

# The importance of the category of consciousness and education for sustainability in methodologies for eco-efficiency in school buildings

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**ABSTRACT:** This document reports the importance of the category of consciousness and education for sustainability in the school environment. Education in school has a potential to make the benefits of the building construction visible for society and media, showing to the students, parents and communities how sustainability in built environment could improve the people life in economic, social and environment aspects. Thus, this paper addresses the main events related to sustainability, such as the Stockholm Conference, the Brundtland report, United Nations Conference on Environment and Development (UNCED) and Agenda 21, until reaching the necessity of the elaboration of Methodologies for environmental assessment of building, and later, the development of the specific methodologies according to the buildings. It is also described some examples of sustainability in schools in Germany, Finland and Italy and what kind of sustainable systems those countries are currently using.

**Keywords:** SBTool, school buildings, sustainability assessment methodologies, sustainable consciousness, sustainable education.

## 1 INTRODUCTION

The last 12,000 years on the planet are related to the progress of human society. The man gradually abandoned the nomadic lifestyle, and began to organize in small civilizations, developing the cities. At the end of the 18th century until early 19th century, with the industrial revolution, the demographic population increased, so the concern about the inappropriate use of natural resources grew (Andrade, 2009).

The discussions on environmental issues began with the founding of the Club of Rome in 1968. After four years, a small group of professionals in the field of construction associated with scientists, made clear the intentions with the publication of the report "The limits to growth" (UNEP, 2000).

In 1983 was created the World Commission of Environment (WCE). This Commission developed and published the report known as the "Brundtland report" in 1987 (UNEP, 2000). This report consists of a guiding of principles for future strategies of human development and economic growth where it was first defined the concept of sustainable development, being the most famous of the still existing definitions: "Meet the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland 1987).

In 1992, in Rio de Janeiro (Brazil) a conference entitled "United Nations Conference on

Environment and Development (UNCED)" became a symbol of the responsibility of all countries of the world towards sustainability, calling urgent attention to the conservation of several forms of life on Earth and promoting actions to improve quality through cooperation of all countries involved in order to create a global environmental development policy (Von Weizsäcker, 1992).

This Conference was followed by the document named ' Agenda 21 ', in 1997, which is a guide for the creation of national development strategies and policies. It represents the United Nations plan of action for the sustainable development in the 21st century. (Pinto, 1999). In the same year, the United Nations Convention on Climate Change (UNFCCC2), elaborated the Kyoto Protocol with the intention of contributing to the reduction of the greenhouse effect (Hildemberg, 2010).

The environmental impact caused by construction has increased these past few decades. The construction industry is one of the main polluter activities, producing around 40% of world's total emission of Green House Gases (GHG) and 180 million tons of waste per year (OECD, 2003). It is also responsible for the use of 25-40% of the energy consumption and 50% of the raw materials extracted from earth in the members of OCDE countries (Organization for Economic Co-operation and Development) (Gervásio, 2010).

In response to these problems, a few initiatives led to the first methodologies for the assessment of sustainability for constructions that started to emerge. Over the years, several methodologies for environmental assessment of building were created, like SBTool, LEED, BREEM, CASBEE, HQE, NABERS, among others.

Once the rating system has profound impact on the results of the evaluation, the attention has been given to the evaluation studies and the strategies used to allocate the credits and the questions evaluated. These methodologies are adapted according to the region and the country concerned (Lee, 2013).

Over time, these methodologies have become more specific, trying to be adapted to the several types of constructions and functions. Nowadays there are specific methodologies for hospitals, service buildings, urban areas, schools, among others.

The development of a methodology for school buildings is necessary because the environments of schools are very particular. In addition, sustainability in a school building improves the performance, safety and health of teachers, students and staff. Increased attention to the construction, design, and operational practices of schools contribute to national sustainability goals for the environment (Healthy Schools, 2013).

Other benefits acquired with sustainable renovations for school buildings are: increase the life cycle of the building, energy and water efficiency, reduced the operating and maintenance costs, the pollution and landfill waste and also improved the health of students and staff, the indoor air quality and reduced absenteeism. (Ohio Energy Project 2000).

The category of consciousness and education for sustainability has a great importance within a methodology for assessing sustainability in a school building. The sustainable buildings principles and practices should be introduced to all students in every discipline at school ever since they will be our society's ability to adapt to the impacts of climate change and also will determine the future of Green Building (Advancing Education for Sustainability, 2010).

LEED and BREEAM had already created specific systems for schools, BREEAM Schools and LEED for schools. One of the benefices of the methodology BREEAM Schools is about the consciousness and education for sustainability, providing a learning resource through the demonstration of higher environmental standards to pupils, staff and the broader community (BREEAM Schools, 2004). The LEED for schools doesn't have any category similar to this.

## 2 EXAMPLES OF SUSTAINABILITY IN SCHOOLS IN EUROPE

The application of the sustainability system brings the building several benefits, such as increased performance and building quality, greater transparency in the planning phase and in the construction of the building, security sustainable planning, and reduces the risk of accidents. It is a powerful marketing tool, facilitating and increasing the amount of rent and the sale of the property. Other advantages of using this system in a building would be the reduction of life cycle costs, decrease in energy and water consume, user satisfaction (environmental comfort and quality of life) and improved public image (DGNB, 2011).

### 2.1 Sustainability in schools in Germany

Sustainable development is handled by the European Union (EU) as a long-term task, where its 28 members are encouraged to support and implement the requirements of environmental action plans. Since 1971, Germany has an Advisory Council on the Environment (SRU). In April 2001, it was created the Council for Sustainable Development (RNE), where 15 people from public life, appointed for three years by the Federal Government, addressed interconnected sustainability issues of, such as the politics, economy and society sustainable development (Spindler, 2012).

In April 2002, the RNE prepared a national sustainability strategy related to the actions of government and society, through the creation of ten rules that seek a balance between ecological, economic and social development, with the participation of all stakeholders in sustainable development. Other aspects also taken into consideration are: sustainable production, use of renewable natural resources in the context of their regular, avoiding hazards and risks to human health and the environmental system, the structural change of consumption reduction expenditure of energy and public resources and social cooperation (Spindler, 2012).

Systems of sustainability certification in buildings are becoming very important internationally and also in Germany. Several evaluation systems with different approaches have been used by the international market. Germany uses some sustainability certification systems such as BREEAM, LEED and DGNB (Himmler & Schwede, 2012).

The conference in Rio de Janeiro in 1992 has been the main impetus for the reorientation of environmental education or education for sustainable development (GNI) in Germany. GNI has overall approach to sustainability, through a combination of economic, environmental and social aspects. German Environmental Association has created a manual with the aim to provide practical ideas and teaching methods used in secondary school every day and also for informal environmental education initiatives aimed to children and teenagers (Klima 2005).

This manual is a contribution from the Saarland for Sustainable Development (2005-2014). The study has the following issues: energy, electrical power control, climate, energy savings, heat, temperature, energy savings plan, alternative energy in the city, solar energy, wind energy, air, climate and education facility for sustainable development (Klima, 2005).

This manual is not designed to be used as a "recipe ", it does not provide individual models or spreadsheets, but suggestions and examples that should be executed according to specific situations. When the teachers are responsible for the implementation of this plan, they become more creative in preparing activities and games that will be applied to students with the goal of making them more informed and conscious about sustainability issues (Klima, 2005).

According to this manual, the central points of learning for sustainability are individual differences to see the world, because the diversity and relativity of modes and settings are basic requirements for the success of sustainable action. It must find different and interesting ways to demonstrate the sustainability issue to students since the beginning, trying to engage them, leading the subject to student's reality (Klima, 2005).

## 2.2 Sustainability in schools in Finland

The use of sustainability assessment methodologies have been used to assist in the environmental performance of buildings and building stocks. Currently, some countries have used several methodologies that are designed to meet specific needs. In Finland, there are specific tools used for this purpose (iisbe.org/annex31, 2004).

The Commission on Sustainable Development in Finland in 2013 decided to develop a new strategy for sustainable development of social commitment for Finland, which should be made until 2050. This commitment is to increase the effectiveness of the sustainable development policy and productivity, and also comply objectives required by the sustainable development Conference (Rio + 20), the UN, the U.S. and to participate in the sustainable development of European cooperation networks (Ympäristöministeriö Suomi, 2014).

The Commission on Sustainable Development was created with the accompaniment of several experts, whose task is to prepare, challenge and evaluate the work of this Commission, and commitment to social progress through sustainable strategies of national politics and social practices enterprises, communities and organizations may also have a social commitment aimed at the goals of sustainable development.

All kindergartens, schools and educational institutions in Finland were invited to make their own report to the sustainable development policy commitment in January of 2014. Some organizations agreed to support these educational institutions through information that will guide and simplify this process. The goal is that 15 % of these schools receive a certificate of sustainable development activities.

The Sustainable Development Program provides a model of how these educational institutions shall prioritize the goals of sustainable development, the environment for learning, teaching and everyday life, as well as the responsibilities, timelines, resources and monitoring. A review of the activities and the program will be updated annually.

These models already exist to facilitate early planning of schools, seeking these certificates of sustainable development. The certificates can be applied in primary schools, secondary schools and vocational schools. These models should be used for one year and then must be reviewed and adapted to a new stage. The topics chosen should include energy conservation, sustainable consumption, waste prevention, environment, local culture and multiculturalism.

These models priorities are:

- Lectures and practical issues, such as reducing the environmental impact and sustainable development;
- Participation of children and young people in planning and implementing the project;
- Development and continuous adaptation of the chosen model to the new needs.

The differences between the models can be related to the level of demand, assessment and support given by them, and the evaluation criteria include design, types of implementation, monitoring and education project given by teachers, assessment and development. Some examples of these systems are: Keke System, International System Green Flag and Eco School

Keke System provides a model of self-evaluation according to the school; the International System Green Flag, whose school activities program is reviewed by an external audit twice a year through a report and may receive or not a certification; and Eco School, where those involved have the opportunity to interact with other parts of the world in schools. These evaluation systems sustainabilities have four main phases:

Self-Assessment – The school select five sustainable criteria for pre- evaluating. The teachers and students have separated system and subject to an assessment in accordance with topics of interest such as languages, arts and skills.

External Audit - An external audit shall be ordered after the school self-evaluation process. The auditor may be called to support the development of the school, as well as certification goals. Before performing the audit of the institution, the self-evaluation report should be checked. The auditor should investigate the school facilities and interviewing faculty, staff and student representatives of the school, making a summary report, which will be held by discussing feedback with representatives of the institution.

The purpose of the discussion is to provide feedback on the strengths of the evaluation criteria chosen by the schools in order to improve the goals achieved. The corrective action by the auditor has a diagnosed within 3 months to be rectified so that it can be provided a certificate.

Update annual self-assessment - The certificate requires the maintenance of the annual self-assessment of the educational institution.

Renewal of certification - If the school makes the annual self-assessments in accordance with the rules, facilitates the auditor renew the certificate.

Some subjects used in these models of sustainability of school systems are: energy efficiency, water, waste prevention and recycling economy, sustainable consumption, durable choices, and food provided by local markets, cultural heritage and multiculturalism, safety and recovery of the local community in all respects.

The Keke System is a tool that should be adapted and implemented according to the needs of the school in which it is applied. The school may proceed to implement the system at their own pace, seeking pathways to economic, social and cultural sustainability. Its purpose is to support the sustainable development program for school construction and operation of the development of annual goals chosen for the certificate (Ympäristöministeriö Suomi, 2014).

### **2.3 Sustainability in schools in Italy**

Italy uses some sustainability assessment systems for schools, such as LEED per le Scuole, the Protocollo ITACA Nazionale 2011, EDIFICI SCOLASTICI (iiSBE Italy), and the BREEAM system is just starting to get organized.

In 2010, Italy GBC (Green Building Council Italy) prepared an Italian version, 2009 Italy LEED NC (New Construction and Restorations) adapted to the reality and standards of Italy. The LEED for school construction applies in new construction and restructuring of school buildings is focused on indoor environmental quality of local learning, considering aspects such as air quality, thermal and acoustic comfort, location, construction and implementation by students' sustainable practices. Some examples of sustainable practices are building green roofs, teaching about building sustainability, control of water and energy consumption (LEED per le Scuole).

Italy has adapted the methodology of the Green Building Challenge to the Italian context, creating its own system of sustainability: The Protocollo of ITACA was drafted by the Istituto per la Trasparenza degli Appalti y Compatibilità Ambientale, and consists of a national system of accreditation of environmental sustainability. The ITACA meets constructions of different sectors, with residential ITACA, ITACA office, to ITACA Mall and ITACA for industrial buildings for school buildings (Protocollo ITACA, 2012).

Besides the traditional assessment methodologies sustainability mentioned above, Italy also uses the Eco Schools, which is an international certification program for schools, aims to promote environmental education and sustainability through environmental management of the

school building, seeking Green Flag certification system. The Eco Schools combine theory and action in order to reduce the environmental impact and spread the practices of sustainability among students, their families and the entire community as well as being an international tool for good environmental practices (FEE Italia, 2014).

According to Santoli et al. (2014), public buildings should serve as an example of energy efficiency for the whole community, especially school buildings, since these are better to promote ecological responsibility for future generations through a new lifestyle. There is a necessity to find a balance between cost savings and comfort of users through an efficient control system of humidity, temperature, air speed and purification. Currently, the Italian schools have spent a lot in energy consumption and have proven ineffective in indoor air quality.

In order to reduce the emission of harmful gases to health at local and global level, there is a necessity to change the behavior related to energy consumption. The reduction of energy consumption in public schools and any public construction should be carried out in order to decrease the cost and environmental impact. The Government needs to start a process of regeneration of urban energy and should use the school building as a tool for this process (Santoli et al., 2014).

### **3 CONSCIOUSNESS AND EDUCATION FOR SUSTAINABILITY**

This paper mentioned the certificate KEKE, used in Finland, and the international certificate Green Flags and its use in Germany and Finland. These certificates work to inform and evaluate the conscientization of students and school employees.

This new category is not intended to evaluate these issues as deeply as the certificates above mentioned, because this category is part of a certificate of sustainability that involves a lot of different aspects, thus it is impossible to be very deep in every subject, since a certificate is supposed to be more practical as it can be.

The main function of this category is to promote and assess the awareness related to sustainability in students, teachers and staff of a school. Even though there is a school built according to the standards of sustainability, if users of this construction do not understand how to use them properly sustainable way, is not achieved the expected results in terms of sustainability.

For buildings that are still being designed, it will need to produce a manual for users of the future building in order to indicate how to use the building prioritizing sustainability, like how to optimize water and energy consumption, recycle the trash, and others. As an example we can report the preference for the use of natural lighting and ventilation and the use of smart discharges whenever is possible.

The assistance of a manual of how to use a school in a sustainable manner is one of the solutions, but, to achieve a better result, it is necessary to understand why it is more sustainable, and how to solve the problems that can occur when unsustainable attitudes are taken.

In existing buildings, it could provide the specific materials needed for student and staff to learn about sustainability, and after the schools do the self-evaluation, the formal evaluators are called to assess the level of student and employee learning. A way of evaluation is the application of specific questionnaires for students, teachers and school staff, in order to determine the awareness of them about sustainability.

In case of application of the methodology in school buildings to be constructed and in existing buildings it will be required to use posters in schools to teach and encourage the implementation of sustainable practices. Few other materials can be used for the dissemination and awareness of sustainability, such as lectures, games, educational tours and material of literature on the subject, among others.

Themes will be provided related to sustainability, as how to optimize water and energy consumption, how to recycle the trash, among other indications. As an example, we can report the preference for the use of natural lighting and ventilation and the use of smart discharges whenever is possible.

After the school performs the self-evaluation, the formal evaluators will be called to assess the level of students' and employee's learning. The way of evaluating is the application of specific questionnaires for students, teachers and school's staff, in order to determine their awareness about sustainability.

#### 4 CONCLUSION

It is undeniable the importance and necessity of implementing the awareness of the impact of sustainability in the society, and this category allows the utilization of the school as a vehicle to disseminate the importance that the experience of sustainability has in people's lives using students as tools, since they can spread this idea in their families and in the society in which they live, therefore turning it as a part of their daily life in a natural way.

The importance of consciousness and education for sustainability in schools is fundamental, not only for students of a particular school, but also for the whole society. Sustainable schools provide a comfortable and healthy environment, helping to learning as well as save energy, money and resources.

The students will be the developers of futures communities, healthy regenerative environment and new economic opportunities so, they will determine the future of green building and our society's ability to adapt to the impacts of climate change. As occupants of every type of building, their behavior will define the environmental, social, and economic impacts of a building.

#### REFERENCES

Advancing Education for Sustainability: *Teaching the Concepts of Sustainable Building to All Students* July 2010 [internet] Available at <http://www.campusgreenbuilder.org/>

Andrade, J.B. 2009. *Avaliação da sustentabilidade do edifício solar XXI utilizando a metodologia SBTool<sup>PT</sup>*; Faculdade de Engenharia da Universidade do Porto, Portugal

BREEAM Schools 2004 [internet] available at: <http://ecoconsulting.net/www/breemschools.pdf> [accessed 8 January 2014].

Brundtland, 1987. *Our common future*. Oxford: Oxford University press, 1987.

DGNB Certification System Barcelona. 2011 [internet] Available at: <http://www.eic.cat> [access 29 april 2014]

Fee Italia, 2014. Eco-schools. [internet] Available at: <http://www.eco-schools.it/> [access 7 march 2014]

Gervásio, H. 2010. Sustainable Design and Integral Life-Cycle Analysis of Bridges. Philosophiæ Doctor in Civil Engineering, Departamento de Engenharia Civil Faculdade de Ciências e Tecnologia da Universidade de Coimbra.

Healthy Schools, 2013: *Environmental Factors, Children's Health and Performance, and Sustainable Building Practices*. [internet] Available at [http://epa.gov/ncer/rfa/2013/2013\\_star\\_healthy\\_schools.html](http://epa.gov/ncer/rfa/2013/2013_star_healthy_schools.html) [accessed 23 august 2014]

Hens I., Nath B. 2003. "the Johannesburg Conference." *Environment, development and sustainability*, 5( 1-2), 7-39.

Hilgenberg, F.B. 2010. *Sistemas de certificação ambiental para edifícios. Estudo de caso: AQUA 2010*. Universidade Federal do Paraná, Brasil.

Himmler, R. & Schwede, D. 2012. LEED Certification in Germany, Austria and China – Experience from planning and construction practice. *Xia-international*. [internet] Available at: <http://www.xia-international-online.com/> [accessed 12 march 2014]

iisBE.org/annex 31, 2004. *IEA Annex 31. Energy-related environmental impact of buildings*. [internet] Available at: [http://www.iisbe.org/annex31/pdf/m\\_directory\\_tools.pdf](http://www.iisbe.org/annex31/pdf/m_directory_tools.pdf) [accessed 23 may 2014]

Klima. 2005. *Vorsorge für unseren planeten*, Edition Spohns Haus, German. [internet] Available at: [http://www.saarland.de/dokumente/res\\_umwelt/bne\\_klima.pdf](http://www.saarland.de/dokumente/res_umwelt/bne_klima.pdf) [accessed 5 june 2014].

LEED per le Scuole. 2014. Italy. [internet] Available at: [http://www.gbitalia.org/uploads/4562\\_quart\\_scuole\\_low.pdf](http://www.gbitalia.org/uploads/4562_quart_scuole_low.pdf) [accessed 3 may 2014]

Lee, W.I. 2013. *A comprehensive review of metrics of building environmental overview of the sbtool assessment framework*.

Miana, A.C., 2010. *Adensamento e forma urbana: inserção de parâmetros ambientais no processo de projeto. Doutorado em arquitetura e urbanismo, tecnologia da arquitetura*. Faculdade de Arquitetura e Urbanismo da Universidade de São Paulo, São Paulo.

Ohio Energy Project. 2000. *Energy Smart Schools: Creating a Sustainable Learning Environment in Ohio, Ohio's Energy Smart Schools Program Booklet*.

Pinto T.P. 1999. *Metodologia para gestão diferenciada de resíduos sólidos da construção urbana*. São Paulo. 189p. These (PHD) – Escola politécnica, Universidade de São Paulo, São Paulo.

Protocollo Itaca Nazionale Edifici Scolastici. 2011. Versione settembre 2012 [internet]. Available at: [http://www.itaca.org/documenti/news/protocollo%20itaca%202011\\_s\\_250912.pdf](http://www.itaca.org/documenti/news/protocollo%20itaca%202011_s_250912.pdf) [accessed 27 february 2014].

Santoli,,E, Fraticelli, F. Fornari, F. & Calice, C. 2014. Energy performance assessment and a retrofit strategies in public school buildings in Rome. *Energy and Buildings* 68) 196–202

Spindler, E.A. 2012. *Geschichte der nachhaltigkeit vom werden und wirken eines beliebten begriffes*. [internet] , German. Available at: <http://www.nachhaltigkeit.info/media/1326279587phpejpyvc.pdf> [accessed 10 may 2014].

UNEP – United nations Environment Program, 2000. *The Vienna convention for the protection of the ozone layer & the Montreal protocol on substances that deplete the ozone layer*. Kenya: Unon. 54p [internet]. Available at: <<http://www.unep.org/ozone/pdf/montreal-protocol 2000.pdf>> [accessed 25 march 2014].

Ympäristöministeriö Suomi 2014. [internet] Denmark. Available at: <http://www.ym.fi> [accessed 17 march 2014]

Von Weizsäcker, E.U. 1992. *Erdpolitik. Ökologische realpolitik an der schwelle zum jahrhundert der umwelt*. Darmstadt: Darmstadt University Press.