om de schooltuin water te geven of het toilet mee door te spoelen.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. De apparaten op school die water gebruiken zijn zuinig met water. Bijvoorbeeld: de afwasmachine.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. Onze school heeft regels hoe we zuinig met water om moeten gaan.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. Wij gaan wel eens op waterexcursie. Bijvoorbeeld naar een watermuseum, gemaal, schip of rioolwaterzuiveringsinstallatie.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Totaalscore					

Opdracht 3. Advies aan de directeur!

Kies twee onderwerpen van de scorelijst uit waarop jullie school slecht of middelmatig scoort. Schrijf hieronder een advies aan jullie directeur en vertel hem hoe hij het probleem kan oplossen. Bedenk ook wat jullie zelf kunnen doen om het probleem op te lossen.

Advies 1 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:

Advies 2 Nr. scorelijst _____ Score _____

Omschrijf het probleem:

Ons advies aan de directeur is:

Dit gaan we zelf doen:



APPENDIX E: LEKKER LEREN, LEKKER LEVEN



Anna Vanderveen

Lekker leren, lekker leven
over hoe schoolgebouwen kunnen onderwijzen
voor een duurzaam gelukkige wereld

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Lekker leren, lekker leven

over hoe schoolgebouwen kunnen onderwijzen
voor een duurzaam gelukkige wereld

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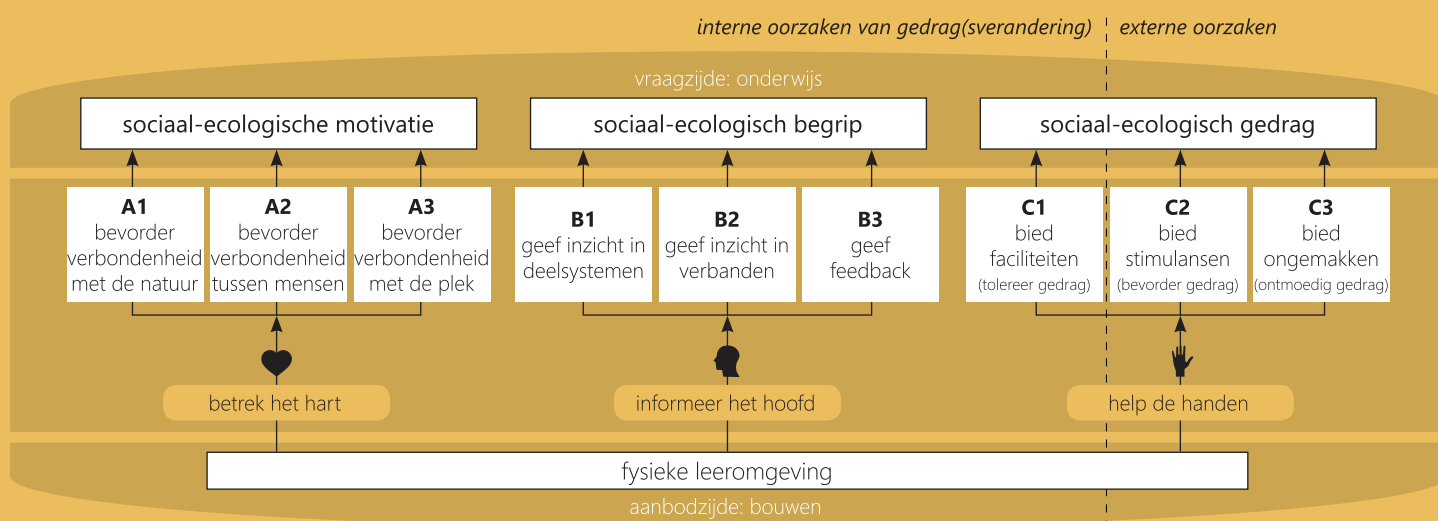
Eindhoven, 1 april 2016

Samenvatting

Wij vormen onze gebouwen en daarna vormen die gebouwen ons. Daarmee heeft de architectuur van de fysieke ruimte een educatief karakter. Steeds meer onderwijskundigen en bouwprofessionals zijn zich bewust van de belangrijke rol die de fysieke ruimte speelt, zeker in onderwijsomgevingen. Toch krijgt de fysieke leeromgeving amper aandacht in (inter)nationaal onderzoek naar 'transformatief duurzaamheidsleren'. Dit is een type duurzaamheidsleren dat streeft naar duurzame ontwikkeling in harmonie met menselijk geluk. Eerder onderzoek laat zien dat dit interne oorzaken van gedrag(sverandering) behoeft. Momenteel hebben zowel scholen als bouwprofessionals geen inzicht in hoe fysieke leeromgevingen hieraan (kunnen) bijdragen.

Daarom presenteert dit onderzoek een raamwerk dat de ontwerpkenmerken blootlegt die bijdragen aan transformatief duurzaamheidsleren en dat inzicht biedt in hoe deze kenmerken zich tot elkaar verhouden. Het raamwerk borduurt voort op het 'hart, hoofd en handen'-model, hetgeen een passend organiserend principe is gebleken voor transformatief leren voor duurzaam geluk. Het raamwerk bestaat uit drie focusgebieden: (1) *betrek het hart* (om sociaal-ecologische motivatie te bevorderen), (2) *informeer het hoofd* (om sociaal-ecologisch begrip te bevorderen) en (3) *help de handen* (om sociaal-ecologisch gedrag te bevorderen). Binnen elk focusgebied zijn drie ontwerpkenmerken onderscheiden (zie A1 tot en met C3).

Het raamwerk is ontwikkeld middels inductief literatuuronderzoek en onderzoek aan de hand van een casestudie. Data zijn verzameld door middel van interviews en observaties. Deductief onderzoek is nog nodig om de veronderstelde relaties te bevestigen en te kwantificeren. Om scholen en ontwerpers te informeren en te assisteren, presenteert dit onderzoek bovendien een routekaart voor het proces van gebouwtransformatie. Het ontwikkelde raamwerk speelt in deze routekaart een centrale rol. Het biedt een basis voor de evaluatie van huidige schoolgebouwen. Het analyse-instrument dat daarvoor is ontwikkeld, biedt tevens een hulpmiddel om de uitvraag van de school helder te formuleren en ideeën voor transformaties te ontwikkelen.



Architecture as educator for sustainable happiness

a framework and a roadmap to provide guidance in the transformation of physical learning environments for transformative sustainability learning

Abstract: We shape our buildings, and afterwards our buildings shape us. Hence, the architecture of the physical environment has an educational character. Increasing numbers of both educators and building design professionals are becoming aware of this important role of physical space, especially in educational settings. Yet, the physical learning environment is hardly gaining attention in global research on transformative sustainability learning (TSL). TSL is a type of learning that aims at sustainable development in harmony with human happiness. Previous research has shown that this requires intrinsic strategies to change behaviour. Currently, both schools and designers lack insight into how physical settings contribute to this. Therefore, this study presents a framework which reveals the design characteristics of physical learning environments which support TSL and provides insight into how individual design characteristics relate to each other. The framework is built on the heart, head and hands model, which has been found to be a suitable organising principle for TSL. The framework comprises three focus areas for building performance: (1) engage the heart (to foster motivation), (2), exemplify to the head (to foster understanding) and (3) enable the hands (to foster behaviour). Within each focus area, three design characteristics are distinguished. The framework is developed through an inductive study of literature and case study research with data collected by means of interviews and on-site observations. Deductive research is required to confirm and quantify the qualitative relationships hypothesised. In order to inform and assist schools and designers, this study presents a practical roadmap for building transformation, in which the developed framework plays a central role. The framework provides a basis for the evaluation of occupied built environments. This is illustrated by means of a post-occupancy evaluation (POE) of a case study school. The instrument developed for the analysis simultaneously provides a frame to clarify the school's request and to generate ideas for building transformation.

Key words: physical learning environment, transformative sustainability learning (TSL), sustainable happiness, performance based building, post-occupancy evaluation (POE).

1. Introduction

It requires no introduction that a building can contribute to one's sense of happiness through the provision of a safe and comfortable shelter. Yet, the impact of the physical environment on happiness goes far beyond this. The way we shape the physical interface between individuals within their communities and the natural environment is a reflection of larger cultural values and holds a close relationship with our attitude towards the non-human world (Upitis, 2015; Hertzberger, 2008). We shape our buildings based on these values, and afterwards this influences how we develop and internalise values ourselves (Upitis, 2015). Therefore, the physical environment not only influences human behaviour, well-being, cognition and emotion in that particular setting, it just as well influences the outcomes after leaving the setting (Gifford, et al., 2011). Hence, the physical environment plays a teaching role.

Although valid for every building typology, this is particularly important for school habitats. Here the primary target group, namely pupils, is in a phase of life in which norms and values are being internalised intensely. Pupils' localised places of study are the centres of their experiences that help to teach them how the world works and how they fit into that world (Gruenewald, 2003). Also, habits are being formed in early years. As a result, education and educational settings do not only prepare children for the future, they just as well create the future. This stresses the need to contemplate on which lessons we want pupils to learn from education and physical educational settings. As Taylor (1995) wrote:

'We expect schools to prepare children for living in a democratic society, yet we provide a learning environment that resembles a police state — hard, overly durable architecture, giant chain-link fences, locked gates, guards, and even guard dogs. Such architecture fails to encourage the sense of ownership, participation, or responsibility required for a democracy.'

Orr (1997) describes this architecture as the 'hidden curriculum' of the building, which powerfully influences the learning process. According to Orr, educational buildings are typically approached as structures that quietly serve the educational process, but require no care and interaction of those who use it. The lesson learned is mindlessness: these buildings teach that disconnectedness is normal and we learn passivity and disengagement from our surroundings. Orr even states that, as commonly practiced, educational buildings could easily be converted to use as a factory or prison. Similarly, Upitis (2015) observed that schools have been built largely as a reflection of the 'factory model' for learning, meaning that pupils are 'processed' until they are deemed ready to leave school as if they were products to be fabricated.





Voorwoord

...

*Ecologisch duurzaam denken
dat is waar het nu om draait
Niet meer langer stille wenken
plannen waar geen haan naar kraait*

*Nee, beginnen bij de kleintjes
bij het basisonderwijs
als de creatieve breintjes
nog niet stoffig zijn en grijs*

*als de wereld nog een wonder
nog een plek vol plannen is
nog geen drama met gedonder
maar een speelplaats, blij en fris*

*Als je dán dat grut kunt boeien
als je dán hun potentieel
voeden kunt en laten bloeien...
wat een prachtig schouwtoneel!*

*Moge het je zijn gegeven
dat zo'n kans je wordt gegund
We gaan het denk ik wel beleven
Die masterthese... wordt een stunt!*

M. V.-K., 5 december 2014

Met dit gedicht gaf Sinterklaas in december 2014 het startschot van de laatste fase van mijn studietijd, waaraan ik startte in april daarop. Het eindproduct van een heerlijk onderzoekjaar ligt nu voor je.

In de afgelopen jaren ben ik opgeleid binnen de wereld van de bouwkunde. De bouw is een grote sector en omvat vele talenten, disciplines, intellectuele niveaus, verdienmodellen en ideeën over de toekomst. Een groot aantal partijen werkt structureel aan het bereiken van hun beeld van een 'betere wereld'. Tegelijkertijd is de vernieuwing, die velen benodigd achten voor een duurzaam gelukkige toekomst, bij vele, vele anderen nog lang niet doorgedrongen. De excuses: 'zo doen we het al veertig jaar', 'dat behoort niet tot ons takenpakket' of 'dat past niet in onze business case'. Hierover heb ik mij verbaasd, gefrustreerd, soms verdrietig en vaak sceptisch gevoeld.

De laatste tijd barst ik echter van de energie, want mijn ervaringen hebben veel in mij losgemaakt en me bevlogen doen beginnen aan de uitdaging waarvan je het resultaat nu voor ogen hebt.

'Ecologisch denken': het houdt in dat je zaken beschouwt als onderdeel van het grotere geheel. Menselijk en niet-menselijk leven en de levende en de niet-levende natuur vormen een geheel waar we allemaal deel van uitmaken. 'Duurzaamheid' gaat over welke zaken we daarin willen laten voortduren. Daarbij moeten we afwegingen maken, want vaak betekent het behoud van het ene, de opoffering van iets anders. Ik geloof dat we veel beslissingen daaromtrent irrationeel en onbewust maken, omdat ons gedrag volgt uit routines die we ons om welke reden dan ook hebben eigengemaakt. Juist daarom besloot ik mij met dit onderzoek te richten op 'de kleintjes'.

Voorwoord

Kinderen zijn nog volop in een proces waarin ze zichzelf in de wereld een houding vormen, die voor een groot deel bepaalt hoe ze op latere leeftijd hun voelen, denken en handelen aangaande die wereld vormgeven. Het is dan ook betreurenswaardig dat men in de internationale discussie omtrent onderwijs voor duurzame ontwikkeling heeft moeten constateren dat, alhoewel in het onderwijs een mogelijke oplossing voor veel problemen schuilt, we het huidige onderwijssysteem eerder als een onderdeel van die problemen moeten zien. Het bouwt namelijk voor een groot deel voort op de paradigma's die veel heersende problemen hebben veroorzaakt. Het cliché 'de jeugd heeft de toekomst' werkt duidelijk twee kanten op. Om met Nelson Mandela te spreken: "Onderwijs is het meest krachtige wapen dat je kunt gebruiken om de wereld te veranderen". Laten we proberen de wereld ten goede te veranderen. Kinderen zijn daarin de sleutel. Ze zijn heerlijk! Ze hebben een tomeloze energie en vervelen zich nooit, mits hen een omgeving wordt geboden waarin zij hun kinderlijke nieuwsgierigheid en creativiteit kunnen botvieren. Het is aan ons, de volwassenen, om daartoe ruimte te creëren en hen te helpen leren hoe zij hun energie kunnen inzetten ten gunste van nastrevenswaardige doelen.

Dat die ruimte in fysieke zin aandacht behoeft, daarover zijn velen het inmiddels eens. Ten aanzien van scholenbouw wordt volop geëxperimenteerd, onderzocht en vernieuwd. Door de enorme (ver)nieuwbouwwraag die aan het loskomen is, maakt de wereld van de bouw zich op voor een grote opgave, die werkgelegenheid en omzet met zich kan meebrengen. Talloze concepten, producten en zelfs 'totaaloplossingen' zijn daardoor inmiddels op de markt.

Aan de ene kant is dat prachtig: het brengt een grote beweging op gang, die al op veel plekken tot schitterende resultaten heeft geleid. Aan de andere kant is een dergelijke populariteit gevaarlijk, wanneer er (nog) onvoldoende grip is op waar het eigenlijk heen moet. Regelmatig is helaas namelijk de grote vraag: voor welke problemen vormen de geboden 'oplossingen' precies de oplossing? Ik geloof dat, naast het besparen en opwekken van energie, het verbeteren van het binnenklimaat en het terugdringen van gebouwkosten voor scholen, er nog een heel andere potentie schuilt in de grootschalige (ver)nieuwbouw die voor ons ligt. In dit rapport exploreer ik die dimensie van de gebouwde omgeving, die een hulpmiddel kan zijn om aan maatschappelijke uitdagingen het hoofd te bieden.

Mijn onderzoek is erop gericht het spectrum aan gebouwkenmerken bloot te leggen dat aandacht behoeft wanneer men streeft naar een fysieke leeromgeving die bijdraagt aan onderwijs voor duurzaam geluk. Het schept randvoorwaarden voor veranderingen die stapsgewijs kunnen worden geïntroduceerd, zonder daarvoor oplossingen in de vorm van nieuwe producten of bouwkundige (totaal)oplossingen aan te reiken. De komende jaren ga ik graag met scholen, gemeentes en gebouwonwerpers aan de slag om daar invulling aan te geven.

Tot slot

Ook voor mijzelf was ruimte de afgelopen jaren enorm belangrijk. Ik ben zeer gelukkig dat mij de ruimte is geboden om middels dit onderzoek mijn eigen interessegebied te exploreren en een plek te vinden waar ik me thuis voel. Ik wil Jos, Masi en Maurice daarvoor hartelijk bedanken. Ook alle collega's bij SME Advies en Hak in het bijzonder hebben daarin een speciale rol gespeeld. Ik kijk er enorm naar uit om vanaf volgende week met jullie te mogen samenwerken aan inspirerende projecten. Ik twijfel er niet aan dat alle hulp en warme woorden van mijn lieve familie daarbij zullen voortduren.

Anna Vanderveen

“Onderwijs is het meest krachtige wapen dat je kunt gebruiken om de wereld te veranderen.”

Nelson Mandela

It can be argued that it is not too strange that schools reflect this factory model for learning. Many of our educational buildings originate from times when the factory model dominated the development of the world. Through industrialisation and efficiency gains our (relative) negative environmental impact decreased and, in most nations, the resulting rise in wealth accompanied a rise in average (subjective) well-being (Veenhoven, 2004). Nonetheless, since the 1960s there has been growing concern about our natural environment. In combination with emerging social challenges around the world, this has given rise to a call for more ‘sustainable’ development. Since then, enormous efforts have led to remarkable efficiency gains in many fields (Veenhoven, 2004). However, there is more to sustainability than efficiency advances. Wals and Rodela (2014) wrote:

‘Popularly stated, sustainability is not only about doing the things we do better (i.e. more efficiently) but also about doing things differently (i.e. developing new routines) and, perhaps foremost, about doing better things (i.e. developing new principles, vantage points and values).’

Developing new routines and values is not an easy undertaking, especially since *changing* routines is harder than *developing* routines (Geisen, 2013). Therefore, sustainability requires an early start, education thus being one instrument that can be used to move towards a more sustainable world (Wals & Jickling, 2002; Buckler & Creech, 2014). However, in a survey of current practice, a UN report concluded that ‘at current levels of unsustainable practice and overconsumption it could be concluded that education is part of the problem’ (UNESCO, 2005), since current educational systems still largely build on the paradigm which has caused the social, ecological and economic problems currently leading. As Orr (1991) said, we must not assume that it is education that will save us, or advance us; rather it is education of a certain kind. Hence, in this post-industrial era we need to rethink our approach towards education and the physical environments in which education takes place. This study explores the influence of the latter on ‘transformative sustainability learning’.

1.1. Transformative sustainability learning

Several approaches exist to integrate sustainability into education. Wals and Jickling (2002) explored possible ways of designing education for sustainable development in relation to human well-being and attitudes. Figure 1 represents their attempt to conceptualise learning processes. On the left side, ‘instrumental views’ of education for sustainability are presented, juxtaposed with more ‘emancipatory views’ on the right side. The instrumental approach is described as resulting in an ‘eco-totalitarian regime’, where rewards, punishments and conditioning of behaviour forcefully create a sustainable society from the perspective of the natural environment.

Since this society will almost certainly lack 'justice' and 'happiness', the emancipatory view is proposed, representing 'a very transparent society, with action competent citizens, who actively and critically participate in problem solving and decision making, and value and respect alternative ways of thinking, valuing and doing'.

'Eco-totalitarian regime'



Transmissive learning:
authoritative
hierarchical
technocratic
conditioning

'Sustainable happiness'

Transformative learning:
integrated
participatory
democratic
social learning



Figure 1 Two conceptualisations of learning processes with regard to sustainability in education (Wals & Jickling, 2002) in relation to 'transmissive' and 'transformative' sustainability learning (Sterling, 2001)

The hierarchical approach (left) and the participatory approach (right) towards education closely relate to the different typologies of sustainability education identified by Sterling (2001). They range from 'transmissive' to 'transformative' in their pedagogical approach (Holdsworth & Sandri, 2014).

The transmissive approach regards the transmission of current knowledge and facts about sustainability, which closely relates to the hierarchical, authoritative methods described by Wals and Jickling in the 'eco-totalitarian regime'. On the other hand, transformative sustainability learning is a mere participatory and democratic approach, which closely relates to the emancipatory views presented by Wals and Jickling. It is argued by many that sustainability education requires a paradigm shift from transmissive to transformative learning. Transformative sustainability learning is a type of sustainability learning that facilitates personal experience for pupils, resulting in profound changes in knowledge, skills and attitudes related to enhancing ecological, social and economic justice (Sipos, et al., 2008).

This empowering approach contrasts sharply with the prevailing interpretation of sustainable development. 'Sustainability' is often experienced as a concept that comprises discomfort, as one is supposed to abandon certain behaviours or consumptions in order to leave a legacy to generations one will never even get to know. Correspondingly, Vugt, et al. (2014) argue that environmental problems are often caused or exacerbated by self-interest, amongst other things. Brown and Kasser (2005) therefore suggest that 'as long as environmentally responsible behaviour is framed in self sacrificial terms, individuals will be faced with tough choices about how to act' because such behaviour is assumed to detract from their own happiness. This study therefore starts from the perspective of 'sustainable happiness'.

"Zet een homogene groep kinderen in een besloten ruimte (een zogenaamd 'klaslokaal'), bewerk ze gedurende een jaar (vul ze met kennis), zorg ervoor dat ze het vastgestelde curriculum hebben geleerd (toets ze volgens vastgestelde normen), schuif ze door naar de volgende bewerkingsruimte (een ander klaslokaal) en zet deze cyclus voort tot ze de leeftijd hebben bereikt waarop ze geacht worden klaar te zijn om te vertrekken (en de arbeidsmarkt te betreden)."

(Upitis, 2015)

de aanleiding van dit onderzoek:
Betekenisloos leren

“Leren heeft geen context meer. We breken ideeën op in kleine stukjes die geen enkele relatie meer hebben met het geheel. We geven leerlingen een baksteen met informatie, dan geven we ze nóg een steen en nóg een. Als ze afstuderen, gaan we ervan uit dat ze een huis hebben. Wat ze in werkelijkheid hebben is een stapel bakstenen waar ze weinig mee kunnen.”

(Kohn, 1999)





Een duurzaam gelukkige wereld

over hoe we 'duurzame ontwikkeling' zouden kunnen interpreteren en vormgeven

"Duurzame ontwikkeling is ontwikkeling die aansluit op de behoeften van het heden zonder het vermogen van toekomstige generaties om in hun eigen behoeften te voorzien in gevaar te brengen.

Het bevat daarmee twee belangrijke begrippen: (1) het concept van de 'behoefte', in het bijzonder de essentiële behoeften van de armen in de wereld, waaraan absolute prioriteit moet worden gegeven en (2) het idee van de beperkingen opgelegd door de stand van de techniek en sociale organisatie op het vermogen van het milieu om huidige en toekomstige behoeften te vervullen." (VN-commissie Brundtland, 1987)

Als je deze, meest gangbare definitie van 'duurzame ontwikkeling' leest en de kernbegrippen 'behoefte' en 'beperkingen' daarin tot je neemt, dan snap ik wel dat veel mensen het concept 'duurzaamheid' ervaren als iets wat ten koste gaat van hun eigen geluk. Zeker wij westerlingen, die niet tot de 'armen in de wereld' behoren, lijken offers te moeten brengen. Gelukkig is er hoop!

Tallose onderzoeken laten namelijk zien dat wanneer we ermee ophouden duurzaam gedrag te zien als een opoffering van het eigen geluk, de concepten 'geluk' en 'duurzaamheid' elkaar juist kunnen aanvullen en versterken. Niet voor niets spelen ook in de definitie van commissie Brundtland de 'behoefte van het heden' een belangrijke rol.

Dat werpt de prangende vraag op wat die 'behoefte' eigenlijk zijn. Wat wordt daarmee bedoeld en wellicht nog wel veel belangrijker: wat verstaan we er zelf onder? Wanneer we onze 'behoefte' interpreteren als louter een dak boven ons hoofd en brood op de plank, dan benadrukt het de soberheid waarmee veel mensen 'duurzame ontwikkeling' associëren. Zien we het echter als het geheel aan zaken dat verantwoordelijk is voor ons levensgeluk, dan scheidt het de uitdaging bevredigende levensstijlen te ontwikkelen, die tegelijkertijd de rest van de wereld niet schaden. Zulke levensstijlen behelzen wellicht een andere smaak voor voedsel, voor hobby's, voor stijl, voor werk. Daarvoor moeten we jong beginnen.



“Duurzaam geluk is geluk dat bijdraagt aan individueel, gemeenschappelijk en / of wereldwijd welzijn zonder andere mensen, het milieu of de toekomstige generaties uit te buiten.”

(O'Brien, 2005)

1.2. Architecture and education for sustainable happiness

It can be argued that our unrestrained pursuit of happiness, especially in the last decades, is a major cause of environmental exploitation and degradation. However, it has been found that bringing 'sustainability' and 'happiness' together within the concept of 'sustainable happiness' actually holds significant possibilities for individual, community, and global well-being (Brown & Kasser, 2005). O'Brien (2010) defined it as follows:

'Sustainable happiness is happiness that contributes to individual, community and/or global well-being without exploiting other people, the environment or future generations.'

The concept of sustainable happiness extends happiness research and reinforces the relationship to sustainability (O'Brien, 2010). For example, a mindful consideration of one's inner states and behaviour along with a set of values oriented more towards intrinsic than extrinsic aims appear to simultaneously benefit both individual and ecological well-being (Brown & Kasser, 2005). These findings are hopeful, given that such supportive factors as intrinsic values can be cultivated (Brown & Kasser, 2005). This stresses the important role education plays in moving towards a sustainable world.

In order to scale up global action in this field, an international 'Global Action Programme on education for sustainable development' has recently been launched. This Global Action Plan calls for 'whole-institution approaches' towards education for sustainable development. This entails that educational contents, pedagogies and physical environments (right in Figure 2) should be aligned towards education for sustainable development (Wals, et al., 2015). Although increasing numbers of both educators and design professionals are becoming aware of this important role physical space plays (Cleveland & Fisher, 2014), the physical learning environment is hardly gaining attention in global research on transformative sustainability learning.

Certainly, much research is being done on physical (learning) environments in relation to sustainable development. In order to clarify why the aims and outcomes of such studies do not contribute to sustainability learning, this study adopts a dichotomy set by Veenhoven (2004). Veenhoven explains that whether one will live a happy life partly depends on the life-chances one possesses. Veenhoven (2004) divides life-chances into *external* and *internal* qualities. In the first case the quality is in the environment, in the latter it is in the individual. The first category is referred to as 'the liveability of the environment', covering good living conditions. This quality of life is central in the thinking of building professionals.

The second category regards ‘the life-ability’ of the person, concerning how well one is equipped to cope with the challenges of life and masters ‘the art of living and living well’ (Cruz, et al., 2009). This quality of life is central in the thinking of educators. Since it has been found that the physical environment plays a teaching role, this paper argues that building professionals should concern their influence on ones ‘life-ability’ as well.

The division of life-chances into ‘liveability’ and ‘life-ability’ provides a categorisation to position earlier work on architecture in the context of education; see Figure 2.

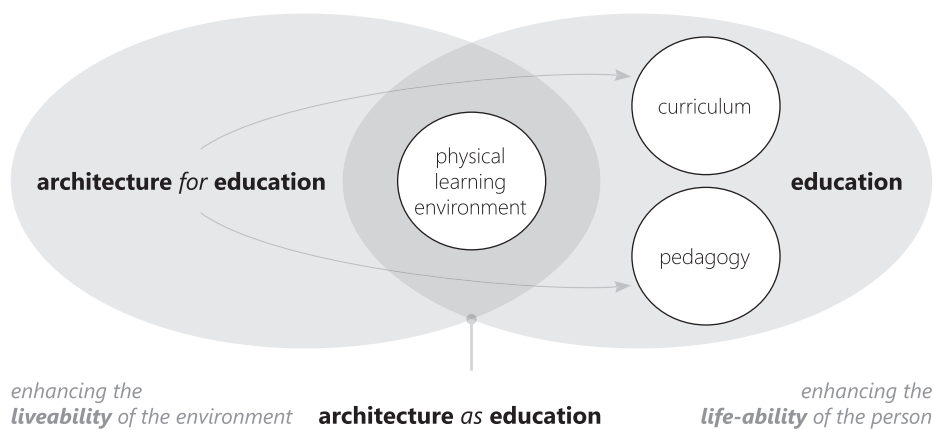


Figure 2 Architecture *for* education and architecture *as* education.

Architecture *for* education influences the liveability of the environment at a global scale (this is unrelated to the education taking place in the building), the curriculum uptake and pedagogies. Architecture *as* education has an educational role of its own, on which this study elaborates in relation to transformative learning for sustainable happiness.

The liveability of the environment (left in Figure 2) is influenced by architecture *for* education. Research on ‘green’ or ‘sustainable’ architecture for education primarily focuses on the enhancement of the liveability of the environment. Much of the work focuses on energy-efficiency, aiming at the creation of a liveable environment at a global scale. Furthermore, research concentrates on liveable environments at a smaller scale, as vast research stresses the effects of the indoor environment on student and teacher outcomes, including health and productivity (Wargocki & Wyon, 2007; Spengler, et al., 2001). Such measures have an influence on the extent to which the curriculum is learned, as reduced concentration will lead to a reduced knowledge uptake. Claims of improvements of pupils’ performance of up to 14% are made if building conditions are improved compared to common practice (Fisher, 2005; Wargocki & Wyon, 2007). Also, the physical environment has an influence on how learning processes and pedagogies are shaped.



De meervoudige relatie tussen onderwijs en gebouwen

over gebouwen *voor* onderwijs en gebouwen *als* onderwijzer

Duurzame scholenbouw

energiebesparing

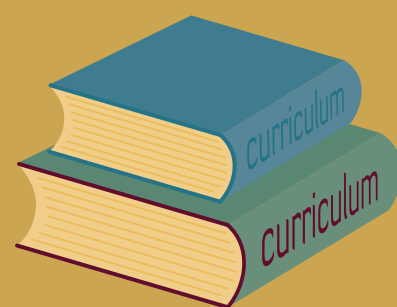


Duurzaam onderwijs

Aandacht voor duurzaamheid in het onderwijs betekent niet dat er een nieuw vak of domein bij moet komen. Wals en anderen (2015) beschrijven dat het feitelijk gaat om een systeemverandering waarbij drie pijlers van het onderwijs in samenhang worden ontwikkeld: het **curriculum** (de feitelijke inhoud), het **onderwijzen** (zowel de algemene pedagogische omgang met de leerlingen als het meer specifiek didactische handelen in relatie tot de leerstof) en de **fysieke leeromgeving** (het schoolgebouw, het schoolterrein en de omgeving).

Duurzame scholenbouw

Dit onderzoek richt zich op de rol van de fysieke leeromgeving in duurzaam onderwijs. Binnen de bouw wordt onder de term 'duurzame scholen' vaak verstaan dat scholen aandacht hebben voor onder andere energiebesparing en -opwekking, een gezond binnenklimaat, verantwoord materiaalgebruik en aanpasbaarheid. Wanneer we deze thema's met een educatieve bril bekijken, merken we echter dat ze pas waardevol zijn wanneer ook de leerlingen iets meekrijgen van de maatregelen die worden getroffen, of liever nog: dat ze zelf maatregelen (leren) treffen. >



whole-school approach voor duurzaam onderwijs



De meervoudige relatie tussen onderwijs en gebouwen

over gebouwen *voor* onderwijs en gebouwen *als* onderwijzer

Het is dus de kunst om duurzame maatregelen omtrent scholenbouw op een dusdanige manier vorm te geven dat ze een rol (kunnen) spelen in het onderwijs dat in deze gebouwen plaatsvindt. Daarom dienen niet alleen de directe sociale, ecologische en economische impact van het gebouw en de bouwmaterialen in ogenschouw te worden genomen. Ook de educatieve rol van de fysieke omgeving is van groot belang. Deze heeft een effect op de lange termijn, doordat de kinderen die in de gebouwen opgroeien er voor een deel hun beeld van de wereld op baseren. Wanneer hun school een belangrijk herkenningspunt en een plek van samenkomst in de wijk vormt, leren ze dat hetgeen ze daar doen van betekenis is, terwijl een weggestopte, lelijke plek het gevoel geeft dat wat er op school gebeurt van weinig belang is voor de samenleving als geheel. Skylines gedomineerd door anonimiteit maken de wereld tot een betekenisloze omgeving, terwijl interactie met wat er in die omgeving gebeurt hen laat zien dat ze invloed hebben

op hoe de wereld zich ontwikkelt. Automatisering en uitbestede verantwoordelijkheden bevorderen passiviteit, terwijl betrokkenheid hun verantwoordelijkheidsgevoel bevordert. Kinderen ervaren of de publieke ruimte het domein is van de commercie of van de burgers. De fysieke ruimte vertelt hen of ze zichzelf beter per auto of per fiets kunnen verplaatsen. Onbebouwde stukken grond die uitnodigen tot criminaliteit jagen hen weg, terwijl speel- en buurttuinen hen uitnodigen tot spel en creativiteit.

De vormgeving van de fysieke ruimte draagt daarmee normen en waarden uit. Ze zegt iets over hoe we onze samenleving opbouwen, waar we waarde aan hechten en wie we op een voetstuk plaatsen. Eveneens beïnvloedt het ons denken daarover: we vormen onze gebouwen en daarna vormen die gebouwen ons. Schoolgebouwen bieden dus niet alleen een plek om *in* te leren, ze zijn tevens een middel om *mee* en *van* te leren. Daardoor ligt er een grote verantwoordelijkheid bij ontwerpers.

Onderzoeksdoel

De gegeven voorbeelden illustreren de veelzijdigheid van hoe gebouwen niet alleen onderwijs faciliteren, maar er zelf ook een bijdrage aan leveren. Renovatie en vernieuwbouw bieden de kans daaromtrent gericht veranderingen aan te brengen, door het behoudenswaardige te behouden of zelfs in ere te herstellen, problemen op te lossen en kansen aan te grijpen. Wat krijgen op dat wat 'behoudenswaardig' is, dat wat een 'probleem' vormt of dat wat een 'kans' behelst, vraagt om een intensieve dialoog. Met dit onderzoek tracht ik een brug te slaan tussen de daarbij betrokken partijen, die heel verschillende talen spreken. Om scholen en gemeentes en product- en gebouwonwerpers te informeren en te assisteren in die dialoog, presenteert dit onderzoek een raamwerk dat inzicht biedt in de gewenste karakteristieken van schoolgebouwen in het kader van onderwijs voor duurzaam geluk. Een routekaart laat zien hoe dit raamwerk kan worden gebruikt in concrete (ver)bouwopgaven.



“Wij vormen onze
gebouwen en
daarna vormen die
gebouwen ons.”

(Upitis, 2015)

Leeswijzer

Deze rapportage bestaat
globaal uit vijf delen:

introductie en methode

het raamwerk

de routekaart

een voorbeeldevaluatie

discussie en conclusies

Similar to how open space plans in office environments are penetrating common practice, insight into the influence of physical space on learning processes is now leading to the transformation of educational buildings. Hence, the influence of architecture *for* education is three-fold: it influences the liveability of the environment at a global scale (this is unrelated to the education taking place in the building), influences the curriculum uptake and influences learning processes; see Figure 2.

Meanwhile, architecture *as* education (central in Figure 2) has an educational role of its own. Based on a critical review of the literature on the evaluation of physical learning environments, Upitis (2015) states that ‘there is very little research on how space dictates what is learned and how it is learned’. The gap in the literature thus regards the common space of architecture and education: architecture *as* an educator for sustainability learning. The research at hand elaborates on how the physical learning environment contributes to transformative learning for sustainable happiness.

1.3. Research goal and relevance

Currently, insight into how physical space contributes to transformative sustainability learning is lacking. Therefore, the first goal of this research is to reveal the design characteristics of physical learning environments which support transformative learning for sustainable happiness and capture them in an appropriate framework.

The second aim of this study is to provide insight into how individual design characteristics relate to each other in order to ‘get the balance right’ between the application of diverse design characteristics. Getting the balance right between measures is of great importance, since research shows that any approach to influence behaviour must incorporate interventions focusing both on the internal and external causes of behaviour (Defra, 2008; Jackson, 2005). This is due to the fact that people’s reasons for doing what they do are multiple and complex. Moreover, it has been discussed that sustainable happiness requires intrinsic strategies. The framework gives insight into how the design characteristics of the physical learning environment distinguished provide either internal or external stimuli for behaviour (change) in order to facilitate this balance.

Hence, the framework provides theoretical understanding with regard to how physical space contributes to transformative sustainability learning. In order to foster the application of this theoretical understanding in practice, section 4 aims to provide guidance to decision-makers in the process of building transformation. A roadmap is presented to inform and assist schools and designers with regard to the use of the framework in the process of building transformation.

2. Research methodology

In the initial stage of this study, no hypothesis was present with regard to the design characteristics of physical learning environments which support transformative learning for sustainable happiness. Therefore, an 'inductive' research approach is taken. With an inductive stance, theory is the outcome of research (Bryman, 2012). In other words, the process of induction involves drawing generalisations and ideas out of observations.

In order to arrive at an applicable hypothesis, the study began with unstructured literature and case study research, which are used instrumentally to distinguish design characteristics. The case study is thus used to accomplish something other than understanding this particular school environment, so the inquiry regards an 'instrumental case study', as opposed to an 'intrinsic case study' (Stake, 1995). The school selected as a case is 'de Sokkerwei', an elementary school in Castricum, the Netherlands. The school is considered the first 'sustainable school' in the Netherlands and was built in the year 2001. It has been selected primarily for its famous reputation of being a built environment that contributes to sustainability learning.

The case school has been used by means of on-site observations and unstructured interviews with pupils and staff. The literature study is used complementarily to the case study research, to gather relevant theories and knowledge both in and outside the domain of building, in order to apply this understanding in the field of physical learning environments. The inductive search for an applicable model in this context has been influenced thoroughly by the extent to which it can be understood easily. For input and quality control during this process, a meeting with a group of experts and multiple meetings with individuals have been held. The interviewees regarded people from both the demand and the supply side.

The results of the meetings primarily regarded the coherency in the categories which constitute the framework and the extent to which the experts were able to comprehend these categories within limited time. The attendees of the expert meetings were professionals from various disciplines, including building technology, architecture, architectural philosophy, philosophy, anthropology, environmental policy and management, sociology and pedagogy.

Through an iterative, qualitative process nourished by literature inquiry and case study research, a coherent framework has been developed. The inductive character of this study entails that further, deductive research is required to verify and quantify the hypothesised relationships.



“Zo kan men
tegelijkertijd in én
van de school leren.”

(Weenen, 2000)



Een introductie op 'de Sokkerwei' in Castricum

over hoe het raamwerk tot stand is gekomen

"Een duurzame basisschool is een school die duurzaam basisonderwijs ontwikkelt en verzorgt, in een duurzaam gebouwd schoolgebouw, dat voor huisvesting dient en met zijn omgeving tevens een middel is voor het onderwijs. Zo kan men tegelijkertijd in én van de school leren. Dat is de kern van het concept voor de ontwikkeling van de nieuwbouw van de Openbare Basisschool De Sokkerwei te Castricum." (Weenen, 2000)

Na het lezen van bovenstaand citaat zal het je vast niet verwonderen dat de Sokkerwei bekend staat als de eerste 'duurzame basisschool' van Nederland. Het bijzondere aan het gebouw is de hereniging van bouwen én onderwijs op het gebied van duurzame ontwikkeling. Bij de ontwikkeling van de nieuwbouw was er aandacht zowel voor het duurzaam bouwen voor het onderwijs, als voor bouwen als duurzaamheidsonderwijs (zie pagina 14-16). De Sokkerwei heeft als casus gediend voor dit onderzoek. Observaties van de gang van zaken en diverse gesprekken met leerlingen en personeel

hebben veel inzicht gegeven in hoe de fysieke leeromgeving van de Sokkerwei wordt ervaren en hoe deze een rol speelt in het onderwijs. Ook heb ik gesproken met één van de geestelijk leiders achter de ontwikkeling van het gebouw, Hans van Weenen. Gebaseerd op de observaties, gesprekken en uitvoerig literatuuronderzoek is het raamwerk tot stand gekomen dat in deze rapportage is gepresenteerd. Om te komen tot een werkbaar raamwerk zijn vele richtingen en paden geëxploreerd. Legio gesprekken met experts op zeer diverse deelgebieden hebben daaraan bijgedragen.

Dit alles betekent dat de categorieën en ontwerpkenmerken (zie het raamwerk op pagina 4) zijn gedestilleerd middels een kwalitatief, 'inductief' onderzoeksproces. Inductie is een techniek die geen logisch onontkoombare conclusie oplevert, maar een conclusie die aannemelijk is, die een zekere waarschijnlijkheid heeft. Dat betekent ook dat de relaties die in dit raamwerk zijn aangebracht (nog) niet als 'bewezen' moeten worden beschouwd, maar als een *hypothese* ten aanzien van de invloed van de fysieke leeromgeving op gebruikers.

Naast de input die de observaties en gesprekken op de Sokkerwei hebben geleverd voor de ontwikkeling van het raamwerk, is deze specifieke omgeving samen met de leerlingen (pagina 43) uitvoerig onderzocht; zie de sectie 'een voorbeeldevaluatie'.

Bouwen voor het gebruik

over de 'vraag achter de vraag' en gewenste 'gebouwprestaties'

Het aanbod

De bouwsector biedt aan gebruikers van alles aan. We bouwen hele bruggen, huizen, kantoren, scholen en wat al niet meer. Die zijn opgebouwd uit talloze onderdelen en over elk onderdeel heeft een productontwikkelaar nagedacht. Gebouwonwerpers voegen al die onderdelen samen tot een bouwwerk waar de klant om vraagt, maar wat vraagt die eigenlijk?

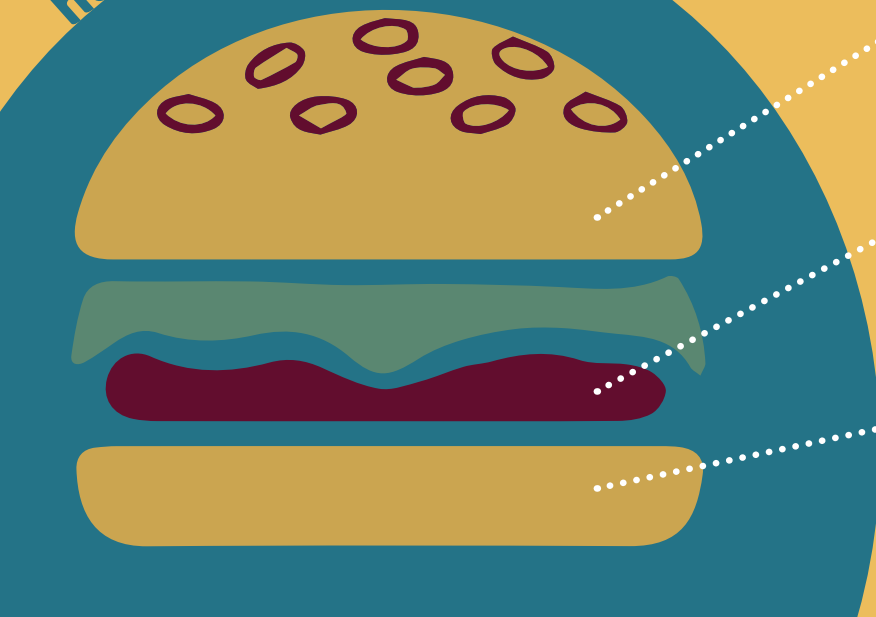
De vraag achter de vraag

Het citaat van Henry Ford, dat je hiernaast kunt lezen, benadrukt dat we, voor we als bouwers plannen maken, nog eens moeten kauwen op de vraag die ons gesteld is (Maas, 2015). Wat is de echte behoefte achter de vraag? Wat speelt er allemaal nog meer? Wat zijn de echte criteria om te kiezen tussen mogelijke oplossingen? Om deze vragen te beantwoorden in het kader van scholenbouw voor duurzaam onderwijs, adopteert dit onderzoek het 'Hamburgermodel'.

Prestatiecriteria

Het Hamburgermodel beslaat drie domeinen: vraag, aanbod en de brug daartussen. Die brug moet ervoor zorgen dat het aanbod zo goed mogelijk aansluit op (de vraag achter) de vraag. Daarvoor zijn evaluatiecriteria nodig, want welke 'prestaties' zijn er eigenlijk gewenst? Het raamwerk dat dit onderzoek presenteert (pagina 27), biedt zulke prestatiecriteria. Daarmee scheidt het randvoorwaarden voor de prestaties die het aanbod dat ontwerpers en bouwers van de fysieke ruimte leveren. Ook helpt het vragers om hun vraag helderder te formuleren.

het 'Hamburgermodel'



Vraag

Wat is de echte behoefte achter de vraag die de klant stelt? Om de klant te helpen, is het belangrijk om te luisteren naar wat hij bedoelt in plaats van naar wat hij zegt.

Prestatiecriteria

De criteria die worden gebruikt om de prestaties van gebouwen te evalueren dienen ervoor vraag en aanbod op elkaar af te stemmen.

Aanbod

Het aanbod van de bouwsector bestaat uit de bouwwerken die hij levert. Dat dient zo goed mogelijk aan te sluiten op de vraag.

“Als ik mensen
had gevraagd wat
ze zouden willen
hebben, hadden ze
geantwoord:
snellere paarden.”

Henry Ford

3. Theoretical understanding: the framework

This section presents the framework developed in this study; see Figure 3. It holds the theoretical understanding gained in this inductive inquiry, which regards the design characteristics of physical learning environments considered successful in the context of transformative learning for sustainable happiness.

The framework developed is composed of three domains: demand, supply and the bridge between them. These three domains are adopted from the ‘performance concept’ for building (Szigeti & Davis, 2005). Performance-based building is an approach to the design, construction and evaluation of buildings to meet certain performance requirements. The concept can be illustrated by means of two halves of a hamburger bun, which represent the demand and supply side of building (Gielingh, 1988). The established performance criteria compose the bridge between demand and supply. The framework developed in this study builds on this ‘Hamburger Model’. In the context of physical learning environments, education is the demanding discipline and building is the supplying discipline. This study bridges gap between these domains by means of nine design characteristics constituting this gap.

The following sections discuss the framework; the demand and the supply side are explored in the context of physical learning environment for transformative sustainability learning and the gap between demand and supply is bridged by means of the nine design characteristics A1 to C3 which are distinguished in this study.

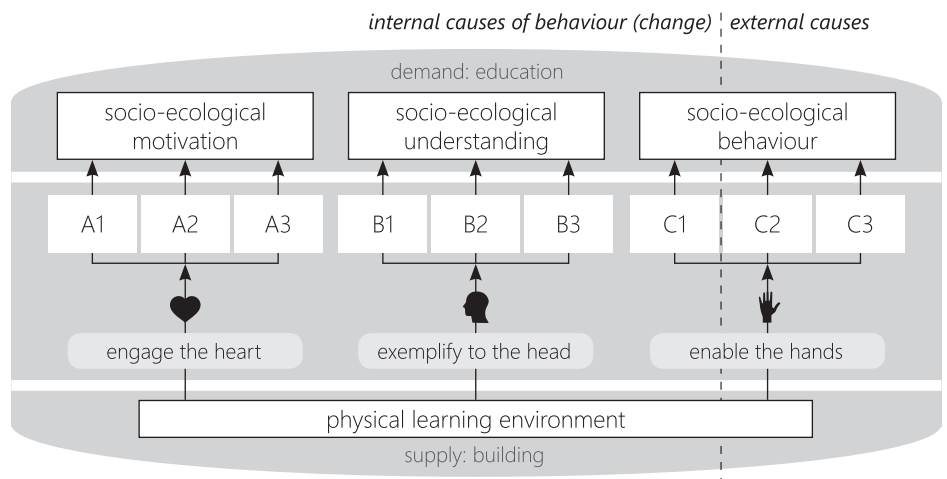


Figure 3 The framework developed in this study, presented by means of the ‘Hamburger Model’

3.1. An exploration of demands

Since school habitat transformation is often an once-in-a-lifetime job for decision-makers, such as school staff and employees at local governments, it is often hard for them to express an adequate demand towards supplying parties. Their set of demands consequently often results from 'common' practice and habits. Hence, the wants they express are not necessarily a manifestation of their underlying demand. Therefore, rather than asking clients about their wants, this section explores demands for transformative learning for sustainable happiness based on literature research.

Previous research has found that the organising principle of 'the head, the heart and the hands' is useful to involve the whole person in transformative learning (Sipos, et al., 2008). Heart, head and hands is essentially shorthand for engaging affective, cognitive and psychomotor learning domains (Bloom, et al., 1964). What are the life-abilities, or sustain'abilities' (Wals, 2015), the individual needs to develop in these domains when one aims to contribute to a sustainably happy planet?

Using the heart, head and hands model, three related competences have been determined: socio-ecological *motivation*, socio-ecological *understanding* and socio-ecological *behaviour* (see Figure 3). Singleton (2015) applied the head, heart and hands model to the physical environment and concludes that the context of place provides a framework of authentic experience for deeper reflection, sense of belonging and body/sensory stimulation that acts as a catalyst for deep engagement, which is required for transformation. When aiming to contribute to transformative learning for sustainable happiness, the demand on physical learning environments thus comprises a positive influence of the physical learning environment on the individual for the three life-abilities distinguished, on which the following subsections elaborate.

3.1.1. Socio-ecological motivation

Socio-ecological motivation covers the domain of affection. This regards the existential and normative dimension of sustainability (Wals, 2015), including passion, values, ethics and concerns. Affection and empathy with human others and the non-human world lead to an attitude that stimulates plans, goals and intentions to behave in a certain manner in certain settings (Gifford, et al., 2011). Motivation alone, though, will not succeed in realising such socio-ecological behaviour. It is well reported that for many people there is a gap between their high level of concern about the environment and their actions (Defra, 2008). Many people are willing to do a bit more to limit their environmental impact, yet people have a much lower level of understanding about what they can do and what will make a difference. The second competence distinguished therefore covers 'socio-ecological understanding'.





De ingrediënten voor duurzaam geluk

betekenisvol leren met hart, hoofd en handen

Op pagina 12 is een korte introductie te vinden op hoe we 'duurzame ontwikkeling' zouden kunnen interpreteren en vormgeven. Om dat gestalte te geven, is een drastische omvorming van huidige systemen nodig. Er wordt daarom door velen betoogd dat onderwijs voor duurzaam geluk noodzakelijkerwijs 'transformatief' van aard is; het moet breken met veel paradigma's die heden ten dage heersen. Enerzijds kán het daarmee de sleutel zijn naar een duurzame gelukkige wereld. Anderzijds kan het onderwijs de problemen juist versterken.

Zo schrijft Grant (2013) over diverse onderzoeken naar studenten die economie studeren en die gedurende hun studie steeds minder waarde gaan hechten aan onder andere behulpzaamheid, verantwoordelijkheid en eerlijkheid. Daarnaast worden ze steeds egoïstischer en minder zorgzaam. Dit staat haaks op wat er nodig is voor een duurzaam gelukkige wereld. Daarvoor zullen we onszelf moeten ontwikkelen op manieren die tegelijkertijd voor onszelf, voor anderen en voor niet-menselijk leven waardevol zijn.

Dat betekent dat opgelegd gedrag of puur rationele benaderingen voor gedragsverandering niet afdoende zijn; transformatief leren voor duurzaam geluk kan alleen plaatsvinden wanneer de handen, het hoofd én het hart betrokken zijn. De volgende pagina gaat dieper in op hoe 'het hart, het hoofd en de handen' de ingrediënten kunnen zijn voor duurzaam geluk. Wanneer we streven naar schoolgebouwen die bijdragen aan een duurzaam gelukkige wereld, gaat het er dus om hieraan een positieve bijdrage te leveren middels die gebouwen.

Voelen en willen WAAR JE VAN HOUDT, DAAR WIL JE VOOR ZORGEN

De eerste levenscompetentie die in dit onderzoek is onderscheiden als ingrediënt voor duurzaam geluk, is 'sociaal-ecologische motivatie'. Duurzaamheid gaat over (leren) zorgen voor jezelf, de ander en de wereld om je heen. Betrokkenheid, empathie, passie, waarden en normen spelen daarin een belangrijke rol. Wanneer we streven naar een duurzaam gelukkige wereld, is het van groot belang dat mensen handelen vanuit intrinsieke motivatie. Mensen die intrinsiek handelen, zijn namelijk onder andere creatiever en ze hebben een hogere inzet, hogere gevoelens van zelfcompetentie en trots en meer plezier in hun taakuitvoering. Daarvoor moet het 'hart' worden betrokken bij het leren.

Denken en begrijpen HET GEHEEL IS MEER DAN DE SOM VAN DE DELEN

De tweede levenscompetentie die in dit onderzoek is onderscheiden als ingrediënt voor duurzaam geluk, is 'sociaal-ecologisch begrip'. Duurzaamheid is een complex begrip om te doorgronden. Dit heeft al veelvuldig geleid tot betekenisloos onderwijs: onderwijs waarin leerlingen uitgenodigd worden 'duurzame dingen' te doen zonder dat zij enig begrip hebben van waar zij mee bezig zijn (zie pagina 9). Daarnaast zijn er veel mensen die graag iets goeds willen doen voor de wereld, maar niet weten hoe zij daaraan zelf invulling kunnen geven. Om mee te denken en te werken aan een duurzame wereld, vormen kennis, inzicht, bewustwording en reflectie belangrijke voorwaarden. Een holistische kijk op de wereld, waarin wordt erkend dat losse onderdelen tot een synergie kunnen komen die meer waard is dan de delen afzonderlijk, is daarvoor cruciaal. Daarvoor moet het 'hoofd' worden betrokken bij het leren.

Doen LEREN DOOR DOEN

De derde levenscompetentie die in dit onderzoek is onderscheiden als ingrediënt voor duurzaam geluk, is 'sociaal-ecologisch gedrag'. Leren door doen vindt bijvoorbeeld plaats door bepaald gedrag heel vaak te vertonen, waardoor je er beter in wordt en waardoor het een gewoonte wordt. Ook kan 'doen' in sommige gevallen leiden tot meer motivatie of begrip. Een goed voorbeeld daarvan is tuinieren; door het werken in de tuin ontwikkelen veel mensen meer verbondenheid met de natuur (het hart) en leren van alles over hoe de natuur functioneert (hoofd). Motivatie en begrip zullen leiden tot bepaalde intenties voor gedrag, maar of men daar ook naar handelt, is mede afhankelijk van externe factoren. Deze factoren zijn zeer divers. De sociale omgeving (zie pagina's 76 en 88) speelt bijvoorbeeld een belangrijke rol. Dit onderzoek gaat in op hoe de *fysieke leeromgeving* de 'handen' betreft bij het leren.



**sociaal-ecologische
motivatie**



**sociaal-ecologisch
begrip**



**sociaal-ecologisch
gedrag**

3.1.2. Socio-ecological understanding

Socio-ecological understanding covers the domain of cognition and critique. This regards the contents of sustainability and the ability to reflect on issues accordingly (Wals, 2015). Such understanding requires one to adopt an integral, holistic view, in which relationships are understood and connections are seen. Thus, as well as thinking within a cell of specialised knowledge, we have to think outside that cell (Graham, 2003). This is often referred to as ‘systems thinking’, which is the process of understanding how those things which may be regarded as systems, influence one another within a larger system. Systems thinking focuses on the study of patterns, connections and relationships between such (sub)systems. Alongside specialised knowledge, systems thinking is one of the core competences for socio-ecological understanding.

3.1.3. Socio-ecological behaviour

Socio-ecological behaviour regards the actual behaviour exhibited. People’s reasons for doing what they do are multiple and complex. Motivation and understanding will result in intention and cognition to behave in a certain manner, but whether one acts accordingly depends on many more things, such as habits, routines and external causes of behaviour change. Existing habits and routines are beyond the scope of this research.

In all cases, it should be noted that categories can be distinguished, but not separated. Rather, the distinctions can be used to map different dimensions of the performance of physical learning environments, in order to clarify discussions and position earlier research regarding it. For example, the phenomenon of ‘learning by doing’ entails that through ‘doing’, socio-ecological understanding and motivation can be enhanced. Reciprocal relationships exist between behaviour, understanding and motivation.

3.2. An exploration of supplies

The ‘supply’ side of the Hamburger Model (lower part of Figure 3) regards the actual physical environment designed or constructed. Several examples exist of schools that have developed their physical environment as ‘architecture as education’. For example, the Italian ‘Reggio Emilia’ pre-primary schools, the ‘Green School’ in Bali and ‘de Sokkerwei’ in the Netherlands are often referred to in (scientific) literature. What is the special ‘performance’ that these physical learning environments deliver? In order to answer this question, Kong, et al. (2014) studied the special design elements and features present in the famous ‘Green School’ in Bali, which give the school the character of a ‘three-dimensional textbook’ for environmental education. In a similar manner, Dutt (2013) explored how physical learning environments play a role in mediating students’ relationships to the natural world.

Both Kong, et al. and Dutt studied a school environment and demonstrate the special design elements and features present in that particular environment. Yet, since the design of physical environments is highly contextual and dependent on the specific function and location, such design elements cannot simply be copied to other settings. For example, Kong, et al. studied a school in a rural part of Indonesia, which setting requires a wholly different approach than, for example, western European cities. Similarly, in the case Dutt selected for her inquiry, a forest and two gardens were present on school property. Dutt stresses that this is unusual and that further research is required in less rural settings. These studies are typical for much of the work done regarding the impact of the physical environment on pro-environmental behaviour. Such research has been conducted primarily in relation to case studies where natural and outdoor environments dominate the built ones.

Both Kong, et al. and Dutt aimed to draw lessons from these specific, yet valuable cases. Based on an analysis of the design elements present, they formulated generalised design models, aspects, themes or principles. Those comprise the performance characteristics which lead to the cases studied being considered successful with regard to sustainability learning. Here, the results transcend the domain of supply and enter the third domain distinguished: the gap between demand and supply.

3.3. The gap between demand and supply

In order to provide insight into the influence of physical settings on student learning, all references discussed above aimed to conceptualise their results and capture them in design models, aspects, themes or principles. As discussed above, their inquiries are however limited in scope, primarily due to the strong focus on nature connectedness only. This study responds to that by a broader scope, applicable for both natural and built environments in both rural and urban settings.

The categorisation of design characteristics, which constitute the gap between demand and supply, is based on the three competences elaborated on earlier (socio-ecological motivation, socio-ecological understanding and socio-ecological behaviour). As a result, three focus areas are defined to study the underlying design characteristics of physical learning environments which support transformative learning for sustainable happiness: 'engage the heart', 'exemplify to the head' and 'enable the hands'. The following sections elaborate on the three focus areas distinguished and the design characteristics that constitute these categories.

“Architectuur is een
hulpmiddel om levens
mooier te maken.”

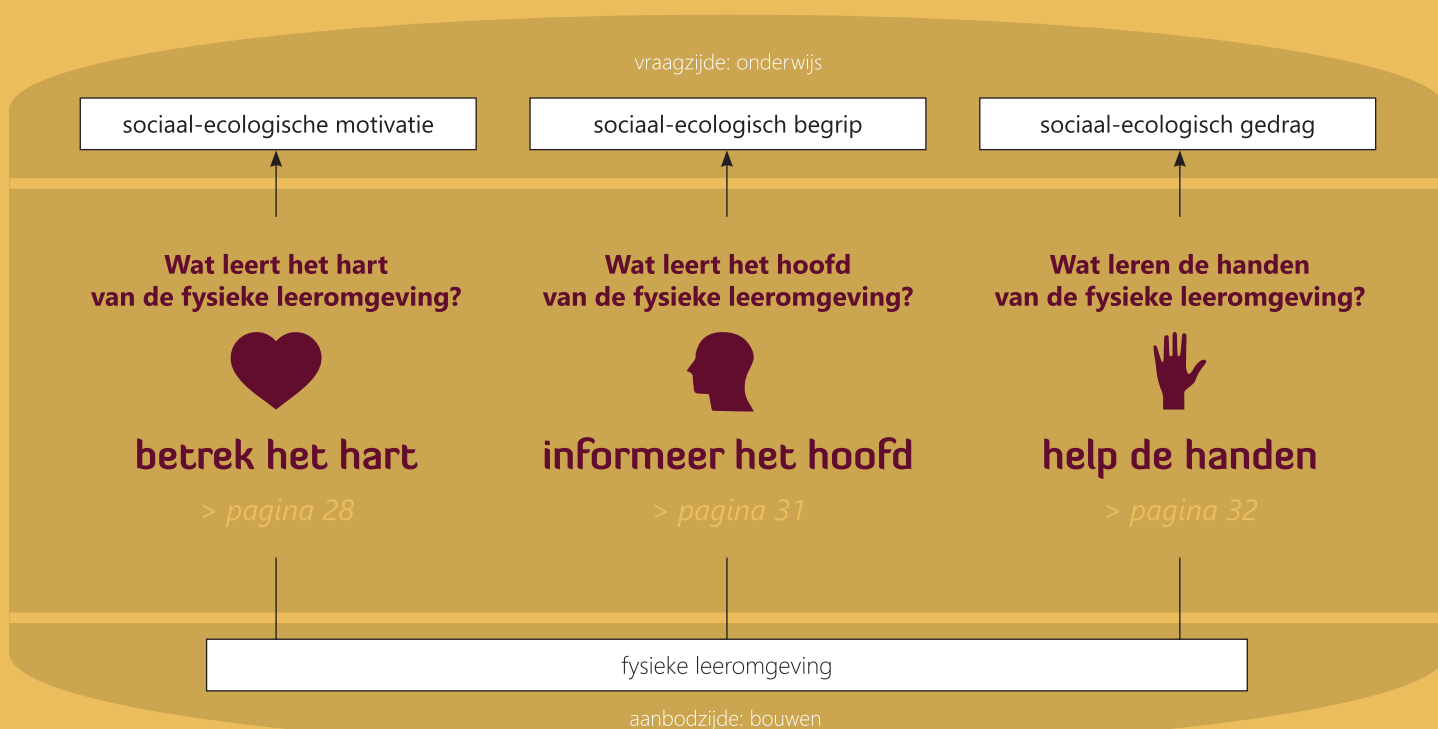
(Heringer, 2013)

Het raamwerk aangaande het gebouw als onderwijzer

Hieronder zijn de contouren geschetst van het raamwerk dat in dit onderzoek is ontwikkeld. Zoals deze schets laat zien, is het raamwerk gebaseerd op het 'Hamburgermodel' voor bouwen (zie pagina 20) en het 'hart, hoofd en handen'-model (zie pagina 23-24). De kernvraag van het onderzoek is:

"Hoe draagt de fysieke leeromgeving bij aan de ingrediënten voor duurzaam geluk, te weten sociaal-ecologische motivatie, sociaal-ecologisch begrip en sociaal-ecologisch gedrag?"

De volgende pagina's behandelen de drie focusgebieden (hart, hoofd en handen) afzonderlijk. Binnen alledrie de categorieën zijn *ontwerpkarakteristieken* gedestilleerd die bijdragen aan één van de drie ingrediënten voor duurzaam geluk, zoals besproken op pagina 24. Het resulterende raamwerk is in haar volledigheid gepresenteerd op pagina 36.



introductie en methode

het raamwerk

de routekaart

een voorbeeldevaluatie

discussie en conclusies



betrek het hart

bevorder verbondenheid
met de natuur

bevorder verbondenheid
tussen mensen

bevorder verbondenheid
met de plek



3.3.1. Engage the heart

Attachment theory, the joint work of John Bowlby (1969) and Mary Ainsworth (1973), argues that the type of attachment a child develops with his or her caregiver will influence, or even determine, how the child develops (Bretherton, 1992). The image of self and hedonistic, anti-social, selfish or empathic behaviour towards others in adult life: it can to a large extent be explained through the attachment developed in early years. The influence of the physical environment on such attachment is two-fold. Firstly, the physical setting influences attachment with nature and (other) people. Secondly, attachment with place is a category on its own. Hence, the focus area 'engage the heart' regards the influence of the physical learning environment on the type of attachment one develops with (1) *nature*, (2) *people* and (3) *place*. This categorisation is based on the common distinction of three hierarchically situated and dynamically interrelated dimensions of sustainability, namely (1) the biological, geological and climatological substrate and its planetary boundaries, (2) the social relationships between humans and (3) the human-made structures (Wals, 2015).

A1. Foster nature connectedness

The design characteristic 'foster nature connectedness' regards the physical learning environment's influence on non human concerns, comprising flora and fauna. Theory and correlational research suggest that exposure to nature may increase cooperation, and, when considering environmental problems as social dilemmas, sustainable intentions and behaviour (Zelenski, et al., 2015).

Fostering nature connectedness comprises different levels of contact. While some found that even exposure to nature videos has an effect (Zelenski, et al., 2015), others found that not only the presence of nature, but the experiential interaction with the natural world, including animals, is of great importance for nature connectedness (Dutt, 2013).

A2. Foster human connectedness

The design characteristic 'foster human connectedness' regards the physical learning environment's influence on human concerns, comprising egoistic and social-altruistic concerns (Snelgar, 2006). Pupils' localised places of study are the centres of their experiences that help teach them how the world works and how they fit into that world (Gruenewald, 2003). As a result, their image of self and degree of otherness are influenced by that place.

A3. Foster place connectedness

The design characteristic 'foster place connectedness' regards the physical learning environment's influence on the psychological bound with the particular place.



Place attachment, also discussed under the terms 'rootedness' and 'sense of place' (Chawla, 1992), is often understood by environmental psychologists as the bonding between individuals and places (Ramkissoon, et al., 2012). Critical ecological educators have claimed that such love of place is the key to fostering sustainability behaviours (Mayer & McPherson Frantz, 2004), as research results indicate that individuals are more likely to show pro-environmental behaviour when positively attached to a place. For example, research has shown that place attachment through participation in maintenance and operation of school habitats can generate a sense of commitment and responsibility, resulting in positive behaviour towards that place. This is not to say that international and domestic issues are peripheral to place-based education, but that students should first have a grounding in the history, culture and ecology of their surrounding environment before moving on to broader subjects.

3.3.2. Exemplify to the head

The school habitat can serve as a 'three-dimensional textbook' for teaching environmental science (Spengler, et al., 2001). The influence of the physical environment on socio-ecological understanding can be structured by means of a metaphor regarding a system of gear wheels. By means of this metaphor, three design characteristics can be explained.

B1. Demonstrate subsystems

In order to function well, each gear of the system needs to be in order. Hence, one needs to understand the 'subsystems' within the larger system. Yet, in a world of increasing complexity, specialised knowledge on the individual gear wheels is not sufficient.

B2. Demonstrate relationships

The interaction and relationships between the wheels are of importance. As discussed under 3.1.2, systems thinking is required to understand how those things which may be regarded as systems, influence one another within a larger system.

B3. Provide feedback

Understanding subsystems and relationships is not sufficient for an adequate socio-ecological understanding about what one can do to make a difference. For example, one can be motivated to contribute to the prevention of further climate change and understand that one's energy use is relevant to this end, but if one is not acquainted with one's own energy use, it will be hard to make effective changes. The last design characteristic distinguished in this respect therefore is 'provide feedback'.

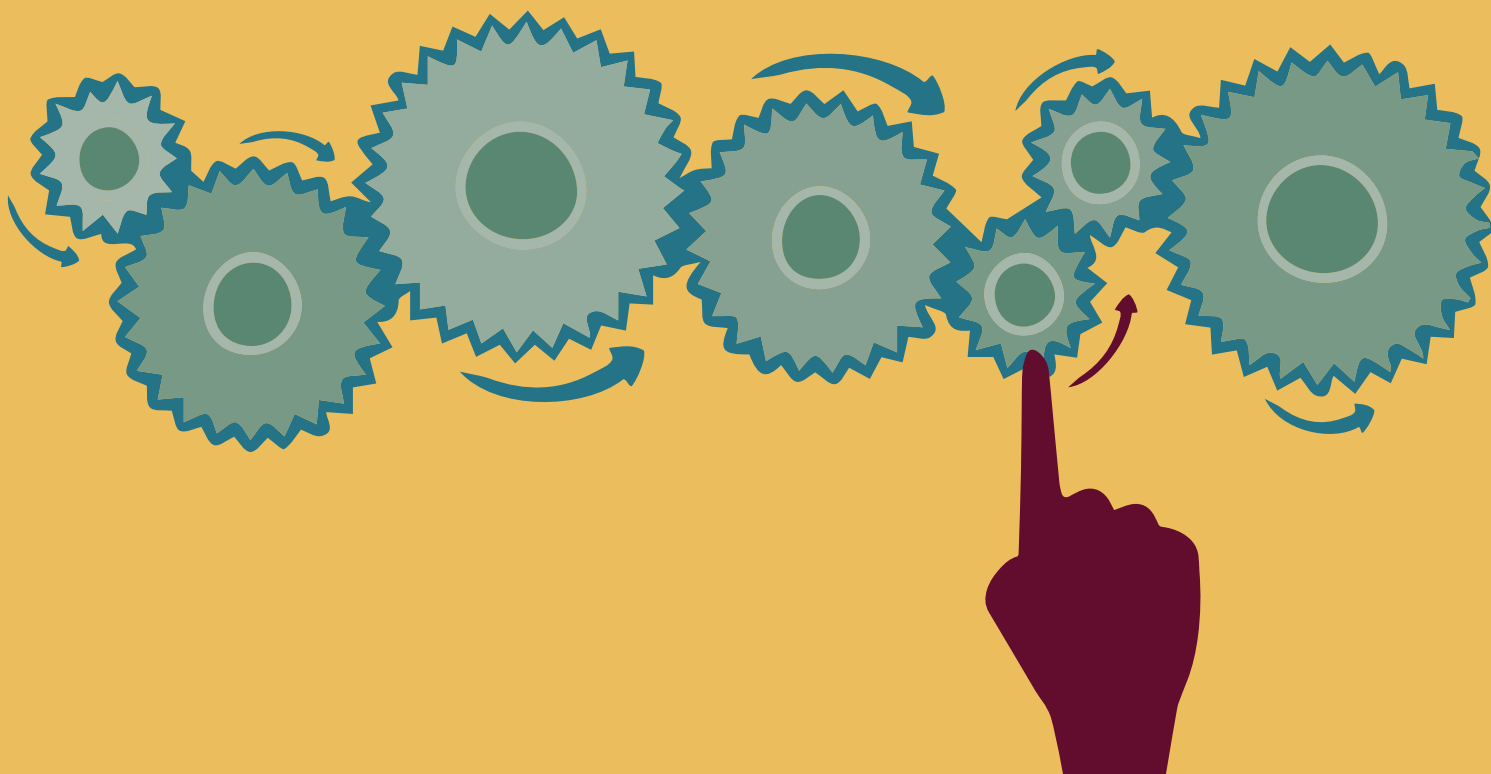


informeer het hoofd

geef inzicht in
deelsystemen

geef inzicht in
verbanden

geef
feedback





help de handen

bied faciliteiten
(tolereer gedrag)

bied stimulansen
(bevorder gedrag)

bied ongemakken
(ontmoedig gedrag)



Kong, et al. (2014) concluded that through the exposure of materials, technologies and processes, buildings in Green School Bali were transformed into powerful teaching tools. Moreover, in-depth interviews resulted in suppositions that students' enhanced understanding led to socio-ecological motivation. This stresses the notion that the three focus areas distinguished ('engage the heart', 'exemplify to the head' and 'enable the hands') have strong mutual interactions.

With regard to all three design characteristics in this area, an important note should be made. The rise of 'sustainable' efforts in the building industry is leading to many product developments to improve building performance. For example, measures are being taken to decrease energy use. Simple examples regard heating and lighting systems which turn off and on automatically, based on schedules or sensors. If working well, these kind of systems should be able to enhance the liveability of the environment. However, from an educational perspective such measures may be considered undesirable, as the awareness regarding certain themes (energy use, in this case) may decrease. Also, people may become 'lazy' when used to the idea that everything is taken care of without their efforts and disconnectedness is enhanced. The focus area 'exemplify to the head' therefore calls for communication regarding such systems. Fortunately, many developments provide excellent possibilities to integrate measures in the physical environment with educational strategies. For example, building automation often allows for (real-time) digital communication about how the building performs or how it is used. Important to consider with regard to such 'communicating buildings' is that building occupants use their (school) habitat for a variety of purposes. Domination of communication over other activities should be prevented. According to their preferences, occupants should be able to move the information between the *centre* and the *periphery* of their attention. Weiser & Brown (1996) refer to this kind of technology as 'calm technology'. This way, the school habitat can be both a *liveable* environment and a 'three-dimensional textbook' to enhance one's *life-abilities* (see Figure 2).

3.3.3. Enable the hands

In order to discuss the influence of the physical environment on socio-ecological behaviour, another metaphor is introduced. Imagine a sheep, who is standing by the riverside. Let's say we believe that, for some reason, the other side of the river is a better place to be. If our sheep is motivated to get to that place or understands that for one purpose or another it is better to be there, chances are that he will find ways to get to the other side of the river. In that case, internal causes of behaviour (change) prevail. Internal causes of behaviour (change) regard prevalent perceptions, cognitions and norms (Steg & Vlek, 2009). Socio-ecological motivation and understanding as discussed above are such internal causes of behaviour (change).

Now imagine our sheep again. As sheep cannot swim, the odds are that the sheep will not get to the place we want him to be. Let's help him.

C1. Provide facilities

We can help the sheep by providing the facility 'bridge', giving him the opportunity to move. When opportunities are created and behaviour is 'tolerated', one could see the physical environment as a relatively neutral factor. It will depend on internal causes of behaviour (change) whether one will use the facilities provided. If, on the other hand, internal causes are absent or insufficient, we can choose to induce behaviour. This can be done by changing the circumstances under which behavioural choices are made, by, rather than tolerating, stimulating or repressing certain opportunities (Max-Neef, 1991). This boundary between internal and external causes is indicated in the framework.

C2. Provide incentives + C3. Provide disincentives

With regard to stimulating and repressing behaviour, the well-known 'carrot and stick' idiom is applicable to our metaphor. If our sheep does not use the bridge provided based on internal causes of behaviour, we can entice him with a carrot or we can force him by striking him with a stick. The sheep will move towards the carrot because it wants the reward of food, while also moving away from the stick behind him, since it does not want the punishment of pain.

Important to consider with regard to (dis)incentives is the distinction of 'known, unknown and unknowable sustainability' (Wals, 2015). Moving people away from a place or lure them there holds the notion that we have knowledge on what is desired and undesired. Certainly, there is a lot we *do* know about sustainability, yet we should immediately add that there are still uncertainties, no matter how robust the knowledge appears. One should thus be careful when influencing particular behaviours.

Moreover, an important note should be made with regard to (dis)incentives. The following section elaborates on this.

3.4. Getting the balance right

The (categories of) nine design characteristics constituting the framework have been discussed above. In the discussion, a categorisation of characteristics is made into *internal* and *external* causes of behaviour or behaviour change. This is presented graphically by means of the dashed line in the framework on page 36.

Strategies which provide internal causes of behaviour (change) are called *informational* strategies. Informational strategies aim at changing prevalent motivations, perceptions, cognitions and norms (Steg & Vlek, 2009).



“We proberen met trucjes het gedrag van onze kinderen te manipuleren. Straffen en belonen werken heel goed, maar alleen tot je kind niet meer bang voor of afhankelijk van je is. Het enige wat ze op de lange termijn leren, is dat degene met macht bepaalt hoe dingen gaan.”

(Kohn, 1999)



Balanceren tussen ontwerpkenmerken over het realiseren van 'duurzame' veranderingen

Er bestaan veel manieren om gedrag te beïnvloeden. In deze rapportage zijn negen kenmerken van (onderwijs)gebouwen onderscheiden die een oorzaak kunnen zijn van gedrag of gedragsverandering (zie pagina 36). Daarbij kan onderscheid worden gemaakt tussen *interne* oorzaken van gedrag en *externe* oorzaken van gedrag. Het grensvlak daartussen is weergegeven in het raamwerk op pagina 36.

Op pagina 32 zijn de manieren om gedrag direct te beïnvloeden grafisch weergegeven. Hierbij is gebruik gemaakt van de welbekende 'wortel en stok'-metafoer (C2 en C3 in het raamwerk). De 'stok' houdt in dat je ongewenst gedrag verbiedt of het reguleert binnen bepaalde grenzen

en daarbij dreigt met een straf (de stokslag). De 'wortel' refereert aan beloningen; gewenst gedrag lok je uit door bepaalde stimulansen te bieden. In sommige gevallen zullen mensen zich bewust zijn van zulke bevorderingen en ontmoedigingen van gedrag. Dat is echter lang niet altijd het geval. Een simpel voorbeeld voor de inrichting van ruimte betreft het supermarktvak; veel mensen zijn geneigd die producten te pakken, die op ooghoogte zijn geëtaled. De kritiek op het hanteren van de wortel en de stok om gedrag te beïnvloeden heeft daardoor met name betrekking op de korte termijn waarop ze gericht zijn. De kans is namelijk groot dat zodra de interventies wegvallen, mensen hun gedrag (weer) op een heel andere manier zullen inrichten.

Wanneer we het woord 'duurzaam' begrijpen als 'bestemd om voort te duren', dan wordt daarmee duidelijk dat de wortel en de stok geen duurzame verandering tot gevolg hebben; de reden om het gedrag te veranderen is namelijk niet *geïnternaliseerd*. Het gedrag wordt louter (tijdelijk) *geconditioneerd*.

Daar staat tegenover dat wanneer je reeds van plan was om, bijvoorbeeld, een stuk fruit te gaan kopen, het je zal helpen als dat fruit goed toegankelijk is. Externe oorzaken van gedrag hoeven dus niet per se straffen of beloningen te behelzen. Het kan ook gaan om subtiele stimulansen of barrières om interne oorzaken van gedrag te ondersteunen en daarmee de 'handen te helpen'; zie pagina 36.



proces
De routekaart geeft begeleiding in het proces om huidige situaties om te vormen naar gewenste situaties.



Het raamwerk en de routekaart

over het gebouw als *product* en het *proces* om tot dat product te komen

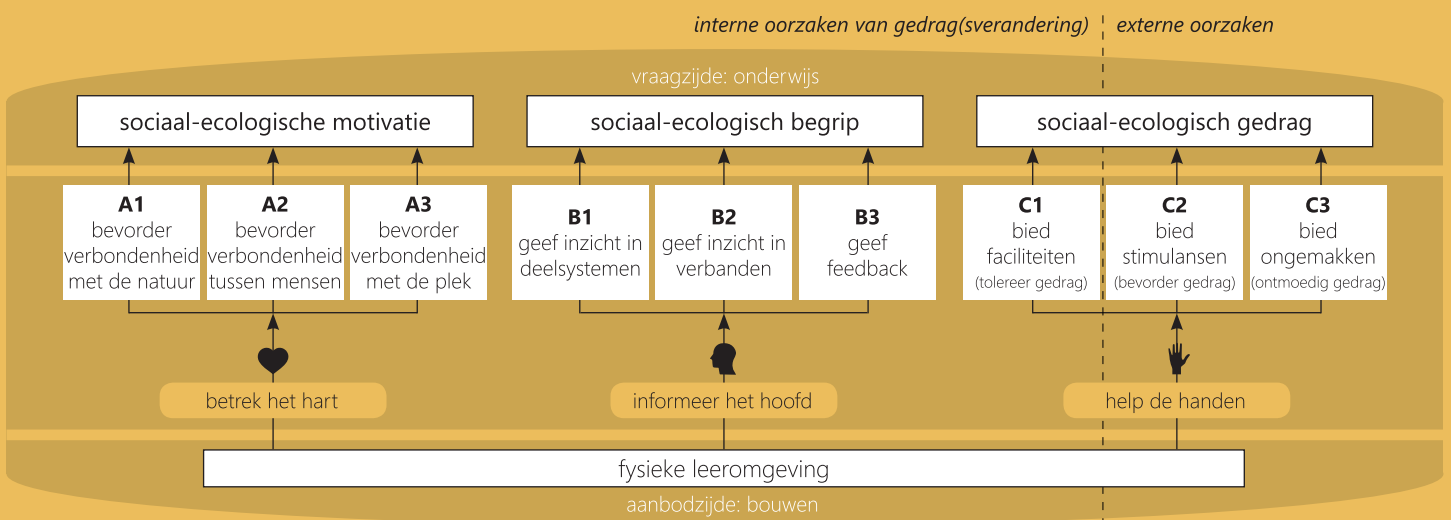
De huidige en de gewenste situatie

Hieronder is het raamwerk gepresenteerd dat in dit onderzoek is ontwikkeld. Het bevat negen ontwerpkenmerken voor fysieke leeromgevingen (A1 tot en met C3), die in deze sectie zijn toegelicht. Van deze kenmerken wordt verwacht dat ze bijdragen aan onderwijs

voor duurzaam geluk, door het hart, het hoofd en/of de handen te betrekken bij het leren. Het bevat dus een theoretisch begrip van hoe fysieke leeromgevingen bijdragen aan onderwijs voor duurzaam geluk. Daarmee geeft het raamwerk inzicht in de *gewenste situatie* omtrent het *product* 'schoolgebouw'.

Het proces: een routekaart

Om te komen tot gewenste fysieke leeromgevingen is dikwijls een transformatie nodig van huidige situaties. Het volgende hoofdstuk speelt in op dit *proces*, om de kloof tussen theorie en praktijk te dichten. Hiertoe is een routekaart ontwikkeld; zie pagina 40.



As elaborated on in section 1.1, informational strategies play an important role in transformative learning for sustainable happiness, since they result in profound changes in knowledge, skills and attitudes related to enhancing ecological, social and economic justice. Therewith, informational strategies are highly educational. Contrarily, one could argue that *structural* strategies do not contribute to sustainability learning. Structural strategies provide external causes of behaviour (change) and aim at changing the circumstances under which behavioural choices are made (Steg & Vlek, 2009). For example, 'nudge theory' and 'fun theory' describe concepts of positive reinforcement without limiting people in their freedom of choice (Thaler & Sunstein, 2008). Thaler and Sunstein explain that putting fruit at eye level counts as a nudge, while banning junk food does not.

The critique on such structural theories and approaches, comprising external causes of behaviour (change), primarily regards their focus on the short-term: when successful, (dis)incentives have an influence on choices made at the moment of exposure to the (dis)incentive. For example, putting fruit at eye level (an incentive, as discussed in the previous section) may lead to an increased purchase of fruit. However, if this is only due to convenience, the altered behaviour will not maintain over time since the behaviour is conditioned, rather than internalised. Chances are that as soon as the customer visits another market or if the market reverses her policy, the customer will fall back into old habits.

One could therefore argue that they do not belong in a framework aiming at a positive contribution to transformative sustainability learning, as they can be regarded 'conditioning of behaviour' and considered part of the 'eco-totalitarian regime' elaborated on in section 1.1. On the other hand, external stimuli can support internal causes of behaviour. For example, if the customer already had the intention to buy fruit, (dis)incentives may help to realise his intentions. In that case, external stimuli *do* have an educational character, as they can help to escape old behaviour patterns or to develop new habits and routines, due to which those behaviours can be maintained and reinforced over time (Defra, 2008). Since (dis)incentives can also be experienced as supportive with regard to internal causes of behaviour, these external stimuli are included in the framework.

In the context of transformative sustainability learning, it is thus important to never apply external stimuli in isolation. Rather, external strategies should always be combined with internal stimuli for behaviour (change). The framework gives insight into how the design characteristics distinguished provide either internal or external stimuli in the physical learning environment in order to facilitate this balance.

4. From theory to practice: a roadmap

As discussed extensively, the current research departs from the aim to contribute to transformative sustainability learning with 'sustainable happiness' as the ultimate goal. In current practice, many developments are taking place which contribute to sustainable happiness without aiming for this specifically, as financial motivations very often dominate. Perhaps the most common measure which simultaneously contributes to sustainable happiness and increases financial profit, is decreasing energy use, which is important from both an economic perspective as well as from the perspective of the natural environment. Other examples regard decreasing operational costs by reducing sick-leave or by increasing the productivity of employees by improving comfort and health (Vanderveen, et al., 2015b).

As opposed to this chrematistic, market-centred dimension of the current economic process (Cruz, et al., 2009), the current research places *people* and the *planet* at the core of the 'development' discussion. This does not at all undermine the importance of the economy, but treats it rather as a servant than as something we should serve. It means that our goal-setting focuses on human and non-human life, while the economy receives attention in order to realise the goals set. In the framework, demands are dealt with from a purely idealistic perspective. Practical implications and limitations, for example related to time, space and money, are not taken into account. Yet, practice proves that this is insufficient for change to arise. For example, Huckle and Wals (2015) argue that the worldwide UN Decade of Education for Sustainable Development (which ran from 2005 to 2014) represents 'business as usual in the end', since current global realities are not faced up. According to them, one of the reasons for this is inadequate guidance.

Similarly, no operational assistance is available to schools to transform their physical learning environment to support transformative sustainability learning. Therefore, this section aims to bridge the gap between theory and practice. To this end, a roadmap is presented in which the potential of the framework for practice is illustrated. The roadmap concentrates on the situation of educational real estate for primary and secondary education in the Netherlands.

Through application in practice, conflicts between the idealistic perspective and practice can be found. For example, products to arrive at the admired performance may be lacking or policy may hinder or prevent certain developments to take place. Hence, the application of the developed framework and roadmap may serve as a research and development agenda or as a basis for policy development.





Van theorie naar praktijk: een routekaart

over hoe dit raamwerk kan helpen bij transformaties van de fysieke ruimte

In Nederland, zoals in diverse andere westerse landen, zullen in de komende jaren ontzettend veel schoolgebouwen worden gerenoveerd of worden gesloopt om plaats te maken voor nieuwbouw. Een belangrijke reden daarvoor betreft de uiterst slechte prestaties van een grote meerderheid van het onderwijsvastgoed in Nederland met betrekking tot het binnenklimaat en energiegebruik (Kamp, et al., 2014). Het huidige 'verandermoment' (Jongh, 2000) waarvoor duizenden scholen daardoor nu (komen te) staan, biedt een prachtige kans om tegelijkertijd te werken aan duurzame gebouwen voor het onderwijs en aan gebouwen die zelf een bijdrage leveren aan duurzaamheidsonderwijs.

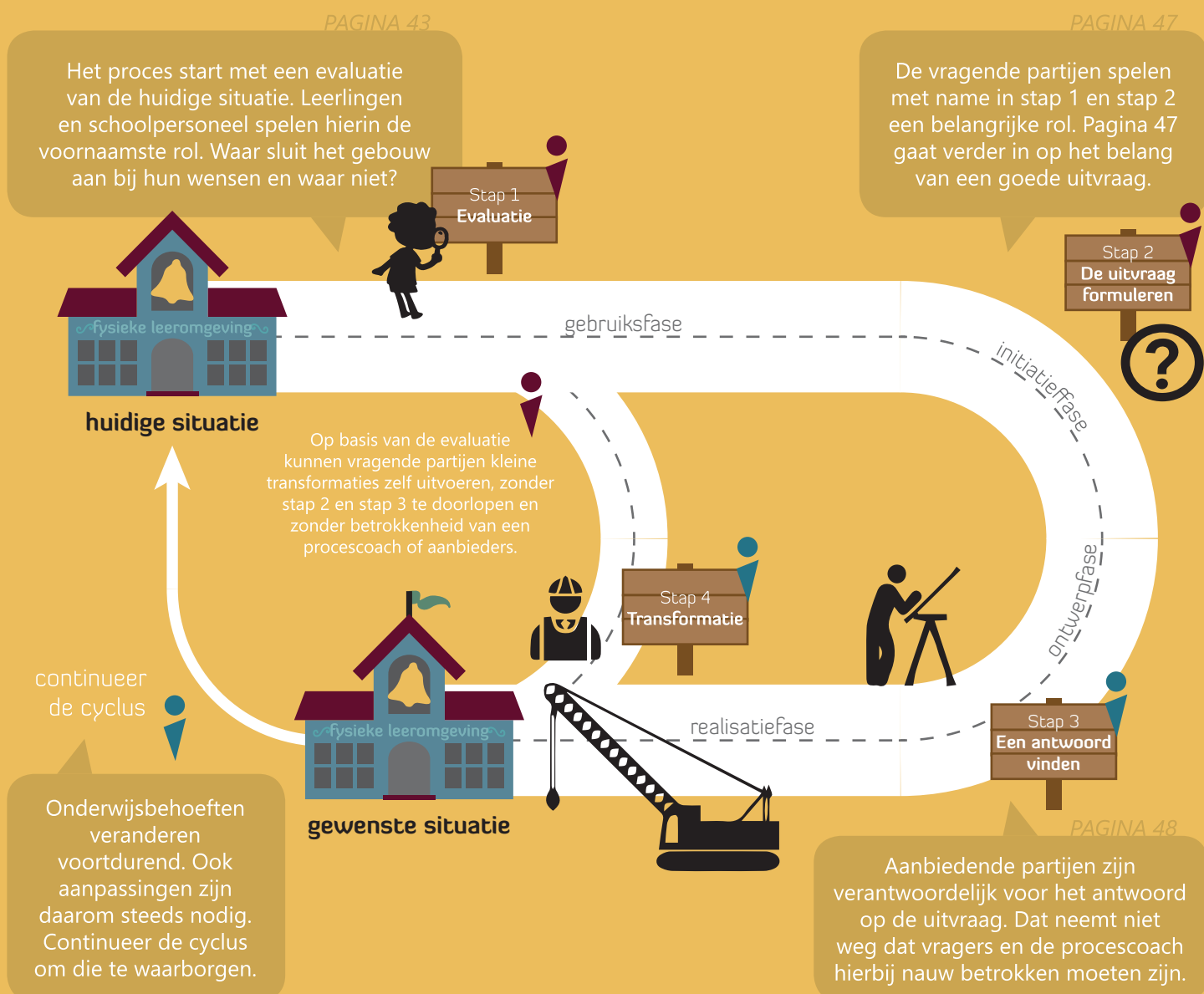
Wat voor rol kan dit onderzoek daarin spelen? Allereerst biedt het ontwikkelde raamwerk een structuur om bestaande gebouwen te evalueren. Door de onderscheiden bouwkenmerken te gebruiken als prestatie-indicatoren kan worden onderzocht hoe een gebouw momenteel een rol speelt in het onderwijs. Hoofdstuk 5 laat zien hoe zo'n gebouwevaluatie eruit kan zien.

Het inzicht dat zo'n analyse geeft, biedt een uitgangspunt voor de dialoog tussen scholen, gemeentes en bouwontwerpers. Zij evalueren wat ze vinden van de huidige situatie: zijn ze er content mee of moet het anders? Waar ligt in het laatste geval de prioriteit?

Vervolgens kunnen ontwerpers met het raamwerk aan de slag: het biedt aan hen een kader, dat randvoorwaarden schept voor de producten en gebouwen die ze ontwerpen. De negen ontwerpkenmerken zijn gebaseerd op theoretisch onderzoek en ontwikkeld vanuit een 'ideaalbeeld'. Toepassing in de praktijk moet uitwijzen waar ideële uitgangspunten botsen met de praktische realiteit.

De volgende pagina's lichten meer in detail toe hoe het raamwerk kan worden gebruikt in de levenscyclus van gebouwen en welke partijen daarin welke rollen (kunnen) vervullen in het geval van basis- en middelbare scholen in Nederland. Dit is grafisch weergegeven in een routekaart.

Een routekaart in de levenscyclus van gebouwen



“Complexiteit vraagt om samenspel in duidelijke rollen.”

(KIEN, 2015)

Vragers

- leerlingen
- personeel
- schoolbestuur
- gemeente



De procescoach

De procescoach waarborgt de samenwerking tussen vragers en aanbieders.



Aanbieders

- ontwerpers
- product-ontwikkelaars
- bouwers



4.1. A roadmap in the life cycle of buildings

The life cycle of building covers six stages, namely planning, programming, design, construction, occupancy and adaptive reuse/recycling (Preiser, et al., 1988); see Figure 4. The goal of the roadmap presented in this section is to provide guidance in this life cycle of buildings in order to arrive at suitable and sustainable school habitats in the context of transformative learning for sustainable happiness.

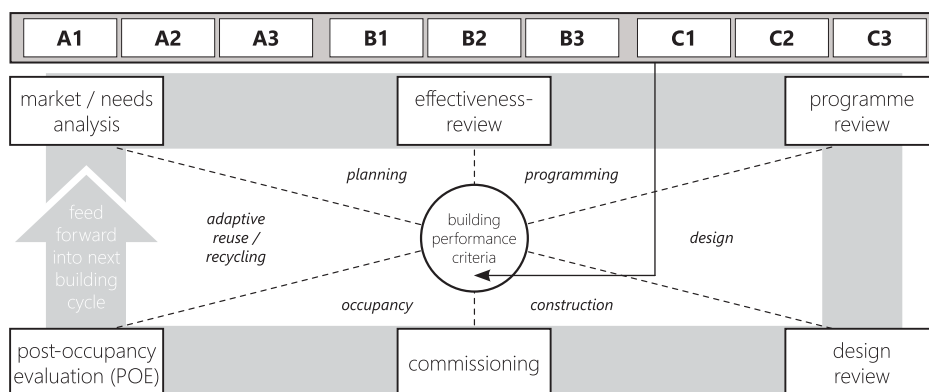


Figure 4 Building performance evaluation (BPE) cycle (Preiser, et al., 1988). The nine design characteristics A1 to C3 constituting the framework developed in this study (see Figure 3 or page 36) can serve as building performance criteria.

In order to evaluate to what extent the desired building performance is planned or realised in diverse stages of the life cycle of buildings, one has to have criteria for evaluation. As presented in Figure 4, building performance criteria therefore play a central role in building performance evaluation. The nine design characteristics constituting the framework can serve as such criteria. The framework thus provides a basis for building performance evaluation. To guide various actors in these phases, the roadmap developed comprises a step-by-step approach and is presented graphically on page 40. The following sections elaborate on this roadmap, on the actors involved and on how the developed framework plays a role in the roadmap.

4.2. Step 1: post-occupancy evaluation

Building performance evaluation regards evaluation in the complete life cycle of buildings, as presented in Figure 4. In order to develop appropriate plans for transformation, insight into the current situation is required. The roadmap therefore starts with a 'post-occupancy evaluation' (bottom left in Figure 4) of a school habitat. Post-occupancy evaluation takes place after or during the 'occupancy' stage of the building life cycle. It is the process of evaluating buildings in a systematic manner after they have been built and occupied for some time (Preiser, et al., 1988).

Through an analysis of a current school habitat and a comparison with the established performance criteria, insight can be gained into the discrepancy between the present and the desired situation. As presented in the roadmap, this paper argues that pupils should be engaged in the evaluation of their school habitat. Many researchers and practitioners, including the Australian and European Performance Based Building (PeBBu) Networks, found that in order to enhance the adoption and implementation of performance based building, stakeholders from especially the demand side should actively be engaged (Foliente, 2004). In the case of school design, pupils are the primary occupant group, which makes their opinion on the building performance important to incorporate. Moreover, it is in line with transformative sustainability learning to involve pupils in the process rather than outsourcing the task of POE. This way, the physical learning environment can serve as an instrument for education not only after it is completed, but also in the process of building transformation.

Section 5 elaborates on such an evaluation of a case study school. Data gathering is done through unstructured interviews and structured on-site observations with pupils (age 10 to 11) and teachers. The observations and interviews with the pupils are structured by the adoption of 'BREEAM Junior'¹, which served as a data gathering instrument. BREEAM Junior is a for education adapted version of BREEAM, which is the most widely used sustainability assessment code for buildings in Europe. The quick scan tool BREEAM Junior can be used by pupils and includes behavioural assessment criteria. This allows for the evaluation of the influence of built structures on behaviour. Pupils' answers on the questions with regard to the school building provide insight into their socio-ecological understanding. Insight into motivation is gained through interviews.

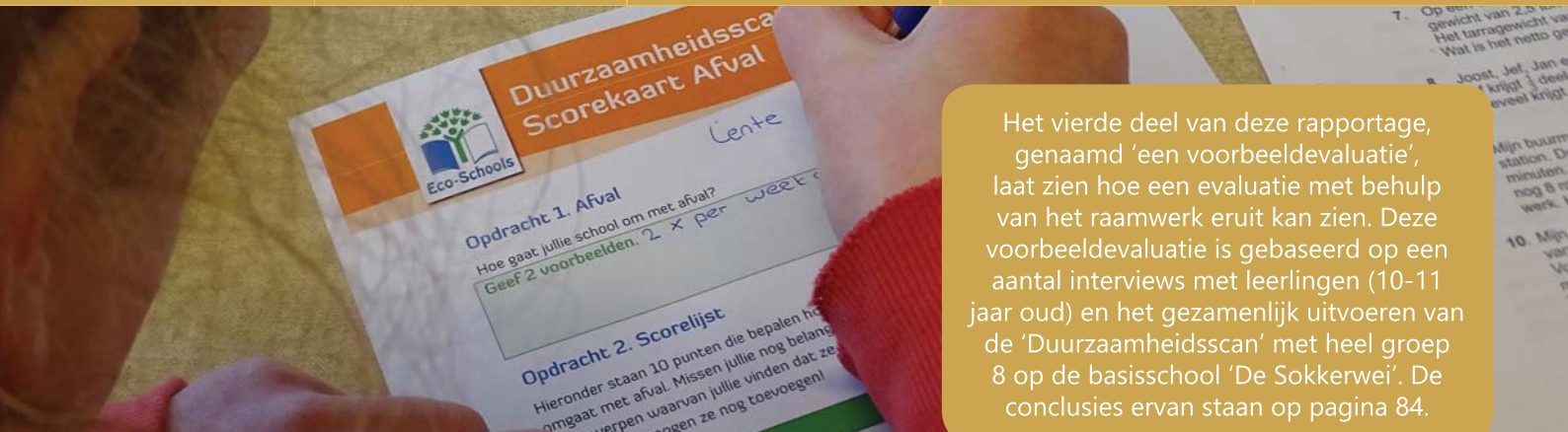
Performance criteria alone, however, do not provide a structure to systematically analyse built structures. To this end, a building decomposition method is required. Throughout history many decomposition methods have been developed. Schmidt, et al. (2011) provide a structured comparison of decomposition systems which are most often used. This research adopts the decomposition method developed by Brand (1994). His decomposition constitutes six layers; site, structure, skin, services, space plan and stuff. The main difference between the decomposition of Brand and many others regards its range; while many methods regard the 'building' only, Brand takes into account other built, or physical structures as well, such as the exterior 'site', and 'stuff' inside the building. These layers are important to incorporate when the wide-ranging 'physical learning environment' is studied.

¹ BREEAM Junior is identical to the Sustainability Scan used in the Netherlands by Eco-Schools, the largest sustainable schools programme in the world (see page 43).

In dit onderzoek is de 'Duurzaamheidsscan' van Eco-Schools gebruikt. Wil je daar ook mee aan de slag? Neem dan contact op via info@eco-schools.nl.

“Helaas is de meerderheid van de mensen die de kwaliteit van architectuur ontwerpen, ervoor betalen en haar formeel beoordelen, niet de groep die de gebouwen gebruikt. Het resultaat is een erfenis van vele ongeschikte en onduurzame gebouwen.”

(Mallory-Hill, Preiser, & Watson, 2012)



Het vierde deel van deze rapportage, genaamd 'een voorbeeldevaluatie', laat zien hoe een evaluatie met behulp van het raamwerk eruit kan zien. Deze voorbeeldevaluatie is gebaseerd op een aantal interviews met leerlingen (10-11 jaar oud) en het gezamenlijk uitvoeren van de 'Duurzaamheidsscan' met heel groep 8 op de basisschool 'De Sokkerwei'. De conclusies ervan staan op pagina 84.

Stap 1: evaluatie

student-led change: de Eco-Schoolsmethodiek voor duurzame verandering

Scholen bestaan om mensen te onderwijzen. Daarvoor leiden we docenten op, ontwikkelen we onderwijsconcepten en -methodes en bouwen we onderwijsgebouwen. Toch lijken we dat doel dikwijls uit het oog te verliezen. In de dagelijkse praktijk vragen namelijk allerlei dingen om aandacht, die kunnen afleiden van ons primaire doel.

Het is daarom belangrijk om die realiteit zo nu en dan te ontstijgen en te evalueren wat we eigenlijk vinden van waar we mee bezig zijn. Vanzelfsprekend spelen leerlingen daarbij een belangrijke rol: zij vormen immers de doelgroep voor wie we de school in eerste instantie hebben opgetuigd. We onderscheiden hier twee belangrijke rollen van leerlingen: leerlingen als wereldverbeteraars en leerlingen als gebouwbeoordelaars.

Leerlingen als wereldverbeteraars
Volwassenen hebben levenservaring. In de vele jaren die zij reeds op deze aarde rondlopen, hebben ze velerlei kennis en kunde ontwikkeld. Aan de ene kant stelt dit hen in staat te functioneren binnen de maatschappij. Aan de andere kant belemmert het hun denken daarover. We ontwikkelen denk- en doegewoontes, waar we soms achter staan en soms ook niet. In beide gevallen blijkt het voor veel mensen moeilijk daarin op oudere leeftijd nog (grote) veranderingen aan te brengen. Eco-Schools, het internationale, door de VN erkende keurmerk voor duurzame scholen, zet daarom de leerlingen centraal. Onder het motto 'student-led change' leiden leerlingen de duurzame verandering binnen hun school en thuis. Zij blijken bovendien heel goed in staat volwassenen mee te krijgen!

Zoals besproken op pagina 35 is een verandering pas 'duurzaam' als deze bestand is om voort te duren. Dat is alleen het geval als volgende generaties haar continueren. Het evalueren van de fysieke leeromgeving biedt een manier om een volgende generatie wereldverbeteraars op te leiden. Observeren, reflecteren en de dialoog aangaan met medestudenten leveren daaraan een grote bijdrage. Wat vinden leerlingen fijn? Wat vinden ze mooi? Wat vinden ze stom? Wat vinden ze slecht? Wat vinden ze goed?

Leerlingen als gebouwbeoordelaars
Leerlingen zijn de primaire doelgroep van scholen en schoolgebouwen. Reden te meer om hen actief te betrekken bij de evaluatie (en het ontwerp, waarover op pagina 48 meer) van hún gebouw!

introdactie en methode

het raamwerk

de routekaart

een voorbeeldevaluatie

discussie en conclusies



Een nieuwe rol: de procescoach

de koppelaar tussen droom en daad

“Scholen hebben dromen. Scholen kunnen plaatsen zijn waar je graag komt, wat langer blijft en dan niet met hoofdpijn en tranen in de ogen weggaat, waar leerlingen en leerkrachten in hun eigen sfeer en ruimte hun talenten kunnen ontplooiën, waar ouders hun kroost in vertrouwen afleveren, waar het ondersteunend personeel, inclusief de boekhouder, fluitend aan het werk is.” (KIEN, 2015)

Dikwijls lukt het niet om de dromen van vragers te realiseren. Bezoek een willekeurige school, vraag naar de ervaringen met betrekking tot het gebouw en de kans is groot dat de eerste reacties negatief zijn. Kunnen we docenten daarvan de schuld geven? Nee, natuurlijk niet; zij zijn opgeleid om geschiedenis te doceren, om de sociale cohesie op school te bevorderen, om ‘rugzakleerlingen’ te begeleiden of om uit te leggen hoe

je een staartdeling maakt. Kunnen we bouwers ervan de schuld geven? Ook dat lijkt twijfelachtig. Zij zijn opgeleid om installaties te plaatsen, om de stevigheid en stabiliteit van de constructie te waarborgen of om de bouwplaats zo efficiënt mogelijk in te richten. De praktijk wijst uit: zowel de vragende als de aanbiedende partijen zijn dikwijls niet in staat om de samenwerking tot een goed einde te brengen.

Scholenbouw is een bijzondere markt binnen de bouwsector. In het geval van bijvoorbeeld de bouw van kantoren zijn de opdrachtgevers vaak speciaal opgeleid voor het opdrachtgeverschap. Als gevolg worden schoolbesturen en gemeentes in het kader van scholenbouw daarom vaak ‘onprofessionele opdrachtgevers’ genoemd. In lijn daarmee zouden we de architecten en bouwers van diezelfde scholen net zo goed ‘onprofessionele opdrachtnemers’ kunnen noemen. Zowel de vragers als de aanbieders zullen de samenwerking op een andere manier moeten gaan vormgeven. De ‘procescoach’ speelt daarin een sleutelrol.

“De samenwerking draait in grote lijnen om drie partijen: vrager, aanbieder, coach. De coach waarborgt de samenwerking die moet leiden tot de totaaloplossing waarvan we dromen.”

(KIEN, 2015)

Adopting the six layers distinguished by Brand and combining them with the nine design characteristics distinguished in this study, an instrument for analysis can be constituted; see Table 1. This instrument facilitates an analysis of diverse layers of a specific physical learning environment with regard to the distinguished design characteristics. The instrument provides a structure to study all elements present in the physical environment with regard to their role in transformative sustainability learning. The layer analysis regards the interpretation and explanation of data collected by pupils by means of Table 1. Section 5 presents such an analysis of the case study school in order to provide insight into the functioning of this instrument.

Table 1 The instrument for analysis is based on the nine design characteristics A1 to C3 constituting the framework developed in this study (see Figure 3) and the decomposition method set by Brand (1994)

	Engage the heart			Exemplify to the head			Enable the hands		
	A1	A2	A3	B1	B2	B3	C1	C2	C3
Site									
Structure									
Skin									
Services									
Space plan									
Stuff									

The analysis of the design characteristics with regard to the building layers (see Table 1) is considered a task too specialised for pupils and school staff. It is therefore suggested that a ‘process coach’ fulfils the role of building analyst (see the roadmap on page 40). In some cases, the architect (supply side) or a skilled school board member, parent or municipality employee (demand side) might be competent to conduct this analysis. However, it is valuable if this understanding is gained before selecting an architect. Moreover, previous research has shown that school building processes are often harsh due to inadequate communication and collaboration between demanders and suppliers and that a process coach could solve this problem (KIEN, 2015). Therefore, it is suggested to appoint a process coach who can fulfil these tasks simultaneously and acts as the bridge between demanders and suppliers in the diverse necessary fields.

4.3. Step 2: problem structuring and formulating the request

The analysis by means of Table 1 indicates how the present school habitat performs. Simultaneously, it shows the gaps in its current performance. The analysis and evaluation therewith provide a basis for the dialogue with regard to the school’s ‘needs analysis’ (see Figure 4), which captures the school’s request and constitutes the premises for the design of the physical environment.

This study specifically focuses on application in the Netherlands. In the Dutch situation, local governments are the owner of educational real estate. School boards are responsible for maintenance and operation. This means that in substantial transformations, both parties are involved. Yet, the task of building transformation is often a once-in-a-lifetime job for these decision-makers. Therefore, it is typically hard for them to express an appropriate demand towards supplying parties. As discussed previously, their set of demands consequently often results from 'common' practice and habits and represents the culture they are in, rather than the actual needs they have. This study responds to that situation by providing guidance to these non-professional clients, which include both users (pupils and staff) and other stakeholders (school boards and municipalities); see the roadmap on page 40.

The dialogue with regard to the school's needs analysis is closely related to the school's vision on sustainability and education. The insight gained by means of the post-occupancy evaluation provides a basis for this dialogue, in which all actors at the demand side should be engaged. It is important that the process coach is involved in this dialogue in order to inform and assist schools and municipalities, since it has often been concluded that one of the core issues in building transformation processes regards the inadequate request schools and municipalities formulate.

4.4. Step 3: idea generation and decision-making

In the analysis and evaluation of the case study, presented in section 5, the evaluation by pupils and staff directly led to minor modifications in the physical environment. Even during the evaluation, they started moving furniture based on insights gained with regard to the influence of the physical environment on their behaviour. Such adaptations to fine-tune the building lead to 'adaptive reuse' of the building; see the roadmap on page 40. They regard minor or small-scale transformations of the physical environment. POEs may thus be used for a variety of purposes, such as troubleshooting shortly after moving in, fine-tuning the building during the occupancy stage, providing feedback for problem solving or assessing the need for new construction (Preiser, et al., 1988). Whether this transformation will regard only minor modifications, large-scale renovation or even a new building, depends on the performances of the current school habitat and its discrepancy with the admired situation on the one hand and the availability of resources on the other hand.

Larger transformations will require a more extensive process and the involvement of other actors. The needs analysis, accomplished in step 2, provides a basis for this process. In the planning, programming and design phases (see Figure 4) plans for transformation are made based on the request of demanding parties (step 2).

“Ze moeten geen voorgekookte recepten ter uitvoering aan derden opleggen. Ze moeten pottenkijkers willen gebruiken.”

(KIEN, 2015)

Stap 2: de uitvraag formuleren

de dromen verwoorden

Het zogenoemde 'onprofessionele opdrachtgeverschap' van scholen en gemeentes, zoals beschreven op pagina 44, komt vaak tot uitdrukking in onder andere een slechte of onvolledige vraagspecificatie. Dit houdt in dat ze een opdracht verstrekken die in feite niet bevat wat ze eigenlijk graag willen.

Het belang van de uitvraag

De figuur hieronder maakt duidelijk waarom een goede uitvraag zo belangrijk is. Er bestaan veel variaties op deze figuur, maar de kern van de boodschap is altijd gelijk: in het begin van een project staat er nog weinig vast en zijn er nog weinig kosten gemaakt. De invloed die op het project kan worden uitgeoefend, is daarom in de beginfase erg groot. In de loop van het proces wordt die invloed steeds kleiner en kost het steeds meer tijd en geld om wijzigingen door te voeren. Het is dan ook van groot belang om eisen en wensen te formuleren die de kern van de vraag adequaat beschrijven.

Hier liggen voor alle drie de betrokken partijen - vragers, aanbieders en de procescoach (zie pagina 40) - belangrijke uitdagingen.

De rol van de vragers

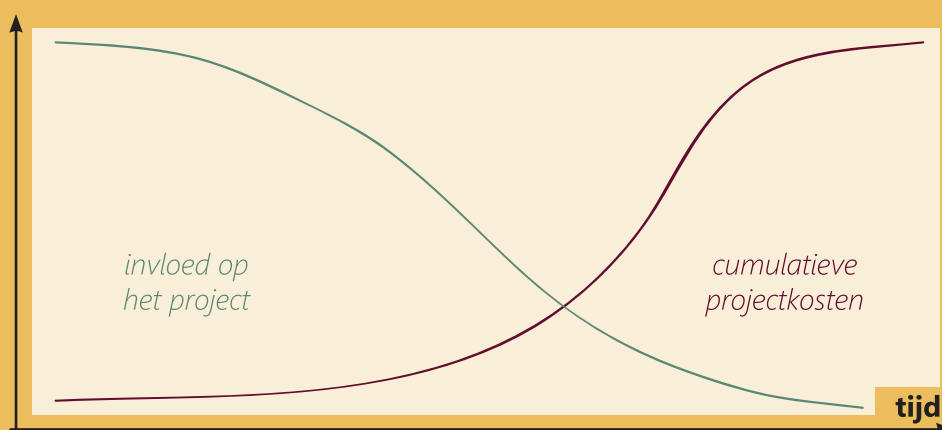
De vragende partijen zijn verantwoordelijk voor het formuleren van de uitvraag. Zij willen een nieuw gebouw, dat moet aansluiten bij hun onderwijsvisie. Het is dan ook van groot belang dat de vragende partijen duidelijk voor ogen hebben waar ze met hun school naartoe willen. Oude schoolgebouwen sluiten aan op oude onderwijsconcepten. De 'voorgekookte recepten' omtrent scholenbouw voldoen daarom in veel gevallen niet meer. Het citaat links geeft verder aan dat het formuleren van de uitvraag een taak is die niet alleen bij de vragers ligt: zij moeten 'pottenkijkers' willen gebruiken. De procescoach en de aanbiedende partijen vervullen die rol.

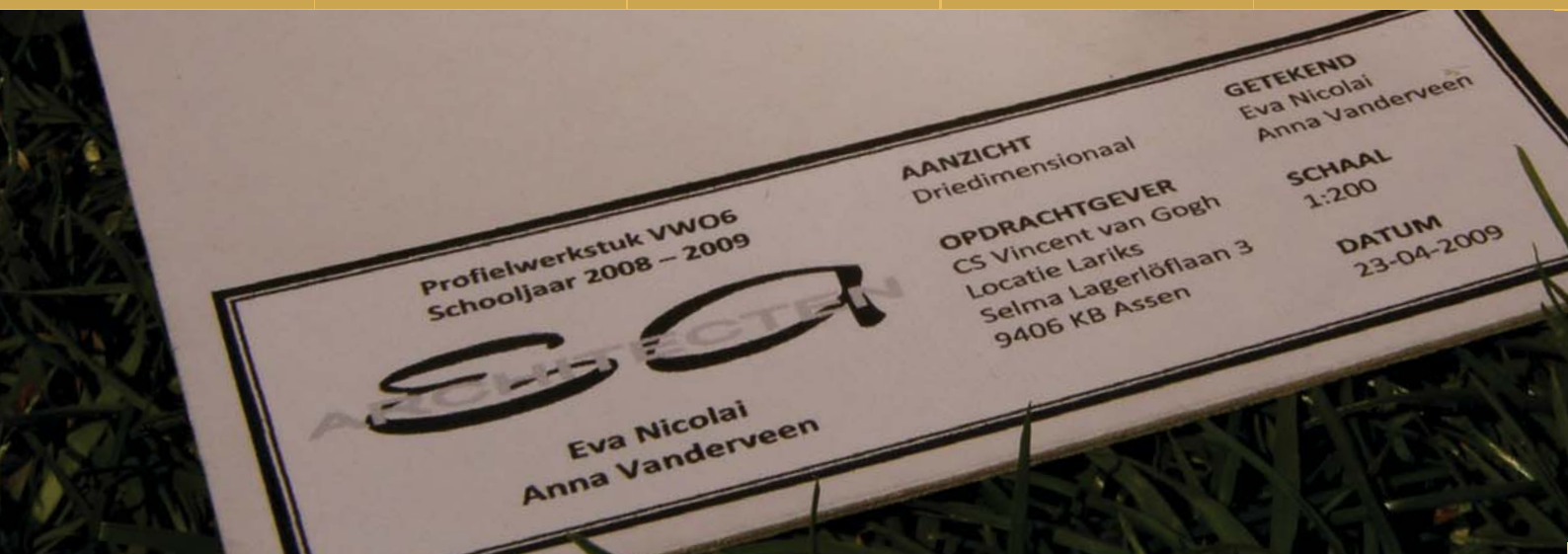
De rol van de aanbieders

Aanbiedende partijen hebben verstand van wat ze kunnen leveren en zijn daarom zeer geschikte pottenkijkers. Tegelijkertijd hebben ze vaak een eigen agenda: zij hebben belangen, die kunnen beïnvloeden hoe zij zich in een project opstellen. Het selecteren van de aanbiedende partijen, inclusief ontwerpers, adviseurs en bouwers, is daarom een belangrijke stap, die door de vragers wordt uitgevoerd, ondersteund door de procescoach.

De rol van de procescoach

Het is de taak van de procescoach om het proces in goede banen te leiden. De procescoach is onafhankelijk en is een heel belangrijke 'pottenkijker'.





Stap 3: een antwoord vinden

van droom naar daad

De vraag is: hoe vertalen we de dromen van scholen naar concrete plannen? Hoe kunnen we deze dromen realiseren met behulp van beton, bakstenen, glas en hout?

Leerlingparticipatie in ontwerpen

Gebouwen vormen studieobjecten waarmee bij elk vak wel een link valt te leggen. Leerlingparticipatie in de ontwerpfase kan daardoor uitermate leerzaam zijn. Er bestaan prachtige voorbeelden van leerlingparticipatie in het ontwerpproces. Ze kunnen meedenken met de ontwerpers of zelf ontwerper worden. Dit kan gestalte krijgen in het basisonderwijs, het voortgezet onderwijs, in het mbo, het hbo en op universiteiten.

Dat betekent niet dat de resultaten en adviezen van leerlingen altijd één op één moeten worden overgenomen bij transformaties. Kleine kinderen willen graag gebouwen vol glijbanen, scholen die lijken op luchtballonnen en zoefmobielen waarmee ze terug naar huis gaan. Het is aan de volwassen vragers, de aanbieders én de procescoach om de vraag achter die vraag bloot te leggen en die te vertalen naar antwoorden.

Ideeën genereren en selecteren

Het raamwerk kan worden gebruikt in die ontwerpprocessen. De negen ontwerpkenmerken A1 tot en met C3 (zie pagina 36) bieden een structuur en een kader om ontwerpen op hun

merites te beoordelen en ideeën te genereren en te selecteren. Tabel 2 op pagina 49 toont globaal hoe dat eruit kan zien. Voor elk van de criteria (de negen karakteristieken) worden ideeën ontwikkeld. Daarna wordt gezocht naar zinvolle en waardevolle combinaties van die afzonderlijke ideeën, om zodoende tot een totaaloplossing te komen die aan alle criteria voldoet. De aanbiedende partijen hebben daarbij een leidende rol. Het is aan de vragers om prioriteiten en wensen aan te geven, waardoor tussen de categorieën van ontwerpkenmerken kan worden gebalanceerd (zie ook pagina 35-36). De procescoach begeleidt de samenwerking.



Het is belangrijk
om onderzoek te
doen mét kinderen,
in plaats van náár
kinderen.

(Khan & Kotharkar, 2012)

This request consists of the performances called for by demanders, which capture the requested performance-in-use. Such performance requirements thus regard 'end result' specifications. Such end result specifications contrast with 'recipe' specifications, in which the provider is instructed with solutions for *how* to respond to the client's demand (Gibson, 1982). Since these instructions are absent in the performance concept for building, it is up to the supplier to invent ways to supply the performance desired.

This applies to diverse system levels; product developers provide specific solutions at a small scale, while the architect is responsible for the ensemble of products at a building level. Both parties may benefit from the nine design characteristics distinguished, when they use them in combination with 'morphological analysis' (Zwicky, 1969). An example of a 'morphological box' used in such an analysis is presented in Table 2. This box, which may be extended to a multidimensional matrix, captures possible solutions for each of the performance requirements set. This method can be used in the planning, programming and design phases as an aid for the generation of ideas, as it fosters creative thinking and facilitates discovery. Through an evaluation of the possible solutions, solutions can be selected and combined, as presented in red in Table 2.

Table 2 The nine design characteristics A1 to C3 constituting the framework developed in this study (see Figure 3) provide a basis for a 'morphological analysis', e.g. with regard to the building 'skin'.

Idea generation and decision-making for the 'skin'								
Engage the heart			Exemplify to the head			Enable the hands		
A1	A2	A3	B1	B2	B3	C1	C2	C3
solution 11	solution 21	solution 31	solution 41	solution 51	solution 61	solution 71	solution 81	solution 91
solution 12	solution 22	solution 32	solution 42	solution 52	solution 62	solution 72	solution 82	solution 92
solution 13	solution 23	solution 33	solution 43	solution 53	solution 63	solution 73	solution 83	solution 93
solution 14	solution 24	solution 34	solution 44	solution 54	solution 64	solution 74	solution 84	solution 94

4.5. Step 4: transformation

The actual transformation of the school habitat takes place after and based on the decision-making phases (step 3). This phase is beyond the scope of this research.

4.6. Continue the cycle

Demands constantly change and without interventions, the school habitat will not keep meeting them. It is therefore of great importance to continue the cycle; keep evaluating the performances and keep adjusting when necessary. For example, practice shows that BREEAM Junior, as elaborated on in step 1, is a suitable evaluation tool to use on a yearly basis.

5. A post-occupancy evaluation using the framework

This section discusses the results of the evaluation of the case school by means of the framework presented in section 3. It regards the first step of the roadmap presented in section 4: 'Step 1: post-occupancy evaluation'. This evaluation provides insight into how the physical learning environment of 'de Sokkerwei' provides input for socio-ecological understanding, motivation and behaviour. The design elements and principles noticed are discussed in relation to the 3x3 design characteristics captured in the framework. In section 5.2 (page 84-85), conclusions are drawn from the evaluation of this school.

5.1. An evaluation of design elements and principles

5.1.1. Engaging the heart

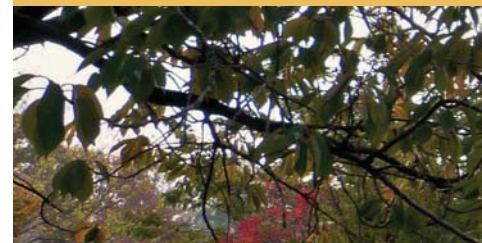
Table 3 presents the results of the analysis of the case school with regard to the first focus area: engage the heart. The following sections discuss this analysis and evaluate the discovered design elements and features.

Table 3 Analysis of design elements and principles contributing to socio-ecological motivation (① building shape and materials; ② the presence of nearby nature and natural school grounds; ③ climatic and seasonal exposure; ④ personalisation; ⑤ place identity; ⑥ building condition; ⑦ scale; ⑧ inclusive design; ⑨ engaging routing)

	Socio-ecological motivation		
	Foster nature connectedness	Foster human connectedness	Foster place connectedness
Site	② ③ ⑤	② ⑦ ⑨	⑤ ⑦ ⑨
Structure	①	④	④
Skin	① ② ③	⑦	⑦
Services			④
Space plan	③	① ⑦ ⑧ ⑨	① ⑦ ③
Stuff	③	④	③ ④

Building shape and materials ①

The perhaps most remarkable thing about the school studied is its circular shape. Orientation visits and interviews quickly led to the conclusion that both pupils and staff very much appreciate this form. The building shape and materials can be seen as an expression of 'organic architecture' (Ree, 2000), or more specifically, of the organic school architecture of Rudolf Steiner. Steiner (1927) maintained that designs should be 'living forms' that also speak to the emotional, psychological, mental, moral, and spiritual natures of human users (Adams, 2005). He argues that architectural forms and spaces should arise organically from such 'inner functions' as well as from outer



"Architectuur staat ten dienste van mensen."

(Ree, 2000)



betrek het hart



De essentie en potentie van bouwen

over waarom 'organische architectuur' actueler is dan ooit tevoren

***"Architectuur is niet autonoom, ze staat ten dienste van mensen. Gebouwen worden voor mensen gemaakt om in te leven en maken deel uit van een, in elk geval in oorsprong, natuurlijke samenhang. Deze mensen zijn levende, natuurlijke en geestelijke wezens die leven in natuurlijke, sociale en culturele samenhangen. Organische architectuur is niets anders dan een poging deze aspecten bij het bouwen te betrekken en in de vormgeving tot uitdrukking te brengen. Zo bezien bevat de term organische architectuur eigenlijk een appèl, of een toekomstideaal, namelijk te bouwen in overeenstemming met het wezen van de mens en de natuurlijke en geestelijke samenhangen waarin we leven."* (Ree, 2000)**

Het behoort tot de wortels van de geschiedenis van het bouwen om te denken over architectuur in analogie met de natuur en het wezen van de mens. Beschouwen we de filosofie van het 'functionalisme', een stroming die in de 20e eeuw terrein won en nog altijd een grote rol speelt in hedendaagse architectuur, dan rijzen er vragen. Wat is precies die 'functie' die zo'n centrale rol krijgt? Veel architecten beweren dat het centraal stellen van de 'functie' ornament uitsluit. Ik ben het daar niet mee eens. Toch ben ik een groot voorstander van het centraal stellen van 'de functie' in de vormgeving van de gebouwde omgeving, want ik

geloof dat de functie van gebouwen veel breder moet worden gezien dan hoe deze vaak wordt geïnterpreteerd. Architectuur staat ten dienste van mensen; als die mensen ornament willen, dan moeten we bereid zijn hen dat te geven. Door nog eens goed na te denken over waarvoor we eigenlijk bouwen en daarbij aansluiting te zoeken bij de samenhangen waarin we leven, ontstaat een heel nieuw soort 'functionalisme'. Dat is de vorm van functionalisme die centraal staat in de 'organische architectuur'; die is er niet op gericht de functie in een uniforme, geometrische vormtaal te kleden. Wat in de organische architectuur centraal staat, is het

zoeken naar de vorm die past bij het wezen van de bouwopgave en daar uitdrukking aan geeft. Door de heterogeniteit van bouwopgaven zijn de uitgangspunten van organische architectuur verre van eenduidig. We zien haar terug op vele gebieden, waaronder gebouwwormen, -kleuren en -materialen. In 'de Sokkerwei' vinden we er een aantal mooie aspecten van terug, waarover de volgende pagina's verder uitwijden. Al deze aspecten trachten uitdrukking te geven aan een architectuur die in overeenstemming is met het wezen van de mens en in harmonie met de natuurlijke omgeving. Gaan we terug naar deze essentie van het bouwen, dan heeft de bouwkunde de potentie om de maatschappij te bewegen richting de duurzaam gelukkige toekomst die we gezamenlijk lijken te ambiëren. Zo kan de gebouwde omgeving een hulpmiddel zijn om maatschappelijke uitdagingen het hoofd te bieden.

Dit verhaal is gebaseerd op Graham (2003) en Ree (2000).

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Doordat de gang om het theater heen langs (bijna) alle klassen komt, is het een ontmoetingsplek (A2) voor leerlingen, docenten en ouders.

Het 'Weitheater', deze centrale ruimte in de school, wordt gebruikt voor allerlei doeleinden. Het brengt de leerlingen en leerkrachten van de school bijeen (A2) op diverse manieren. Hier wordt onder andere overgebleven, de maandafsluiting vindt hier plaats (zie ook de foto op pagina 12) en leerlingen werken hier vaak samen aan opdrachten.



Vormen en materialen

Gebouwwormen en -materialen hebben de potentie mensen nader tot zichzelf, elkaar (A2) en de natuur (A1) te bewegen. In de Sokkerwei zien we dat terug in onder andere de indeling van het gebouw, met het Weitheater als centrale ruimte, en diverse bouwmaterialen, zoals de houten constructie en het groendak.

functions, such as structural and physical functions, in order to build in harmony with the spirit of people and nature in order to arrive at spiritual life within society.

The design measures noticed in this respect are various; see Table 3. The circular shape and the resulting place of togetherness in the centre of the building (which manifest themselves in the space plan) are believed to foster human connectedness. Moreover, the non-rectangular interior and exterior spaces characterise the experience of being at this school and contrast severely with the static or geometrical forms of most architecture and design. As a result, for many of the pupils this school is a very special place in their neighbourhood and is expected to foster place connectedness.

Several natural building materials are applied, which are expected to foster nature connectedness. The structural elements in the circular theatre of the school are made of local wood and can be considered representing a tree, covering this central place of togetherness. Moreover, a vegetated, green roof (part of the building skin) is present.

The presence of nearby nature and natural school grounds ②

The green roof (part of the skin) discussed under ① is the most noticeable form of nature in the school building. By all pupils, it is directly referred to when asked about the sustainable characteristics of their school habitat. Moreover, on the school grounds many trees are present and part of the facilities and finishings are made of natural building materials. Altogether, the appearance of the school is quite 'green'. Research shows that such 'green' school grounds foster human connectedness, as exposure to nature lessens bullying behaviour and often increases cooperation (Zelenski, et al., 2015).

Also, the natural school grounds are expected to foster nature connectedness. However, it seems that the full potential is not realised. Dutt (2013) explored how school design mediates students' relationships with the natural world. She found that not only the presence of nature, but the experiential interaction with the natural world is of great importance for nature connectedness. She provides an example of a pupil for who the design of the building and school grounds is not enough; daily interactions with the natural world inside schools, including animals, are an important element in having an attentive relationship to the earth. Similar results have been found in the case school. Although the school building and site possess quite some natural elements, interaction with nature is scarce. For example, no animals are present at the school and natural elements are limited to the exterior. Also, classes with regard to nature are never held in nature. Rather, pupils learn about nature via the books and lectures provided. No nature interaction is provided inside the school; the design elements noticed are restricted to the school 'site' (see Table 3) (the roof is also only visible from the site).

As a result, pupils from the student council are now lobbying for a school garden. In between the school grounds and the building skin, each classroom has its own little green space. These spaces could be used for gardening, as they used to in the past. Currently, the state of the greenery in these spaces is poor. This is discussed further under 'Enabling the hands'. Moreover, pupils mentioned that one of the reasons that even when initiatives are taken to enhance the state of this greenery, they sometimes negatively affect the greenery when they play hide and seek. This calls for natural school grounds with facilities for both play and gardening in order to foster nature interaction in diverse manners. Currently, the protection of the gardens would mean that pupils are not allowed to play with nature, since no other facilities are provided. As a result, the pupils regularly argue with regard to the use of the soccer field, since it is not large enough for all pupils at the same time and hardly any other opportunities for the larger children exist to entertain themselves on the school grounds.

Climatic and seasonal exposure ③

Whereas 'The presence of nearby nature and natural school grounds ②' can be considered a relatively static aspect, climatic and seasonal exposure goes a step further and concerns the visualisation of natural cycles and events. Affection with the regional climate, the seasons and the weather are important with regard to many forms of consumption and behaviour, such as food selection. The physical environment can strengthen this affection with nature and place through climatic and seasonal exposure.

On the school site, this is done through the presence of deciduous trees. As a result of these trees, in the autumn the school grounds are covered with leaves. Almost all toddlers were playing with these leaves, rather than with the facilities provided for play. They specifically mentioned that the leaves were one of the reasons they so much appreciated the fall season, strengthening their nature connectedness. Moreover, Dutt (2013) found skylights to invite the weather to come to school as they were used explicitly in lessons about weather. They highlighted or celebrated natural weather events, which became meaningful experiences for the students. Similar feedback was given by pupils in de Sokkerwei with regard to their skylights (part of the skin).

Finally, climatic and seasonal exposure may regard the celebration of traditions related to the seasons and the climate. The space plan must facilitate this and stuff can make it come true. For example, a Christmas tree and other seasonal decorations are observed during the Christmas period and pupils mentioned that during other seasons, similar efforts are made with regard to the decoration of the school. The central theatre of the school provides a perfect space for this (see also the photograph on page 7). The pupils are actively engaged in this, fostering their relationship with place and nature.



De seizoenen en het klimaat

Verbondenheid met de natuur en met de specifieke plek komt onder andere tot stand door binding met de seizoenen en het lokale klimaat. De fysieke leeromgeving kan deze binding bevorderen door de seizoenen en het klimaat tot uitdrukking te brengen, interactie ermee te bevorderen en activiteiten daarover te faciliteren.

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Een meisje (4) zegt: "Weet je wat ik het leukste vind aan de herfst? DIT!" en ze stort een bladerenregen over zichzelf uit door een enorme hoop knisperend geel met veel enthousiasme de lucht in te gooien.



"Dat is erg leuk als het regent, want dan zie je al die spetters boven je en dat is grappig, want dan blijf jij lekker droog!"



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De persoonlijke, sociale en culturele identiteit van personen en groepen kan tot uitdrukking worden gebracht in de fysieke ruimte.



De tussenverdieping werd door diverse leerlingen als favoriete plek (A3) omschreven, omdat ze daar het binnenklimaat kunnen personaliseren.



Personalisatie en identiteit

De schooltijd van kinderen is een periode in hun leven waarin zij zich een plek in de wereld vormen. Daarvoor is het van belang dat ze zich 'thuis' voelen in de wereld en plekken hebben waar ze zichzelf mogen en kunnen zijn en erkend worden. De fysieke leeromgeving kan hieraan bijdragen door personalisatie mogelijk te maken.

Moreover, the window sills and diverse furniture following the circular shape of the building are used to exhibit the creations of pupils. This is related to the extent to which the environment enables 'personalisation', on which the following section elaborates.

Personalisation ④

Through the personalisation of place, the psychological bonding with that place can be enhanced. Building elements which contribute to this thus foster 'place connectedness'. Moreover, personalisation may enhance human connectedness if it regards not only 'me', but also 'we'. A lot of 'stuff' is given a place in de Sokkerwei which foster human and place connectedness, such as drawings, pupils' creations and self-made birthday calendars. The structure, primarily its beams, are used to this end. The beams have the same height as regular sheets of paper, which make these beams an ideal exhibiting space for the drawings of pupils. In the classrooms of the toddlers, the ceilings are intensively used. Although the drop ceilings are not experienced as visually attractive, they do facilitate this because the panels can easily be lifted, due to which the ceiling's profiles can serve as anchorages. Also, the chairs and the coat racks are personalised, by means of the children their names and a different drawing for each pupil.

Moreover, personalisation takes place with regard to the services; several pupils mentioned that they preferably work on the mezzanine floor, because there they can adjust the local climate based on their preferences.

Place identity ⑤

Important contributions to the understanding of 'place' have been made by Relph (1976). By the identity of a place, Relph refers to its "persistent sameness and unity which allows that [place] to be differentiated from others". Relph describes this persistent identity in terms of three components: (1) the place's physical setting; (2) its activities, situations, and events; and (3) the individual and group meanings created through people's experiences and intentions with regard to that place. Place identity defined in this threefold way may foster place connectedness. Moreover, the physical setting may comprise natural elements which foster nature connectedness.

The distinctive atmosphere of a place is often referred to as the place's 'genius loci'. The place's physical setting can express and strengthen this uniqueness. In de Sokkerwei, such site specific features are found in the natural setting of the school, including several trees and a pond on the site. During the design process of this school, several stakeholders have stood out to maintain these elements. The pond provides the opportunity to learn about the exceptional water situation of the village, which is situated very near to the sea.

Building condition 6

The condition of buildings is an expression of status; similar to how slums express the position of their inhabitants in society, the condition of educational real estate gives an impression of the value attributed to education, pupils and teachers. This influences one's attachment with place and one's image of self and others (human connectedness). In de Sokkerwei, the pupils considered their school well-maintained. Some pupils mentioned plastic litter on the school grounds (see the section 'Enabling the hands'), but they consider this something they should work on themselves, rather than an expression of their status in society as determined or understood by others.

The decomposition method for built structures (see Table 3) is considered unsuitable to assess building condition, since it regards all aspects of physical environments. This is discussed further in section 6.

Scale 7

The issue of 'scale' is widely discussed in the field of architecture. New technologies have given rise to modern aesthetics, which have drastically changed architectural expressions. New technologies have enabled the production of large parts and spans, and over time the relatively low costs of industrial fabrication have eradicated many forms of human crafts. As a result, the 'human scale' in the built environment is often being threatened. The Roman author, architect, civil engineer and military engineer Vitruvius is famous for his work in this field of human proportions and scale, among other things. He defined the 'Vitruvian Man', as drawn later by Leonardo da Vinci: the human body inscribed in the circle and the square. He argued that physical environments should be based on this human scale. This is essentially related to the 'organic architecture' elaborated on under 'Building shape and materials 1'; according to Vitruvius, architecture is an imitation of nature and as birds and bees built their nests, so humans constructed housing from natural materials and in proportion to its users.

Especially in school environments, the issue of scale even goes beyond one single 'human scale', since humans with all kinds of sizes use the building. The user group ranges from toddlers, to young teenagers, to school staff. In order to engage all of their hearts and to enable autonomous use to all, a variety of scales is thus required.

In de Sokkerwei several building elements are noticed in this respect. For example, the height of the railings on the school site differ between the entrance of the toddlers and the entrance of the larger children. Moreover, windows in both the skin and interior walls are specifically designed for children, as the height is adjusted to them. This is expected to foster connectedness with place and to enhance the image of self, since it expresses that everyone is thought of and welcome to participate.



Schaal

De schaal van diverse aspecten van de gebouwde omgeving heeft een grote invloed op hoe deze wordt ervaren. De 'menselijke maat' speelt daarin een belangrijke rol. Er is echter niet één vaste 'menselijke maat': er zijn grote mensen en kleine, dikke en dunne, verschillen in generaties en dergelijke. Op scholen vormen kinderen de belangrijkste doelgroep.





betrek het hart



Op sommige plekken kunnen rolstoelgebruikers zich, door de beperkte hoeveelheid ruimte, slecht door het lokaal bewegen.

De tussenverdiepingen in de lokalen zijn niet bereikbaar voor kinderen die niet kunnen traplopen.



Het Weitheater is, door de trapjes, matig toegankelijk voor bijvoorbeeld rolstoelgebruikers.

Inclusief ontwerp

De gebouwde omgeving kan 'discrimineren'. Sommige delen van gebouwen zijn voor bepaalde groepen mensen slecht of niet toegankelijk. Andere elementen zijn juist speciaal ontworpen voor die groep, waardoor ze anders worden behandeld dan andere groepen.

Het sociale klimaat beïnvloedt erg sterk of dit als een probleem moet worden gezien. Zo gaven diverse leerlingen van de Sokkerwei bijvoorbeeld aan dat het helemaal niet erg is als een stuk wat slecht bereikbaar is, omdat je elkaar dan gewoon kunt helpen.

Moreover, the issue of scale and autonomous use goes beyond different user ages and lengths. The following section elaborates on 'inclusive design'.

Inclusive design 8

International efforts have increased and are still contributing to an increase of awareness regarding the fact that many people do not have the 'ideal' proportions and size of the man described by Vitruvius as discussed under 7. In many studies, the physical environment has been identified as a dominant factor for a more just and inclusive society in which all needs are understood as integral to society's order and not identified as 'special' (Farrington & Farrington, 2005; Woodcraft, 2012; Sherlaw & Hudebineb, 2015). Accessibility is a key issue towards the freedom of many people to autonomously participate in social life. Historically, improving accessibility began with building special facilities for people with all kinds of 'special' needs, such as chronically handicapped.² Unfortunately, this approach did not lead to inclusion at all, since grouping people together resulted in separation, or integration at best (see Figure 5).

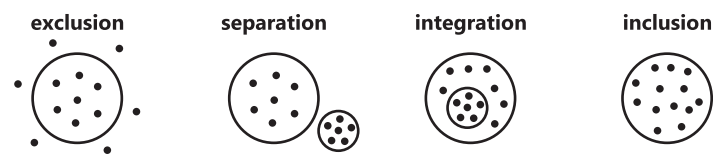


Figure 5 Graphical representation of exclusion, separation, integration and inclusion

In the case studied, special chairs (stuff) for two pupils with a muscle disease are present. Moreover, stairs and steps are not accompanied by ramps or elevators. The steps, the stairs and the chairs therewith embody 'categorical solutions' for accessibility. Categorical solutions are intended for an exclusive target group (Vanderveen, et al., 2015a). In this case, the chairs are designed for use by handicapped (facilitating 'integration'; see Figure 5), while the stairs and steps can only be used by people who have no mobility constraints.

Therewith, categorical solutions characterise 'discriminating' built environments. However, hearing the pupils, the situation in this school is not experienced as a discriminating environment. As discussed further under 'Enabling the hands', the pupils in this school even considered the barriers in the environment (such as the steps) as a stimulus for human connectedness. Unfortunately, no conversations with the pupils with a muscle disease were possible in order to hear their story with regard to this situation.

² See Vanderveen, et al. (2015a) for a historical overview of social inclusion and accessibility in the (public) built environment.

Engaging routing ⑨

The routing in the case school is aligned with its circular shape. In the morning, right before the lessons start, two pupils perambulate this circular route through the building with a bell to inform everybody about the current time. Rather than a reprimanding message of an automated system, the ringing bell therewith becomes a gentle reminder of peers to start your activities. This type of engagement fosters connectedness among pupils, as well as between pupils and other occupants. The same counts for the 'waste service'; twice a week, two to three pupils collect the trash from all classrooms through this route. Most other route designs would not make it impossible for such activities to take place, but this setting is expected to foster such doings as it is beautifully aligned with them. For the pupils, their participation in both duties feels as an honour.

Of course, this is not only due to the architectural form. It is essentially related to the school ethos. If such duties are seen as tedious tasks, the routing may have the opposite effect, as the pupils who collect the trash could be regarded the 'losers' of the week. Section 6 elaborates on this.

Moreover, routing plays a role at different scales, as it does not only concern the routing *in* the school, but also *to* the school. Section 5.1.3 elaborates on the extent to which the location of the school fosters active lifestyles. This is related to the extent to which the routing to the school engages the heart, since a pleasing route may serve as an *incentive* (see section 5.1.3) to walk or cycle, rather than to come by car.

This is a general comment with regard to this section concerning the heart, which is now coming to an end. The framework (see Figure 3) defines a relationship between the engagement of the heart and socio-ecological motivation. However, clearly, engagement of the heart is not always related to socio-ecological issues. We can experience pleasure from all sorts of things. The wide variety of sources of experiences we call 'pleasurable' and sizes and shapes of these experiences, is opposed by the simplicity of the thing they have in common: they feel good (Smuts, 2010). Pleasurable experiences are not (necessarily) pleasurable because we prefer them based on an intrinsic motivation for socio-ecological welfare, but because they feel good.

'Pleasure', as an engagement of the heart, can therewith be deployed as a stimulus for socio-ecological behaviour without being related to socio-ecological motivation. Such an incentive, which engages the heart, thus regards *extrinsic* motivation for socio-ecological sustainabil



betrek het hart



De leerlingen aan zet doordecentralisatie ten voeten uit

Sinds 1 januari 2015 zijn de schoolbesturen in het basisonderwijs zelf verantwoordelijk voor het buitenonderhoud van hun gebouwen. Eerder lag deze verantwoordelijkheid bij de gemeenten, die eigenaar zijn van de panden. 'Doordecentralisatie', zo wordt deze ontwikkeling vaak genoemd. Doordecentralisatie die nóg een stapje verder gaat, blijkt in veel gevallen fantastische resultaten op te leveren!

Zo las ik een artikel van Omdenken over een school waar de toiletten altijd zó vies waren, dat er leerlingen waren die pas thuis weer naar de wc gingen. Van alles heeft de school geprobeerd, maar niets hielp. Uiteindelijk besloot de directie dan maar helemaal te stoppen met het schoonmaken van de toiletten en iedere klas kreeg twee toiletten toegewezen. Niet alleen kregen de leerlingen de verantwoordelijkheid voor het schoonhouden van deze wc's, ze mochten er ook mee doen wat ze zelf wilden. Nu hangen de wc's vol met posters naar de smaak van de leerlingen en het allerbelangrijkste: ze zijn schoon en netjes.

Verder kwam ik op een school waar de docenten mij vertelden dat de school eindelijk schoner was geworden, nadat het corvée was *opgeheven*. Veel leerlingen gooiden hun afval op de grond, toen ze wisten dat er toch nog wel zou worden schoongemaakt. Toen, na de opheffing van het corvée, de verantwoordelijkheid voor een schone school bij hen zelf was komen te liggen, gooiden ze hun afval ineens keurig in de bakken.

Ook op de Sokkerwei zijn de leerlingen nauw betrokken bij onder andere afvalinzameling. Elke week zijn twee of drie leerlingen aan zet, die alle klassen langsgaan om de volle vuilniszakken op te halen. De ronde route door de school faciliteert een rondgang langs alle lokalen. Diezelfde ronde wordt elke ochtend en middag gelopen door twee leerlingen met een ouderwetse bel. Er is geen geautomatiseerd systeem dat je vertelt dat je aan het werk moet, maar een vriendelijke herinnering van je collega's dat het tijd is om je werkzaamheden te starten of te hervatten. Deze leerlingen beginnen vrolijk aan de les!



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Lucht

De kwaliteit van lucht is op veel scholen bijzonder slecht. Hieraan ligt een grote verscheidenheid aan oorzaken ten grondslag. Het informeren van gebruikers aangaande 'lucht' kan inzichten bieden, die vervolgens kunnen leiden tot effectieve maatregelen om de situatie te verbeteren. Bovendien is lucht, zeker in het kader van klimaatverandering, een leerzaam thema.

5.1.2. Exemplifying to the head

Table 4 presents the results of the analysis of the case school with regard to the second focus area: exemplify to the head.

A structure to analyse the influence of the physical learning environment on socio-ecological understanding has been found in the concept of 'metabolism'. Metabolism is a word used in several contexts. As used in its original biological context, the word connotes the internal processes of a living organism (Ayres & Simonis, 1994). In a broader sense, it regards the throughput of resources through a system and thus comprises the inputs, processing, outputs and impacts of a process. Examining the metabolism of a system thus allows to gain insights into resource utilisation and waste production (Kibert, et al., 2002). Physical environments (such as buildings, urban areas and cities) also have such a metabolism which can be mapped and measured (Graham, 2003). This section distinguishes five flows with regard to the metabolism of physical learning environments: air, water, energy, materials and food. The scope of the evaluation is limited to these five flows.

Table 4 Analysis of design elements and principles contributing to socio-ecological understanding, clustered per flow (1 air, 2 water, 3 energy, 4 materials, 5 food)

	Socio-ecological understanding		
	Demonstrate subsystems	Demonstrate relationships	Provide feedback
Site	1	1	
Structure			
Skin			
Services	1 2 3	1	
Space plan			
Stuff	5		

Air 1

Air handling

An air handling unit is placed on top of the roof and demonstrated, as it is visible from the school grounds. However, neither teachers nor pupils seem to be aware of the function of this unit. By one of the toddlers, it was referred to as a 'radio'.

Supply: exposed HVAC system

Air supply is provided by air ducts, attached to the ceilings of the classrooms and in the sight of users. Some teachers pay attention to these services in their classes.

However, as most of the teachers who participated in the building process resulting in this building have now left the school, the number of educators who actively use this feature of the school habitat in their lessons is decreasing.

One pupil elaborated further on the HVAC system than the exposed air ducts in the classroom. He knew where the air comes from before entering the classroom and showed me the inlet in the building façade. These are positioned above the exit of the car park, which is situated underneath the school. As a result, the air entering the classrooms sometimes smells like exhaust air, due to which the understanding of the pupils in that class with regard to the functioning of the HVAC system within the larger system was enhanced. Although they considered this undesirable, it illustrates the variety of ways to demonstrate subsystems and relationships between systems.

Indoor climate

No insight is provided into the state of the indoor climate on the one hand and the relationships between the subsystems present, the presence of people and their settings with regard to the HVAC system on the other. Many pupils complained with regard to the indoor climate; they considered it either too cold, too warm or not fresh. No insight is provided with regard to the factual situation.

Outdoor climate

With regard to the climate outdoors, one element is noticed which elaborates on the relationship between air quality and elements and features present in the physical environment. On the school site, a 'climate grove' is present. Several trees are planted as part of a project aiming to decrease climate change and this is explained on a sign board in front of the trees.

Water 2

Rainwater drainage

The drainage of rainwater is visible in the central hall of the building; rainwater drainage is aligned with the structural elements present. It is however not demonstrated where the water goes subsequently and if it is used in the school, for example to flush the toilets.

Sanitary

Most of the water used by the pupils is used in the bathrooms. Pupils are, however, unaware of the amounts and type of water (black, grey or white) used. The physical environment does not contribute to an enhanced understanding, since no insight is provided into the water flows through the school. Neither subsystems, nor relationships are demonstrated and feedback is not provided.



Het regenwater wordt opgevangen. Het wordt in de fysieke omgeving echter niet duidelijk wat er daarna mee gebeurt.

Water

Water is een zeer veelzijdig thema. Het houdt verband met leven in het water, waterconsumptie en waterveiligheid. In het kader van de gebouwde omgeving is met name de consumptie van water, onder andere voor sanitair, van belang. Afhankelijk van de plek kunnen ook waterleven en waterveiligheid een bijzondere rol spelen.

Waar komt het water eigenlijk vandaan? Waar gaat het naartoe? Hoeveel gebruiken we? Op het gebied van water wordt vrijwel geen inzicht gegeven.



informer het hoofd





informeer het hoofd

De lichten in de toiletten gaan automatisch aan en uit aan de hand van sensoren. Hierdoor wordt energie bespaard. Het zorgt er echter ook voor dat leerlingen zich niet betrokken voelen bij verantwoord energiegebruik. Het is daardoor de taak van leerkrachten om dit soort thema's met leerlingen te behandelen.

De zonnepanelen op het dak zijn duidelijk zichtbaar. Er wordt echter geen inzicht verschaft in hoe deze deelsystemen een rol spelen in het grotere geheel; waar wordt de energie voor gebruikt? Hoe veel energie wordt er opgewekt? Vinden leerlingen en docenten dat genoeg?

Gedurende het uitvoeren van de Duurzaamheidsscan kwamen leerlingen tot de conclusie dat er maar liefst dertig computers aan stonden, die niet werden gebruikt. Hoeveel energie daardoor verloren gaat? Zij hebben geen idee!





Energie

Energie is een veelbesproken thema. De ontwikkelingen hebben betrekking op veel niveaus; van onderzoek en Rijk tot praktijk wordt er gewerkt aan duurzame energie-opwekking, energiedistributie en energiebesparing. De energetische situatie van scholen in Nederland is vaak zeer slecht te noemen. Door te communiceren over de energetische situatie kunnen gebouwde omgevingen bijdragen aan bewustwording en gedragsverandering.

Energy ③

Generation: solar panels

The roof of the school is covered with about sixty solar panels. Due to the slope of the roof, these panels are clearly visible from the school grounds. Hence, these subsystems are demonstrated; see Table 4. However, the extent to which understanding is provided with regard to the functioning of these subsystems is limited. For example, the data gathering with pupils and the interviews show that most pupils are not aware of the amount of energy provided by the photovoltaics. Moreover, insight into the relationship between the solar panels and the larger system is lacking. No insight is provided into what the energy is used for and if the amounts generated cover the amounts of energy consumed in the school.

Generation: windmill farm

Besides the energy generation by means of photovoltaic panels on the school building, the school has invested in a windmill farm. Unfortunately, no educational aspect of this farm is found, since nothing with regard to the windmills is demonstrated towards pupils.

Usage: lighting and computers

The lighting in diverse rooms is automated; the lights turn on automatically when people enter the room. As discussed in section 3.3.2 (page 33), such automated systems hold a risk of disengagement of users. Some of the teachers pay attention to this, by actively discussing such features of the building. The physical environment itself does not communicate regarding it. Neither with regard to the automated, nor to the unautomated lighting systems, insight is provided concerning the energy utilisation of these systems or the relationships with, for example, the energy generated on the roof of the school. The same is true with regard to other equipment, such as the computers. During the evaluation, pupils concluded that thirty computers were turned on without being used, while they were previously unaware of this.

Materials ④

Building materials

During the building process, building materials have gained special attention and many materials have been selected which could be considered sustainable. In order to answer the questions in the quick scan tool with regard to building materials, pupils asked the director and the teacher whether their school has been built in an environmentally friendly manner. They answered 'Yes', while these teachers were actually unaware of the measures taken and materials applied. The story goes that the school is 'sustainable', but insight is often lacking *why* one could consider the school sustainable.

Contrarily, the materials used for the skin and structure used to be 'labelled', so that pupils could read about the origin of the building materials. The labels were made by pupils themselves and they organised tours for external parties, such as teachers from other schools or teachers in training. Nowadays, these labels are not present anymore and most school staff is not aware of the building materials chosen. As a result, no educational aspects with regard to them are identified.

Waste

During their evaluation, pupils concluded that they often misuse the waste bins provided, because they do not have proper understanding with regard to the different waste flows. Therefore, they proposed to illustrate on the bins which kind of products they can throw in that bin in order to enhance their understanding.

Processing and impacts

Due to their participation in the 'waste service' (see section 5.1.1, 'Engaging routing 9') the pupils know what happens with the waste after they throw it away. However, they do not know what happens with the materials after they leave the school and no insight is provided into the impacts of waste through the design of the physical environment.

Food 5

Inputs


The food consumed in the school is exposed in front of each classroom; a table is positioned next to each classroom door, where the pupils set out their consumptions. This provides insight into the consumptions of peers, but lacks information or feedback with regard to their origin, production methods and impacts. The effects of this 'food exposure' are discussed further in section 5.1.3, 'Enabling the hands'.

Waste

The waste materials used to pack food are already discussed under 4. The human waste resulting from food and food waste are not given any educational attention in the case studied, although after the evaluation several pupils started advocating to build a compost heap, which could address this issue. Currently, organic waste is not collected separately.

Processing and impacts

The impact of food, for example related to the health effects of food consumption and the environmental impact of food generation, are not given any role in de Sokkerwei's physical environment. Demonstrating the impacts of the processing of food could regard, for example, insight into the digestion of food as a result of climbing the stairs as opposed to taking the escalator.



Waarvoor is zo'n groendak eigenlijk nuttig (of niet)?

Materialen en voedsel

We maken gebruik van allerlei materialen en producten. Inzicht in de cyclus die die materialen doorlopen, ontbreekt vaak. Waar komen materialen vandaan? Hoe veel gebruik we? Wat gebeurt er met de materialen nadat we ze hebben gebruikt? Wat is de impact van die materialen en producten op onszelf en op het grotere geheel?

introductie en methode

het raamwerk

de routekaart

een voorbeeldevaluatie

discussie en conclusies



informeer het hoofd



Restafval en plastic afval worden op de Sokkerwei apart ingezameld. Leerlingen gaven echter aan niet altijd precies te weten welk afval daar wel en niet in mag. Ze adviseren daarom om op elke bak met voorbeelden aan te geven waar de bak allemaal voor bedoeld is.



Waar komt dat hout vandaan? Wat voor effect heeft die verf op ons binnenklimaat?

Wat gebeurt er eigenlijk met ons 'voedsel' wanneer wij er klaar mee zijn?

introductie en methode

het raamwerk

de routekaart

een voorbeeldevaluatie

discussie en conclusies



help de handen



Dit bakje voor plastic afval en deze papierbak maken het verschil duidelijk tussen de ontwerpkenmerken C2 (stimuleer gedrag) en C3 (ontmoedig gedrag): het plastic bakje is centraal geplaatst, waardoor het gebruik ervan wordt gestimuleerd (C2). Daarentegen wordt het gebruik van de papierbak 'ontmoedigd' (C3), doordat deze zo verstopt staat onder het bureau.



Leerlingen gaven aan bepaald afval regelmatig in de verkeerde bak te gooien, omdat de goede te ver lopen was. Ze hebben de bakken toen direct naast elkaar gezet, om dit ongemak (C3) weg te nemen.



Afval

Afvalpreventie, afvalinzameling en afvalscheiding zijn drie belangrijke aspecten van het thema 'afval'.

Over afvalpreventie lees je meer op pagina 76. De faciliteiten voor afvalinzameling en afvalscheiding zijn door de leerlingen onder de loep genomen.

5.1.3. Enabling the hands

School habitats may provide hands-on examples of technologies and practices for resource conservation, recycling, energy use, air quality, and the like (Spengler, et al., 2001). In order to enable such practices, it is important that the physical learning environment supports this. Table 5 presents the results of the analysis of the case school with regard to this third focus area: enable the hands. The findings are clustered by the themes used in the quick scan tool BREEAM Junior (see page 43).

Table 5 Analysis of design elements and principles contributing to socio-ecological behaviour, clustered per theme (1 litter and waste, 2 food, 3 greenery, 4 safety, 5 mobility, 6 air quality, 7 hygiene, 8 water, 9 energy)

	Socio-ecological behaviour		
	Provide facilities (tolerate behaviour)	Provide incentives (stimulate behaviour)	Provide disincentives (repress behaviour)
Site	3 5	5	5
Structure			
Skin			
Services	6 8 9	9	9
Space plan	1 3 5	1 2 3 4 5	1 2 5
Stuff	1 7	1 2	1 2

Litter and waste 1

In and outside de Sokkerwei, only little litter is present. This is worth a compliment for pupils and staff, especially since the amount of bins present on the school grounds is not large. Yet, a few pupils complained regarding litter on the school grounds. They call for more 'facilities' for waste collection outside. Although this could indeed enhance the waste situation, space for improvement with regard to users' behaviour concerning waste primarily regards the *separation* of waste, rather than the *collection* of waste. Each classroom has its own facilities for separated collection of plastic, paper and residual waste. Nevertheless, several pupils concluded that they hardly used the plastic bin and threw their plastic waste in the residual waste bin instead, because they had to walk too far to the first-mentioned. The evaluation of these facilities by pupils directly led to minor modifications in the physical environment; in order to eliminate such disincentives, they started moving stuff (e.g. the plastic bin) based on insights gained even during the evaluation. Such adaptations regard the 'short cut' in the roadmap presented on page 40. Moreover, they concluded that enhanced 'understanding' would in this case serve as an incentive. Several pupils mentioned they did not know which products should be thrown in which bin. They proposed to illustrate this on the bins. This issue is further discussed previously, in section 5.1.2.

In the heart of the school under study, an 'Eco-place' is arranged. Here, used batteries, clothing and markers are collected, either for recycling or donation purposes. The special thing about this place is its place; although not particularly mentioned with regard to this 'Eco-place', pupils did mention the location of facilities in the school in relation to the actual use of them. The school possesses a large, touch-screen game computer, which is situated in one of the entrances of the building. It is however hardly used by the 5th and 6th graders, "because we are all the way over there": they are situated on the other side of the building and therefore do not encounter it, especially since they use another entrance. By contrast, the Eco-place is situated in the centre of the building. This entails that, contrarily to the game computer mentioned, it is more or less on the route of all pupils. All pupils regularly visit the central space in the school for a variety of purposes, so they encounter the Eco-place on a regular basis. Yet, whether this place concerns either an incentive or disincentive with regard to the actual use of it, depends on the user one observes. Some pupils experience this special place (which manifests itself in the space plan) given to these facilities as an incentive, as it makes it feel as something of importance. They even bring the markers they use at home to the school to make optimal use of these facilities. Yet, the evaluation has shown that other pupils do not even know of the existence of this place, let alone they will use it. Since all pupils do encounter it, it is believed that the design of the Eco-place is inadequate to draw the attention of certain pupils. In their case, a lack of incentives seems to be the reason they do not use the facilities provided.

The pupils are actively engaged in waste collection on the school level. Twice a week, two to three pupils are the 'waste service'. They perambulate the circular route through the school and collect the trash from all classrooms. This is discussed further under 'Engaging routing 9' in section 5.1.1.

Finally, rather than reusing and recycling waste, the school is also concerned with reducing the amounts of waste generated. More and more pupils carry their food and beverages in reusable packings. Although lunch boxes and reusable bottles require no facilities from the physical environment, physical space may stimulate certain behaviours. It is observed that in most classes, the children's consumptions for the day are exposed in front of the classroom. Through this combination of space plan and stuff, it is directly visible whether pupils bring either reusable or non-reusable packings. If social control based on this exposure will take place, is dependent on the prevailing norms of other pupils, staff and parents. Dependent on this milieu, the exposure can be either an incentive or a disincentive to exhibit socio-ecological responsible behaviour. This counts not only for the packings of consumptions, also for the food and beverages themselves, on which the following section elaborates.




 help de handen


Uitgedroogde stiften

over het belang van een fysieke, centrale plek voor duurzaamheid op school

De eerste keer dat ik op de Sokkerwei kom, krijg ik een rondleiding door de directeur van de school. Zij laat me de klassen zien en we komen onder andere bij de peuters terecht. Een van de kinderen is druk aan het kleuren, totdat uit haar stift nog dusdanig weinig kleur komt, dat ze het tijd vindt om actie te ondernemen. Ze laat aan haar juf zien dat de stift het niet meer doet. Ik ben gecharmeerd van de wijze waarop de juf haar wijst op de stiftenbak en haar adviseert om even een andere uit te zoeken. Toch lijkt het meisje niet tevreden met deze reactie. Mijn rondleiding gaat verder, dus ik zie helaas niet hoe het afloopt. Even later, wanneer de rondleiding in het hart van de school is aangekomen, wandelt het meisje ineens weer voor ons langs. "Is juf Trudy er ook?", vraagt ze aan mijn rondleidjuf. Die antwoordt dat

juf Trudy er niet is op donderdagen. Het meisje wil de stift aan haar overhandigen, maar mijn juf zegt dat ze het maar even bij haar eigen juf moet regelen en een nieuwe mag uitzoeken. Nogmaals wijst het meisje mijn juf erop dat de stift niet meer werkt. Ze haalt de dop eraf en bewijst het door met de uitgedroogde stiftpunt over haar hand te vegen. Heel vriendelijk bevestigt mijn juf haar conclusie: inderdaad, hij is op! Wederom lijkt het meisje echter niet tevreden met het antwoord dat ze krijgt. In haar Nederlands dat duidelijk nog minder lang in ontwikkeling is dan zijzelf, zoekt ze de geschikte woorden bij elkaar om duidelijk te maken dat ze deze stift van huis heeft meegenomen en dat juf Trudy een bak heeft om ze in te verzamelen. Nu valt bij mijn juf het kwartje. Al die tijd staan we namelijk al pal naast de

'duurzaamheidshoek' van de school, waar diverse producten worden ingezameld om ze een tweede leven te kunnen geven. Mijn rondleidjuf draait zich om en wijst de drie bakken in deze centrale ruimte van het gebouw aan. Daar worden naast pennen en stiften, ook batterijen en onderbroeken verzameld. Eindelijk is het meisje tevreden. Ze propt de stift in de pennenkoker en volledig in haar sas huppelt ze terug naar haar lokaal.

Centraal én opvallend

Het dilemma van het meisje laat zien wat hier voor probleem heerst; de hoek is heel centraal in het gebouw geplaatst, waardoor deze voor iedereen toegankelijk is, maar hij is niet opvallend genoeg. Later blijkt dat veel leerlingen deze plek helemaal niet kennen!



help de handen



Bekers en knijppakjes

over het belang van het sociale klimaat

In de Sokkerwei zijn voor bijna alle klassen tafels geplaatst, waar de leerlingen hun eten en drinken op uitstallen. Hierdoor kunnen leerlingen zien wat iedereen eet en drinkt. Is het fruit? Zijn het koekjes? Zit het verpakt in wegwerpzakjes, -pakjes en -flesjes? Zit het in brodtrommels en herbruikbare flessen en bekers?

Als de leerlingen en de docenten het 'normaal' vinden dat er gezond gegeten wordt en dat herbruikbare verpakkingen worden gebruikt, dan kan het uitstallen van het eten en

drinken de consumptie en het gebruik daarvan *bevorderen*. Anderzijds kan het exposeren dit *ontmoedigen*, indien sociale normen het gebruik van andere producten toejuichen.

Hetzelfde geldt voor de 'afvaldienst' (zie pagina 63); op de Sokkerwei vinden de meeste leerlingen het een eervolle taak om mee te werken aan het realiseren van een schone school, terwijl het op andere scholen wordt gezien als een rotklusje. Het nadrukkelijk laten zien wie daarbij betrokken zijn, kan daardoor twee

kanten op werken en soms juist een averechts effect sorteren.

Dat betekent dat het sociale klimaat en de normen op de school van belang zijn voor het effect van ontwerpbeslissingen aangaande de fysieke omgeving. Van sommige ontwerpen valt daarom niet eenduidig te zeggen of ze als stimulans of juist als belemmering voor sociaal-ecologisch gedrag fungeren. Pagina 88 gaat verder in op het belang van een 'whole-school approach' bij het maken van zulke keuzes.



Food ②

The same combination of space plan and stuff as discussed above, regards either incentives or disincentives for socio-ecological responsible food selection. If the school ethos is such that consumptions which could be considered unsustainable (either because of the ecological environmental impact or for health reasons) are considered 'cool', the food exposure might repress socio-ecological behaviour. If, on the other hand, socio-ecological motivation and understanding prevail (internal causes of behaviour change), food exposure may lead to a stimulation of socio-ecological responsible behaviour.

In relation to food, another potential lies in the physical learning environment. As discussed in section 5.1.1, pupils are now lobbying for a school garden on the site to grow their own food in a garden on school property. This is further discussed below.

Greenery ③

'Learning by doing' requires active learning. Greenery can contribute to this in diverse fields. For example, several attempts have been made to foster gardening at school. As discussed in section 5.1.1, each classroom has its own little garden (which manifests itself in the space plan and the site). For several reasons, one could argue that the use of these facilities is stimulated. Firstly, the gardens are positioned in front of each classroom in order to foster ownership and a sense of responsibility (motivation as an incentive). Moreover, this location means that a visually unattractive garden is in the sight of the ones who are responsible for it. As a result, pupils now complain about the poor state of the greenery, which they are overlooking from their classroom. Several attempts have been made by different classes to maintain the gardens, in cooperation with parents. Yet, these attempt have stranded over and over. With regard to this aspect, we could conclude that the physical setting is adequate and that the fact that the possibilities offered are hardly used, is due to external factors.

Moreover, a potential for interaction with greenery regards growing food, as discussed above under ② and previously in section 5.1.1. The reason that the school staff is not (yet) granting the pupils' request for a school garden primarily regards safety and security issues, on which the following section elaborates.

Safety ④

The request of the pupils to develop a school garden is not (yet) granted by the school management due to fear of vandalism. The evaluation by pupils and diverse interviews with pupils and staff have led to the conclusion that the safety in the school is very good, but that outsiders sometimes misuse the school grounds after school hours.

No threat is experienced due to this; they regard teenagers who have other interests than the pupils and staff at the school. The school decided not to place gates and fences which can obstruct this, because they very much appreciate the appearance of the school, as discussed extensively in the section 'Engaging the heart' and contrast the citation of Taylor (1995) on page 6. Therefore, no disincentives to repress the behaviour of the teenagers mentioned have been put in place. Now, pupils mooted to accommodate the yard in a greenhouse which can be closed.

The contact among pupils is very good. A few years ago, the school has started to put effort into being a 'peaceful school'. This certification mark puts emphasis on social safety and security in schools. Hearing the pupils, this is really working for them. An interesting, related finding of the pupils' evaluation regards the extent to which the physical learning environment represents 'inclusive design', as discussed in the section 'Engaging the heart'. Pupils found that the school is not very accessible in an inclusive way. Some pupils experienced that themselves, when they had temporary handicaps, for example a broken leg. While some pupils concluded that the accessibility of the school environment should be enhanced, others thought this was not necessary, because they are very willing to help peer students when they are in need. Taking that perspective, one could argue that an *inaccessible* environment is in fact an *incentive* to foster social behaviour, if the school ethos is such as the aforementioned pupils sketched.

Mobility: active design ⑤

The routing to and in schools is principally related to the extent to which the physical environment fosters physical activity. Despite the health disadvantages of limited physical activity and abundant sitting, physical activity levels in children are typically low and sitting times high. By means of 'active design', the physical environment can serve as a catalyst for physical activity, since building layout and furniture may influence children's physical activity and therewith stimulate more active lifestyles (Ucci, et al., 2015; Aminian, et al., 2015).

With regard to the furniture in the case studied, no measures have been found which stimulate physically active behaviour (such as standing-height desks) and no alternative pedagogical approaches were observed which foster physical activity. It could also be argued that this is not facilitated by the classroom environments, which are relatively small and already quite full with pupils and their desks. It was observed that in one class dances were performed by pupils and there was not much space for this to take place. One could even see this as a disincentive towards physical activity in the classroom environment.



Mobiliteit

Mobiliteit is om twee redenen relevant. Ten eerste hebben talloze onderzoeken laten zien dat beweging belangrijk is, niet alleen voor de gezondheid van mensen, ook vanwege de grote invloed op leerprestaties. Bovendien kunnen duurzame vormen van mobiliteit onduurzame vormen (die fossiele brandstoffen gebruiken en schadelijke gassen uitstoten) verdringen.



help de handen



De meeste leerlingen komen met de fiets naar school. Dit wordt bevorderd door de fysieke leeromgeving, door fraai vormgegeven fietsenstallingen - die de ronde vorm van het gebouw volgen -, die bovendien dicht bij de ingangen zijn gepositioneerd. De autoparkeerplaatsen zijn juist weggestopt aan de achterkant van de school.



In het centrale deel van de school is veel ruimte om flink te bewegen.



Vlak voor de school is een bushalte aanwezig. Een goed bereikbare OV-aansluiting wordt vaak als een duurzame oplossing gezien. In het geval van basisscholen valt dit te betwijfelen. Er zijn namelijk maar weinig leerlingen die zo ver van de school wonen dat ze niet lopend of fietsend kunnen komen.





help de handen

HEREN!!!

WILT U IN DE
POT PLASSEN
A.U.B.???



Graag schoenen uit in de
speelzaal.

'Nudging' biedt een alternatief voor dergelijke 'saaie' aansporingen. Bijvoorbeeld het plaatsen van een opvallend schoenenrek draagt de impliciete boodschap uit dat het niet is toegestaan om schoenen te dragen in de speelzaal, zoals bij bijvoorbeeld tempels vaak het geval is.





Luchtkwaliteit en hygiëne

Kennis en inzicht in wat er nodig is voor deze thema's ('informeer het hoofd') is in veel gevallen een voorwaarde voor 'goed' gedrag. De fysieke omgeving moet daarvoor de faciliteiten bieden (bijvoorbeeld een schoenenrek bij de speelzaal, zeep bij de toiletten en regelbaarheid van het klimaat) en kan het gebruik daarvan bevorderen.

Contrarily, in the heart of the school a theatre is arranged, where the entire school can meet. Each month, during the month closing, all the classes gather here and two to three classes perform (see the photograph on page 12). There is sufficient space for this to occur and the large, open space fosters the use of the entire space available.

The case studied regards a (dominantly) one-storey building. Therefore, the positioning of stairs to foster physical activity (as opposed to using escalators) is not relevant. A more interesting facet, which is related to the school site, regards the mode of transportation pupils use. A school's location has been found to influence the choice of transportation (McDonald, 2008). The school studied is positioned in the heart of a neighbourhood and as a result, most children come to school by bike, while some others walk. There were even some parents seen who came to the school jogging.

The norm of bicycles as a mode of transportation is stressed by the integration of bike racks in the architectural design of the school site, as opposed to the tucked away parking lot for cars. The bike racks follow the circular shape of the building and are divided along the diverse entrances, due to which all pupils can easily enter their classroom after parking their bikes.

The parking lot is not as easily accessible as the bicycle racks, which could be considered a disincentive for the use of cars. On the other hand, it results in the phenomenon that the children who do get to the school by car are dropped off alongside the road (a bus stop provides space for this to occur), due to which the parents of these children do not enter the school and social interaction does not take place.

Air quality ⑥

Neither inside nor outside incentives or disincentives are present to enhance the air quality. As discussed in the focus area 'Exemplifying to the head', no understanding is fostered with regard to this issue and to a large extent, the regulation of the air quality in the school is automated. Therefore, human behaviour is eliminated. Only on the mezzanine floors above the classrooms, facilities are provided to users to regulate the indoor environmental climate (as discussed in section 'Engaging the heart' under the design feature 'Personalisation ④'). The often poor air quality is related to the 'hygiene' of and health in the school, as elaborated on in the following section.

Hygiene ⑦

With regard to hygiene in their school, the pupils are not very satisfied. They do not consider the school in general to be very clean and recognise that this is to a large extent due to their own behaviour.

For example, many pupils do not take off their shoes before entering the gym. A sign is present on the door, saying 'please take off your shoes', but this is ignored by most pupils. Facilities and incentives in the physical environment to foster the desired behaviour are lacking, as well as disincentives to prevent the undesired behaviour. For example, no shoe rack is present to stimulate pupils to take off their shoes. A designated space, which could even be personalised (as with the chairs and coat racks, see section 5.1.1, 'Personalisation ④') could stimulate this.

Pupils also mentioned they often lack to wash their hands after using the bathrooms. Yet, facilities for this are provided and easily accessible.


The poor hygiene of the air, as discussed under 'Air quality ⑥', is not due to the behaviour of pupils and teachers. No facilities are provided to them to adjust it, rather than opening the windows, which they regularly do if the outdoor weather allows it.

Water ⑧

Water is used for a wide variety of purposes. During the evaluation, pupils mainly focussed on the bathrooms, where they assessed the toilets and the water taps. During the evaluation, several pupils found out that the toilets have buttons to save water for flushing. These facilities were never observed by them before, although many others do use them on a regular basis. It is expected that an enhanced understanding (see section 5.1.2) could serve as an incentive to foster the use of water-saving facilities, as most pupils sounded motivated to limit their negative impact.

Energy ⑨

As water, energy is used for a wide variety of purposes. Among other things, pupils assessed the use of energy for lighting and computers. They counted that no less than thirty computers were turned on without being used. Besides a lack of insight provided regarding this situation and its effects (see section 'Exemplifying to the head'), pupils are not fostered to adjust their behaviour. With regard to the lighting, most pupils and teachers turn off the lights when leaving the room. As a result, the lights are mostly off when the classes are empty. Yet, in the room for staff, the lights are on surprisingly often. This can be explained through the position of the light switch in the room: it is positioned on the other side of the room than the door through which people enter and leave. Hence, turning off the lights is repressed through the design of the physical environment. This stresses the importance of (dis)incentives for behaviour in the physical environment. In all other rooms, such incentives are present.



Gebruiken we de stopknoppen (C1) van de wc's? Wie wel, wie niet en waarom wel of niet?

Water en energie

Water en energie gebruiken we voor ontzettend veel dingen. Thuis is degene die de meterstanden doorgeeft zich soms nog bewust van de gebruikte hoeveelheden en past daar wellicht zijn of haar gedrag op aan. Hoe biedt de omgeving ons faciliteiten om bewust om te gaan met water en energie? Worden we bevorderd om die faciliteiten te gebruiken?

help de handen



In de meeste lokalen zijn de lichten uit wanneer er niemand in de klas aanwezig is. In de personeelskamer staat het licht verrassend vaak aan. Dit is te verklaren door de positie van de lichtknop: die zit aan de andere kant van de kamer dan de deur. De fysieke omgeving biedt dus een 'ongemak' (C3), waardoor het licht niet wordt uitgedaan bij het verlaten van de kamer.



Conclusies van de voorbeeldevaluatie

A1

bevorder
verbondenheid
met de natuur

A2

bevorder
verbondenheid
tussen mensen

A3

bevorder
verbondenheid
met de plek

B1

geef inzicht in
deelsystemen

B2

geef inzicht in
verbanden

B3

geef
feedback

C1

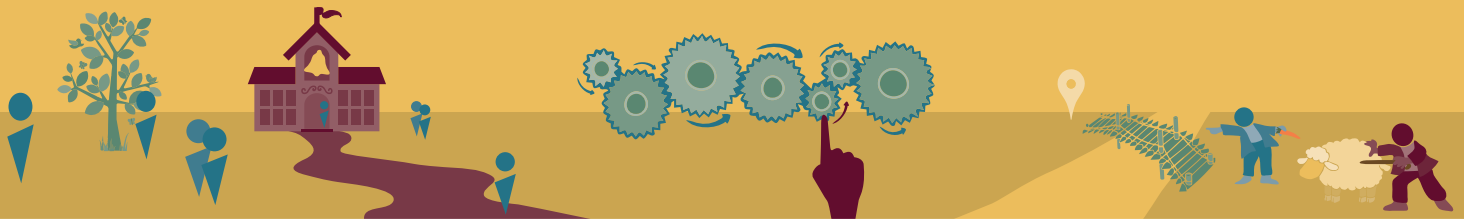
bied
faciliteiten
(tolereer gedrag)

C2

bied
stimulansen
(bevorder gedrag)

C3

bied
ongemakken
(ontmoedig gedrag)



Betrek het hart

Op het gebied van het 'hart' zijn in de Sokkerwei behoorlijk veel kenmerken onderscheiden. Het gebouw brengt mensen nader tot elkaar en tot de natuur, onder andere door de toepassing van diverse natuurlijke materialen en elementen, het nadrukkelijk tentoonstellen van de seizoenen en een gebouwworm die sociale interactie bevordert. Er zijn weinig gebouwaspecten die typerend zijn voor deze specifieke plek, maar er is wel veel ruimte voor leerlingen en docenten om er hun eigen plek van te maken. Diverse elementen, zoals kaptokken en stoelen, zijn gepersonaliseerd en er is veel gelegenheid voor het tentoonstellen van creatieve expressie.

Informeert het hoofd

Op het gebied van het 'hoofd' zijn in de Sokkerwei vrij weinig kenmerken onderscheiden. Enkele deelsystemen zijn gedemonstreerd, zoals het ventilatiesysteem, de zonnepanelen en regenwaterafvoer. De verbanden met het grotere geheel blijven vaak onduidelijk: zo is het bijvoorbeeld niet duidelijk waar het regenwater naartoe gaat, nadat het is opgevangen, en er wordt geen inzicht gegeven in waarvoor de opgewekte energie wordt gebruikt. Van feedback is nergens sprake. Men is bijvoorbeeld niet op de hoogte van de hoeveelheid elektriciteit die door de zonnepanelen wordt opgewekt of de hoeveelheid afval die wordt geproduceerd.

Help de handen

Op het gebied van de 'handen' zijn in de Sokkerwei behoorlijk veel kenmerken onderscheiden. Op diverse gebieden zijn faciliteiten blootgelegd. Opvallend is dat veel van de stimulansen en ongemakken te maken hebben met de *locatie* en het *ontwerp* van faciliteiten; een goed toegankelijke en opvallende locatie werkt vaak als een stimulans voor het gebruik ervan, terwijl een weggestopte, onopvallende of onaantrekkelijk plek het gebruik belemmert. Daarnaast is de *sociale norm* een belangrijke factor gebleken. Deze norm bepaalt of specifieke ontwerpen als stimulansen of juist als belemmering voor sociaal-ecologisch gedrag fungeren (zie pagina 76).

De voorbeeldevaluatie
betreft de basisschool
'de Sokkerwei' in
Castricum.
ZIE PAGINA 19

Lagenanalyse

De fysieke leeromgeving is onderzocht aan de hand van zes lagen van de fysieke omgeving:

- terrein
- draagstructuur
- gevels en daken
- installaties
- plattgrond
- inrichting

De analyse (zie Tabellen 3, 4 en 5 op pagina's 50, 65 en 73) laat zien hoe deze lagen momenteel een rol spelen. Daarmee scheidt de analyse tevens een kader voor toekomstige productontwikkelingen en -toepassingen in scholen.

5.2. Conclusions of the evaluation

The evaluation matrices (Table 3, Table 4 and Table 5) allow to draw conclusions on both the nine design characteristics, as well as the six layers of built structures.

The design characteristics educating for sustainable happiness

The results of the evaluation of the case study show a clear dispersion of building elements and features with regard to the categories of design characteristics. Concerning the focus area 'Engaging the heart', many design features and elements have been identified, which regard all three characteristics distinguished within this focus area. The physical environment brings people closer to each other and to nature, although nature connectedness could be enhanced through the fostering of experimental *interaction* with nature. Site specific features, which express the genius loci of the particular place, are limited, but connectedness with place is realised through various design measures which make the habitat an engaging environment.

The second focus area ('Exemplify to the head') is strongly under-represented in comparison to the other two focus areas. Several subsystems are demonstrated, but their relationship with the larger system is not clarified and feedback towards the users is not provided. Therewith, the function of the physical environment as a 'three-dimensional textbook' is limited.

Several facilities have been identified which enable socio-ecological behaviour, although the lack of other facilities makes certain behaviours impossible. This is discussed further in section 6 under 'The post-occupancy evaluation'. The (dis)incentives distinguished primarily regard the *location* of facilities and their *design*, which have both been found to contribute to the actual use of the facilities provided. Moreover, it has been found that motivation, understanding and the social climate in the school may serve as (dis)incentives.

The layers of built structures

With regard to the first focus area, all six layers of built structures are of significance, although the contribution of 'services' towards socio-ecological motivation in this school is limited. Contrarily, the design features and elements fostering socio-ecological understanding are strongly clustered around the services. These have some influence in the third focus area, although most facilities and (dis)incentives for socio-ecological behaviour regard the space plan and the stuff inside the building. The evaluation shows how the diverse layers of built structures currently play a role in the educating character of the physical environment of the school studied. Besides, it shows where performances are lacking. The evaluation therewith also provides a basis for product development and applications in transformations (this regards step 3; see Table 2).

6. Discussion and conclusions

By means of the framework and roadmap developed, this research makes a contribution to the evaluation of physical learning environments as a basis for transformations towards suitable and sustainable school habitats. A categorisation of performances of the physical learning environment is developed which is useful both for professionals in the field, as well as for unexperienced school staff and other stakeholders. This facilitates and fosters whole-school approaches towards transformative sustainability learning in the years to come and provides a framework for future product developments. Further deductive research is still required to verify the hypothesised relationships (see section 2).

The post-occupancy evaluation

In their book 'Post-Occupancy Evaluation', Preiser, et al. (1988) argue that POEs should consider both the positive and negative aspects of building performance. The framework and roadmap developed in this study currently have a strong focus on the 'DOs' in comparison to the 'DONTs'. Further research could advance this. Deductive research to test the relationships hypothesised in the framework is likely to have a quantitative character. Quantifying the relationships between physical space and human motivation, understanding and behaviour, could comprise a measurement system including both negative and positive outcomes. This way, the value of the POE with regard to transformation plans could increase, because the evaluation will not only show what to maintain, but also what to definitely address.

Applicability of Brand's decomposition method

The choice for the decomposition method of Brand is explained in section 4.2 and is based on the broad scope of this method compared to others. During the evaluation presented in section 5, the layers 'site' and 'stuff' have indeed been found to be very useful in this context. Yet, this method also has its limitations, which have highly influenced the analysis results. For example, it was hard to position 'door steps', 'window sills' and 'interior windows' in this decomposition. Also, the evaluation of the 'Building condition ⑥' (section 5.1.1) using these layers was unsuccessful.

Therefore, other decomposition methods may be more suitable. For example, the SfB elements method (as described by Vanderveen, Laat, Dominicus and Mohammadi (2015)) could provide a solution, as building elements such as 'openings' and 'finishings' are distinguished in this method. Moreover, the distinction between 'fixed facilities' and 'fittings and furniture' could be useful to gain insight into the magnitude of the building transformation required.

Discussie en conclusies

Het raamwerk

De voorbeeldevaluatie (zie pagina 84) laat zien dat het raamwerk een structuur biedt om gebouwde omgevingen te evalueren in het kader van onderwijs voor duurzaam geluk. Aan de hand van diverse gesprekken, bijeenkomsten en een workshop is getoetst of dit raamwerk ook voor vragende en aanbiedende partijen omtrent onderwijshuisvesting een begrijpelijke categorisering is. Dat criterium is leidend geweest bij de ontwikkeling van het raamwerk. De eerste reacties zijn positief.

Zoals reeds beschreven op pagina 19, zijn de ontwerpkenmerken gedestilleerd middels een kwalitatief, 'inductief' onderzoeksproces. Inductie is een techniek die geen logisch onontkoombare conclusie oplevert, maar een conclusie die aannemelijk is, die een zekere waarschijnlijkheid heeft. Dat betekent ook dat de relaties die in dit raamwerk zijn aangebracht (nog) niet als 'bewezen' moeten worden beschouwd, maar als een *hypothese* ten aanzien van de invloed van de fysieke leeromgeving op gebruikers. Vervolgonderzoek is dus nog nodig om de gelegde relaties te controleren en te kwantificeren.

De routekaart

Met de voorbeeldevaluatie is getoond hoe de eerste stap van de routekaart gestalte kan krijgen. De overige stappen zijn nog niet toegepast. Ook is in de praktijk nog niet gepeild of betrokken partijen hiermee uit de voeten kunnen. De Duurzaamheidsscan (zie pagina 43), Tabel 1 (pagina 45) en Tabel 2 (pagina 49) bevatten respectievelijk de evaluatie-, analyse- en ontwerpinstrumenten zoals die nu zijn voorgesteld.

De Duurzaamheidsscan is echter niet speciaal voor dit doeleinde ontwikkeld en daardoor niet op alle fronten dekkend voor dat wat onderzocht wordt. Daar staat tegenover dat hij bijzonder geschikt is voor gebruik in de praktijk; de scan is een heel begrijpelijk instrument voor leerlingen en docenten. Ten aanzien van de instrumenten zoals voorgesteld in Tabel 1 en Tabel 2 is precies het tegenovergestelde aan de hand; deze zijn inhoudelijk dekkend, maar nog niet erg bruikbaar voor mensen die niet tot nauwelijks bekend zijn met het onderwerp. Verdere ontwikkeling van die instrumenten is nodig om ze in te kunnen zetten in concrete (ver)bouwopdrachten.

De voorbeeldevaluatie

De voorbeeldevaluatie is gedaan aan de hand van de negen kenmerken van het raamwerk en zes lagen van de fysieke omgeving (zie pagina 85). Deze analyse biedt inzicht in de bouwlagen die momenteel een bijdrage leveren aan onderwijs voor duurzaam geluk.

Deze gebruikte zedeling van bouwkundige structuren is echter niet op alle fronten geschikt gebleken. Diverse aspecten van de gebouwde omgeving bleken moeilijk te categoriseren. Zo bleken 'drempels', 'vensterbanken' en 'binnenmuren' bijvoorbeeld moeilijk te plaatsen. Een alternatieve indeling van facetten van de fysieke omgeving zou dit probleem verhelpen.

Er is in de evaluatie voornamelijk gekeken naar die aspecten van de fysieke omgeving die een *positieve* invloed hebben op de drie 'ingrediënten voor duurzaam geluk' (zie pagina 24). Zeker in het kader van renovatie zou het interessant zijn om ook de aspecten met een *negatieve* invloed te onderzoeken, opdat die kunnen worden aangepakt. Het kwantificeren van relaties biedt de mogelijkheid dit te incorporeren.



Integraal op weg

over het belang van een 'whole-school approach'

De evaluatie van de fysieke leeromgeving van de Sokkerwei geeft inzicht in hoe deze omgeving niet alleen onderwijs faciliteert, maar er zelf ook een bijdrage aan levert. Zo is in de categorie 'betrek het hart' getoond hoe de fysieke omgeving beïnvloedt wat voor relatie mensen ontwikkelen met de natuur, met de plek, met zichzelf en met de medemens. We moeten echter op diverse gebieden ook concluderen dat de bijdrage van de fysieke leeromgeving beperkt blijft, wanneer leerlingen en docenten geen gebruik maken van de potentie die in het gebouw schuilt. Zo zijn de thema's onder 'help de handen' nauw verwant aan het sociale klimaat, waarvoor docenten als belangrijke rolmodellen dienen. Op pagina

76 is ingegaan op de belangrijke rol die het sociale klimaat speelt in onderwijs voor duurzaam geluk. Verder zijn op pagina 15 (1) de fysieke leeromgeving, (2) het onderwijzen en (3) het curriculum gepresenteerd als belangrijke drie-eenheid voor de transformatie van het onderwijs.

De ontwerpkenmerken in de categorie 'informeer het hoofd' zijn nauw verbonden met het curriculum dat een school aanbiedt. In de Sokkerwei hebben docenten daarover actief meegedacht ten tijde van de nieuwbouw. Inmiddels zijn echter veel van die docenten vertrokken, waardoor de link tussen het onderwijscurriculum en het curriculum dat het gebouw biedt, steeds zwakker is geworden.

Uiteraard is het 'curriculum van het gebouw' niet bedoeld om het bestaande curriculum op een school te vervangen, noch hoeft het volledig te zijn omtrent de onderwerpen die aan leerlingen worden aangeboden. Veeleer moet het worden gezien als een betekenisvolle invulling van en aanvulling op het bestaande onderwijs. Het is aan het team op de school om te bepalen hoe dit gestalte moet krijgen. Het is dan ook van groot belang om de diverse bouwstenen voor duurzaam onderwijs te laten samenkomen, opdat ze elkaar kunnen versterken. Een jaarlijks terugkerende activiteit, bijvoorbeeld het uitvoeren van de Duurzaamheidsscan (zie pagina 43), kan helpen om mensen daarover te informeren en hen erbij te betrekken.



Towards construction and occupancy

The roadmap presented in this paper regards the evaluation of occupied learning environments and the process of the transformation of these environments. However, the actual construction is not taken into account. Moreover, the subsequent occupancy stage requires attention. As mentioned in section '4.6 Continue the cycle' (page 49), demands constantly change and without interventions, the school habitat will not keep to meet them. Current practice shows that the flexibility and adaptability of physical environments are therefore of great importance. Flexibility and adaptability in the context of architecture as education for sustainable happiness still requires research with regard to both the construction and the occupancy stage.

A whole-school approach

The physical learning environment has an educational role on its own, but much of the possibilities present will only be seized if a 'whole-school approach' is taken. As discussed in section 1.2, this entails that curricula and pedagogies should develop simultaneously with physical environments. The findings of this study primarily stress the importance of pedagogies and pedagogues. Educators have the important task to serve as role-models for their pupils and to make use of the possibilities provided in their classes. The case study has shown that without the commitment of teachers, a large discrepancy will exist between the actual and the intended use of buildings. This is strongly related to the findings of Martin (2008) and Cutter-Mackenzie and Smith (2003), among others, who found that teacher literacy is the 'missing paradigm' in environmental education.

Moreover, with regard to several design elements and features evaluated in section 5, it is concluded that the school ethos has a crucial role in the functioning of the physical environment. As Gislason (2010), based on the school climate model adapted from Owens and Valesky (2007), concludes: physical design, school organisation, staff culture and student milieu are vital aspects of the learning environment and their combined role should be addressed. As discussed with regard to the case studied, the school ethos can determine whether certain design elements and features will serve as an incentive, or rather as a disincentive.

One way to foster whole-school approaches could include an, for example, annual evaluation of the physical environment and user behaviour, as mentioned in section 4.6. By carrying out a yearly evaluation with pupils and staff, the attention for certain issues is assured and new pupils and staff will, within limited time, be actively involved in these issues.

The framework for physical learning environments

As discussed extensively, the framework is built on the 'heart, head and hands'-model, which has been found to be a suitable organising principle in the context of transformative sustainability learning (Sipos, Battisti, & Grimm, 2008). Yet, several aspects have been found which could not be placed in this model. This primarily concerns the extent to which the environment fosters inventiveness, creativity and discovery. In his theory 'Human Scale Development', Max-Neef (1991) even distinguishes 'idleness' and 'creativity' as two of the nine universal, fundamental human needs. Idleness is understood as 'the state of mind and spirit that is inviting to the muses' and as such idleness and creation are seen as two inseparable aspects.

Traditionally, invention has been explained as an individual or psychological phenomenon involving an exceptional talent of intuition of the inventor (Miettinen, 1996). This 'Genius Theory of Invention' has however been criticised widely, as it has been found that in addition to the individual, the sociocultural surroundings must be taken into consideration. Accordingly, inventiveness is social or collective in nature. Moreover, many of the important things and knowledge in our daily lives are discovered by accident. The invention theory explaining such 'accidental discoveries in science' is named 'serendipity' (Roberts, 1989). These alternatives to the Genius Theory raise a question: what is the impact of events and processes in both the social and physical environment that cannot be anticipated? As mentioned above, Max-Neef documented that this regards the human 'spirit'. Similarly, one reference (Unknown, 2016) has been found which complements the heart, head and hands-model with the 'spirit'. This dimension could be added to the framework presented in this study, see Figure 6, but requires further research.

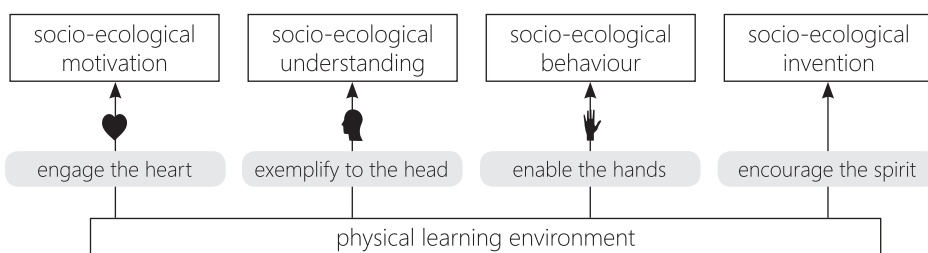


Figure 6 A possible complementation on the framework presented in Figure 3 could regard the 'spirit'.

**BOUWKUNDE ZONDER
BOUWTECHNIEK**

**IS ALS METSELEN
ZONDER STENEN**

mortel, lijm of kliksysteem



**EERST DENKEN,
DAN DOEN!**

Nawoord

‘Bouwkunde zonder bouwtechniek is als metselen zonder stenen’. Dit was één van de vele leuzen die we in Loesje-stijl door onze faculteit hebben verspreid toen het bestaan van de mastertrack Building Technology in het voorjaar van 2013 ter discussie was komen te staan. De kreet bracht de urgentie van onze boodschap over, maar later begon ik mij te realiseren dat we de plank daar nét hebben misgeslagen.

In die lente van 2013 was ik bezig met de afronding van mijn bachelor Bouwkunde aan de TU/e, dus de keuze voor een master moest binnenkort worden gemaakt. Door de fase waarin ik me bevond en de uitdaging waar we, als bestuur van de studievereniging voor Building Technology, ineens voor stonden, heb ik veel nagedacht over de rol en de taak van het onderwijs. Hoe meer ik mij erin verdiepte, hoe sterker ik wist dat deze opgeheven mastertrack voor mij de juiste keuze was. Ik was fortuinlijk te behoren tot de laatste generatie die er, in september dat jaar, nog aan mocht beginnen.

Bouwtechniek neemt een bijzondere plaats in binnen het complexe

veld dat de bouwsector beslaat; bouwtechnici zijn geen specialist in een specifiek domein, maar specialist in het samenbrengen van specialismen. Bouwkunde zonder bouwtechniek zou je dan ook eerder kunnen omschrijven als metselen zonder mortel, zonder lijm of zonder kliksysteem. Als analisten en verbinders ontleden en verenigen we. Die kern van Building Technology werd treffend geformuleerd door Frans van Herwijnen (2013), die de positionering en de inrichting van bouw- en uitvoeringstechniek onderzocht. Hij schreef onder andere dat de afstudeerders van Building Technology met hun diverse competenties zouden moeten zorgen voor een culturomslag in de bouwsector. Dat is nogal wat.

Steeds meer drong tot mij door dat deze rol niet alleen binnen de bouw, doch binnen de wereld als geheel van groot belang is. Het aantal specialisten en specialismen wereldwijd explodeert en de uitdagingen zijn enorm. Na een tijd van industrialisatie en een focus op het verhogen van de efficiëntie van processen, zijn we aangekomen in een tijdperk waarin ‘duurzame ontwikkeling’ centraal staat.

Louter efficiëntieslagen gaan ons daar niet brengen, want naast het ‘beter doen’ van dingen die we al doen, moeten we dingen anders gaan doen en vooral: moeten we andere dingen gaan doen (Wals & Rodela, 2014).

Dat is voor mij de kern van zowel de taak van bouwtechniek binnen de bouw, als de taak van het onderwijs binnen de wereld als geheel. Ik ging op zoek naar een manier om mijn afstudeeronderzoek voor Bouwtechniek te verenigen met mijn grote interesse voor het onderwijs, die in de afgelopen jaren alleen maar toenam door nauwe betrokkenheid bij de ontwikkeling van twee certificaatprogramma’s, die de leegte (moeten) opvullen die de opgeheven mastertrack heeft achtergelaten.

Na een lange zoektocht startte ik, als één van de laatste afstudeerders van Building Technology, aan het onderzoek waarvan je het resultaat nu voor je hebt. Ik heb getracht de lijm tussen disciplines te zijn, die naar mijn idee nodig is op het gebied van scholenbouw. Ik kijk zeer uit naar een toekomst waarin we, op basis van nieuwe inzichten, een culturomslag kunnen realiseren in de bouwsector en in de wereld als geheel.

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Mijn naam is Anna Vanderveen en ik ben één van de zeven miljard mensen die op onze aarde leven. Allemaal verlangen we een veilige, comfortabele en gezonde omgeving, zowel mentaal als fysiek, en we zijn niet alleen in dat verlangen. We delen de wereld met nog eens triljoenen andere levende wezens en we zijn verzameld in gemeenschappen en organisaties. Ik streef ernaar een bijdrage te leveren aan een succesvol samenzijn van al deze actoren teneinde gelukkig leven op onze planeet te laten voortduren.

Met deze rapportage heb ik mijn studie Bouwkunde aan de Technische Universiteit Eindhoven afgerond. Dit afstudeeronderzoek, dat ik in samenwerking met SME Advies en Eco-Schools Nederland heb uitgevoerd, heeft betrekking op de invloed van de fysieke leeromgeving op de ontwikkeling van attitudes, kennis en gedrag ten aanzien van jezelf, de ander en de wereld om je heen. Ik analyseer hoe schoolgebouwen het hart, het hoofd en de handen betrekken bij het leren. Het raamwerk en het stappenplan dat ik middels dit onderzoek heb ontwikkeld, bieden aan scholen, gemeentes en ontwerpers een hulpmiddel om bestaande schoolgebouwen te evalueren en ontwerpbeslissingen voor transformaties te analyseren, voor te stellen en te balanceren.

