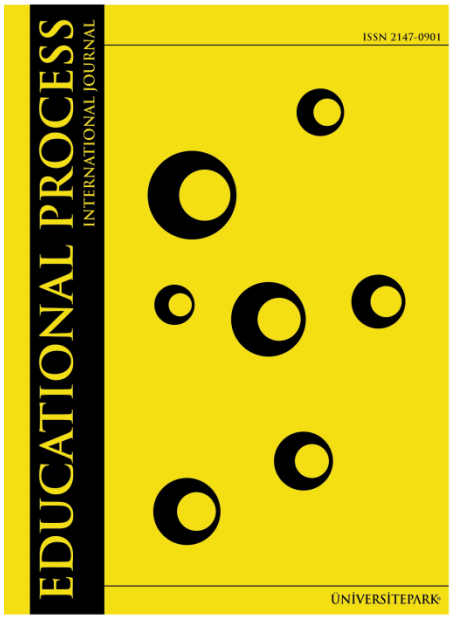

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Certification Systems of Green Schools: A Comparative Analysis

IBRAHIM KOCABAS and MEHTAP BADEMCIOGLU

Abstract

Sustainability is an approach that should not merely be limited to the design of buildings, but be a lifestyle adopted by posterity. Individuals ought to have the consciousness to protect and preserve the natural resources of future generations. After all, this is what will probably make studies on sustainability reach their targets. School buildings are critically important in achieving this goal in that they can enable future generations to be raised with an awareness of sustainability. This explains the reason why, in this study, the following leading green school certification systems and their criteria have been compared and examined: Leadership in Energy and Environmental Design; Collaborative for High Performance Schools; and, Building Research Establishment Environmental Assessment Method. Five schools with these certificates were taken as examples, evaluated and compared. This study, in which descriptive survey model was employed, made it clear that the standards set for green schools serve similar purposes no matter when a green school certification system originated or which countries have adopted it. However, the following variables play an important role in the success of the green school approach: attitudes of administrators; training pattern; location of the school; materials selection; and the responsibilities of educators and learners. School buildings in Turkey should further be discussed in detail with these points in mind.

Keywords: sustainability, green schools, green school certification systems.

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Introduction

Excessive consumption of natural resources due to global warming, environmental pollution and population growth has necessitated a worldwide re-evaluation of the concept of development from different perspectives. It has been suggested that the building industry, which consumes about one third of the world's energy, has a role of ensuring environmental responsibility (Patel & Chugan, 2013). Movements initiated by the European Union and US authorities on the use of resources in buildings have helped many countries to learn about environmentally friendly construction. For instance, the European Union has put into practice the Energy Performance of Buildings Directive in order to maximize energy savings and limit greenhouse gas emissions (ISO, 2010). It is underlined that the aim of this directive is the construction of new buildings that will consume nearly zero energy until 2020 (Cakmanus, Kas, Kunar, & Gulbeden, 2010).

Green buildings are defined as structures designed to remove the construction industry's negative effects of on the environment, as well as on the state of human health (Vyas, Ahmed, & Parashar, 2014). This makes it necessary for a building to be sensitive to the environment in view of its design, construction processes, repair and maintenance, as well as the way it uses natural resources. A green building is one that has the least impact on the environment as long as it exists (Patel & Chugan, 2013). It is noteworthy that World Green Building Council (WGBC), which is advancing green buildings firstly as a reaction to energy and natural resource wastage, specifies that this concept has changed over time and the Council now emphasizes effective energy use more than ever (World Green Building Council, 2013).

A school building becomes "green" when it saves energy, resources and money, and creates a healthy environment that can support learning. The provision of the teaching-learning process in healthy buildings reduces workforce loss and student failure (Arslan, 2010). Moreover, a green school building encourages waste management efforts and recycling, provides drinking water saving devices, as well as gathering and using rainwater for the benefit of the region and local residents. Furthermore, it helps students to develop environmental literacy and to enhance their environmental awareness (Design and Health, 2015).

There are more than 30 globally accepted green building standards and certifications that building industry stakeholders may refer to and take into consideration. The following are some of the most widely used: Green Building Challenge (GBC); Leadership in Energy and Environmental Design (LEED); Building Research Establishment Environmental Assessment Method (BREEAM); Building for Environmental and Economic Sustainability (BEES); Sustainable Building Tool-Canada (SBTool); Life Cycle Assessment (LCAid); Comprehensive Assessment System for Built Environment Efficiency (CASBEE); ECO-QUANTUM; ECOPROFILE; and, GREENSTAR.

This study is aimed at analyzing the similarities and differences between the green school certification systems of LEED, Collaborative for High Performance Schools (CHPS), and BREEAM. Data generated from this study is expected to contribute to the creation of healthier school buildings in Turkey and to raising individuals who are more sensitive to the environment.

The following research questions provide the framework for the current study:

- When and where were these certification systems developed?
- Who developed the systems?
- What are the purposes of the systems?
- Who are the stakeholders of the systems?

Methodology

The descriptive survey model was used in this study in order to compare three green school certification systems. This is an approach that aims to describe a past or currently existing case and enables the events and circumstances to be investigated in detail (Erkus, 2005).

Data have been obtained by way of a literature review. This process is initiated by gathering data and then by discussing its importance, establishing its relation with the problem, and finally, classifying the information stages. In this technique, it is aimed to collect data by examining the existing sources, documents and papers (Balci, 1997). The typical sampling method, developed by Patton, was employed in this study. The purpose of this method is not to select typical situations and generalize the universe, but to have an idea about a certain area by studying the average conditions or to provide information for those who do not have sufficient knowledge about an area, an issue, a practice or an innovation (Patton, 1987).

Data were analyzed by using the descriptive analysis approach. This approach allows the data to be organized according to themes that emerge from the research or interview questions (Yildirim & Simsek, 2003). By means of this approach, the data obtained from this current study were selected, and organized. The, similarities and differences between the certification systems were then analyzed, compared and interpreted.

Results

LEED

Leadership in Energy and Environmental Design (LEED) was established in 1994 by two non-profit organizations; the US Green Building Council (USGBC) and the Natural Resources Defense Council (NRDC). A regularly renewed voluntary enterprise, LEED was advanced in 2007 by the American Green Building Council and lent its name to green building evaluation systems in general (Cevre ve Sehircilik Bakanligi, 2013).

LEED's priority criteria are the physical environment, society, transportation, green energy, heat islands, light pollution, water usage, greenhouse gas emissions, materials, waste, indoor air quality, as well as quantity and user comfort. Data, such as construction records, engineering calculations, and energy model reports, are required by LEED for a project to be implemented, since drawings and diagrams of such are created by means of these data (Anbarci, Giran, & Demir, 2012; Cevre ve Sehircilik Bakanligi, 2013).

The rules stipulating how a LEED certificate can be obtained can be accessed from the LEED Reference Guide or USGBC's website. When the required documents are collected, they are submitted to the USGBC over the Internet. Then, a six-month non-field inspection

review process is started. Each credit, such as indoor air quality, corresponds to a set score, and a certificate is awarded according to the total score that the project receives (Cevre ve Sehircilik Bakanligi, 2013). Scoring is based on a 100-point system. Ranges and total points vary according to the type of building. There are four types of certificates; Certified, Silver, Gold, and Platinum (Anbarci et al., 2012). Table 1 shows LEED grades and point distribution.

Table 1. LEED Rating

LEED Rating	Score
Certified	40-49
Silver	50-59
Gold	60-79
Platinum	80 and over

Another feature of the LEED Certification System is regional credits. The distribution of points is based on strategies that increase energy efficiency and reduce CO_2 emissions. Each credit is evaluated with a list of thirteen environmental impact categories, including climate change, indoor quality, resource consumption, and water usage (Anbarci et al., 2012).

There are various organizations that determine school design standards, taking into account the level-of-acceptance criteria for environmental health. However, the LEED certification system is used for all types of buildings such as existing buildings, commercial interiors, schools, houses, new constructions and renovated buildings, so its scope is rather broad when compared to other systems such as Collaborative for High Performance Schools (CHPS), Energy Star (ES), and Georgia Energy Code Compliance (GECC) (Cevre ve Sehircilik Bakanligi, 2011). In order to understand whether or not a school is LEED compatible, the following six standard areas are considered; energy and atmosphere, building sustainability, indoor air quality, innovative design, materials and resources, and water savings (Chan, 2015).

One of the schools certified for LEED certification is the Woodrow Wilson High School (see Figure 1), a school situated in Dallas, USA, that started in 1935. A project was launched in 2008 in order to create a healthy educational environment, and approximately 7,000 square meters was renovated within a three year period. In 2010, it was approved as a historic building, and on account of its renovation efforts, the school was entitled to receive a gold certificate as of 2011.

Figure 1. Woodrow Wilson High School – Main Entrance
(Cox Graae Plus Spack Architects, n.d.)

A total of US$ 93.5 million was spent on the renewal process at Woodrow Wilson High School. The prominent elements in the project were adapting and reusing old equipment, making links between buildings more accessible, using technologies that enable the efficient use of energy, using larger windows and acoustic panels for natural lighting, as well as having a greenhouse, green roof and photovoltaic panels. Three different buildings of the school (the auditorium, gymnasium, and academic building) were designed to receive LEED certification from the U.S. Green Building Council (USGBC, 2009b). Table 2 shows the distribution of LEED scores obtained by the school.

Table 2. LEED Point Distribution of Woodrow Wilson High School (USGBC, 2009b)

LEED Evaluation Criteria	Score
Sustainable Sites	17/24
Water Efficiency	9/11
Energy and Atmosphere	3/33
Materials and Resources	7/13
Indoor Environmental Quality	9/19
Innovation & Design Process	6/6
Regional Priority Credits	2/4

According to Table 2, the school earned a full score for innovation and design. This score is followed by sustainable sites and water efficiency sections. However, it also received some low scores, especially in the energy and atmosphere section.

Knowing that the support of its students was an important factor in achieving the set target, the school's management included them in the renovation process. For this reason, 35 volunteer students were educated and assigned to convey information to other students on the green features of the school. A guidebook was also prepared and distributed to make them knowledgeable about the "green school approach" (Cox Graae Plus Spack Architects, n.d.).

Another school that qualified for LEED certification is the Thurgood Marshall Elementary School (see Figure 2) in Philadelphia, USA. Built in 1997, the school has four floors and a total area of 114,000 square meters. More than 100 teachers and staff are employed to serve a student body of 700. It was decided in 1989 that the building would be renewed in accordance with LEED Building Operations and Maintenance (O&M) rating system. This project was the first to be accomplished according to criteria set by the U.S. Green Building Council's rating system (USGBC, 2009a).

Figure 2. Thurgood Marshall Elementary School – Main Entrance
(Sheward Partnership, 2010)

The principal, assistant principals, civil engineers, and teachers became members of the project, with a two year scheduled duration. One of the most important sustainability goals for the project was the provision of a high-performance learning and working environment for students, teachers, and staff. Another important goal was to reduce energy costs. Developing energy-related systems in the building was stated as the third goal. According to the O&M rating system, Thurgood Marshall Elementary School qualified to receive LEED certification at the completion of the project. Of the schools that received this certificate, Thurgood Marshall Elementary was the first in Pennsylvania and fifth in the United States (Sheward Partnership, 2010).

It is among the strategies of LEED to be involved with management and maintenance operations. During the certification process, it also pays attention to how students adopt the green school approach. According to this strategy, one student in each class is assigned as a Green Monitor. Each Green Monitor ensures that other students are sensitive to energy saving and recycling (USGBC, 2009a). LEED point distributions of Thurgood Marshall Elementary School are listed in Table 3.

Table 3. LEED Point Distributions of Thurgood Marshall Elementary School

LEED Evaluation Criteria	Score
Sustainable Sites	8/26
Water Efficiency	8/14
Energy and Atmosphere	12/35
Materials and Resources	4/10
Indoor Environmental Quality	8/15
Innovation & Design Process	6/6
Regional Priority Credits	1/4

By looking at the LEED point distributions of Thurgood Marshall Elementary School, it can be seen that the school received a full score for innovation and design. This is followed by water efficiency and indoor environmental quality sections. However, the score for regional priority credits section is low.

Figure 3. North Shore Country Day School – Entrance Gate
(North Shore Country Day School, n.d.)

North Shore Country Day School, in the US state of Illinois, is another school awarded with a LEED certificate (see Figure 3). Donations were collected in 2008 to improve the educational environment of the school. As a result, US$ 30 million was raised to realize the project, and an area of about 65,000 square meters was renewed over a 15 month period. The school building then received silver LEED certification in 2011.

Table 4. LEED Point Distributions of North Shore Country Day School

LEED Evaluation Criteria	Score
Sustainable Sites	10/24
Water Efficiency	4/11
Energy and Atmosphere	11/33
Materials & Resources	8/13
Indoor Environmental Quality	11/19
Innovation & Design Process	4/6
Regional Priority Credits	2/4

As can be seen from Table 4, the school obtained high scores from the innovation and design process, materials and resources, and indoor environmental quality sections, whereas it received a low score for water efficiency.

The incentive that lead the school to apply for LEED certification was interesting and noteworthy. The administration decided to apply for LEED certification so that the school could demonstrate its commitment to the goals of sustainability, which were included in its strategic plan. In order to receive this certification, they achieved a structure that would support coexistence and new forms of education (North Shore Country Day School, n.d.). In other words, the design of North Shore Country Day School makes it possible to combine traditional and progressive education (The Third Teacher, 2011).

The building was designed to maximize the experience of students with an interactive education (The Third Teacher, 2011). Before this process, opinions of the users were sought, and they stated that they wanted to see more use of colors, daylight, and larger environments. The design was accomplished keeping these points firmly in mind, and multi-purpose environments, including a large staircase called V, were planned.

The design team did not ignore the effect of natural light on student achievement, and constructed the walls of the new classrooms from glass. It is now possible in this school to receive more daylight for longer periods of time. Movable chairs and tables were used instead of the classic fixed ones. In addition, interactive whiteboards, projection screens, and video conferencing tools were installed in order to increase the flexibility of the classrooms. Approximately 90% of the materials used during the construction were recycled. The wood used in the construction was certified as coming from sustainable forests. The roof of the building was covered with a type of recycled material durable for a period of 50 years (North Shore Country Day School-LEED Project, 2011).

CHPS

Collaborative for High Performance Schools (CHPS) was developed in California in 2001. The aim of this system is to ensure that school buildings to be renovated or renewed have higher performance than the original. Actually, this system, which was based on LEED, only aimed to assess the sustainability performance of school buildings in California. But later on, it also helped schools in the state to achieve grid neutral energy performance, which means that a school is able to produce its own electricity. Up to now, 46 schools have been awarded with CHPS certificate in the USA. CHPS criteria has now been adopted by 11 US states, including California, Washington, New York, and Massachusetts. Although it is a fairly new system of evaluation, the minimum requirements for CHPS have become compulsory for the school building industry across many regions such as Los Angeles, Burbank, Santa Ana, and San Diego (Arslan, 2010).

Unlike LEED, the CHPS system can only be used to evaluate school buildings. Instead of LEED's graded system (certified, silver, gold, platinum), CHPS has a Pass or Fail evaluation to determine whether or not a building is entitled to obtain a certificate. The most important difference between LEED and CHPS is that building owners have the opportunity to evaluate their own buildings in the latter system. Besides this, guiding publications by LEED are targeted at engineers and architects only, whereas those for CHPS are meant for everyone.

Figure 4. Thompson Elementary School – Main Entrance
(Northeast Energy Efficiency Partnerships, 2012)

Situated in Arlington, Massachusetts, the Thompson Elementary School (see Figure. 4) was entitled to receive the CHPS Verified Leader Certification in 2013. The process of redesigning the school building in accordance with the CHPS standards was completed in 2013 at a cost slightly more than US$ 20 million. Sustainable materials were used during this process, and the school was afterwards able to reduce its energy and water consumption. A CHPS Verified Leader Certification is given to a school that scores at least 50 points in the CHPS system, and, in return, this certificate provides a high level of recognition for that school and its projects. Thompson Elementary School is one of two schools that has received the CHPS Verified Leader Certification (Northeast Energy Efficiency Partnerships, 2012).

During the construction process, resources within 500 miles of the school were used as building materials. Since the vast majority of the wood material used was recycled, the school was certified by the Forest Stewardship Council. During the interior design process, acoustical considerations were taken into account, and an optimum learning environment was created. After the completion of the construction, necessary arrangements were made to ensure indoor air quality (North Shore Country Day School-LEED Project, 2011).

The old school building had single-glazed windows, and there were gaps in the outer walls. However, the new building now has double-glazed windows that also provide the highest level of natural lighting, natural scenery and outdoor connection. Besides, the walls were plastered with an environmentally friendly material. What is more, the energy management system installed in the building helps to reduce energy consumption for both heating and cooling (Northeast Energy Efficiency Partnerships, 2012).

BREEAM

The Building Research Establishment Environmental Assessment Method (BREEAM) is the first of its kind to determine the effects of the construction processes on the environment (BREEAM, 2011). It was developed in 1990 by the Building Research Establishment (BRE) as a tool to measure the sustainability of new non-residential buildings in the UK. The system has been continuously updated in line with the British building regulations. In 2008, it was thoroughly upgraded and thereafter named as BREEAM 2008 (Erten, Henderson, & Kobas, 2009). The purposes of BREEAM are reducing the lifecycle environmental impacts of buildings, providing a reliable environmental label for them, and revitalizing the demand for sustainable buildings (BREEAM, 2011). The architectural constructions within the scope of BREEAM are new buildings, apartments, schools, dormitories, nursing homes, hospitals, prison buildings, and industrial structures (Sev & Canbay, 2009).

BREEAM does not entail a priority list as does LEED. The requirements of BREEAM are listed as construction records, architectural drawings and diagrams, engineering calculations, energy model report, written explanations about the project, site visits, and the completion of BREEAM documentation. The BRE's regulations, publications, standards and certification schemes are controlled by the BRE Global Sustainability Board, and BREEAM assessment experts are trained by the BRE (Erten et al., 2009; ISO, 2010).

Any building that has applied for BREEAM evaluation requires the services of a certified evaluation expert. The expert brings together all the information about a project that will be used to assess whether or not the BREEAM criteria has been met. The BRE employees guided by the information provided by the expert perform two controls. However, there is an extra requirement for projects from outside the UK to pass a pre-qualification control in order to show that local laws governing the applicant's country are equivalent to BREEAM criteria (Erten et al., 2009; Floornature Architecture and Surfaces, 2012). In contrast to LEED, BREEAM uses the following weighted scoring system:

Table 5. BREEAM Rating

BREEAM Rating	% Score
Unclassified	< 30
Pass	≥ 30
Good	≥ 45
Very Good	≥ 55
Excellent	≥ 70
Outstanding	≥ 85

Located in Wolverhampton, United Kingdom, St. Luke's Elementary School (see Figure 5) was found eligible to receive the BREEAM certificate in 2012, and became the first BREEAM Excellent Primary School in the UK. Designed by Architype, the school has a capacity for 450 students, and the two-floor building is constructed totally of timber (Floornature Architecture and Surfaces, 2012). The choice of such warm materials as wood has reduced energy consumption for both heating and cooling. This has been coupled with the correct use of bright colors and natural light.

Figure 5. St. Luke's Elementary School – Main Entrance
(Floornature Architecture and Surfaces, 2012)

Great importance was attached to the internal design of the school. Instead of classical corridors, common areas were created in the school that encourage communication and interaction among students. Such areas as the library and cafeteria were also decorated to support communication among students (Floornature Architecture and Surfaces, 2012).

The wood used in the construction of the school was obtained from fir trees harvested from UK forests. Natural products were preferred for the painting of the school. Ventilation is controlled by a building management system. In addition, biomass is used in the school as a means of heating (Sev & Canbay, 2009). BREEAM has recognized the school as having an ecologically efficient building on account of features such as its geometric shape, carbon-neutral structure, triple-glazed windows, heating system, and insulation.

The evaluation methods employed by the certification systems of LEED, CHPS, and BREEAM are examined comparatively in Table 6. The comparison reveals that, no matter where and when these systems may have been developed, they share plenty of similarities and all pay attention to criteria regarding sustainability of building design, effectiveness of methods employed in building evaluation, and the provision of public awareness for sustainability.

Table 6. Comparison of the Green School Certification Systems

Evaluation System	Time of Origin	Country /State	System Developer	Aims	Stakeholders
LEED	1994	USA	U.S. Green Building Council (USGBC)	Serves as a tool for the design, construction and operation of green buildings*	Building project team, architect, designer, proprietor, contractor
CHPS	2001	USA California	California Energy Commission	Evaluates the performance of school buildings in terms of sustainability in California	Building owner, building operator
BREEAM	1990	UK	Building Research Establishment (BRE)	Sets the best practice for a sustainable building design, construction and operation, and sets comprehensive standards for a building's environmental performance	Building owner, building operator

** Decisions taken based on consensus.*

The five certified schools that have been examined in this current study are the Woodrow Wilson High School, Thurgood Marshall Elementary School, North Shore Country Day School, Thompson Elementary School, and St. Luke's Elementary School. The examination demonstrates that, however different it may at first seem, the way the concept of sustainability is implemented in each school is similar to a certain degree. For instance, it can be said that the certification process in each school necessitated the following criteria to be met: participation of many, if not all, administrators; revision of the education model; right decisions to be taken on the settlement of a new building; finding solutions to interior design problems; appropriate selection of materials; and the sharing of responsibilities between instructors and students. It may be asserted that schools in Turkey should be examined with all these considerations in mind, as detailed in the following section.

Conclusions

The common aspect of green building certification systems is that they set specific criteria for assessing the needs of a school building as well as those of other building types. There is a general similarity in the way that the certification systems deal with certain matters; nevertheless, the evaluation methods and criteria employed differ to a certain degree (Sahin & Dostoglu, 2017; Kartal & Kocabas, 2014). The similarities between these systems are that all of them emphasize the importance of constructing a robust building, providing adequate sunlight and good indoor air quality, selecting appropriate colors, ensuring an efficient energy design, and using the building as a good teaching tool. These are significant issues as far as the students are concerned, since they are the primary users of school buildings. Certification systems such as CHPS, LEED, and BREEAM, attach considerable importance to solar light standards due to the positive effects of this kind of light on eye health and vision, hormones, and lesson concentration. The qualities of a building which influence energy efficiency as well as indoor air quality are similarly dealt with by the various certification systems. However, while LEED and BREEAM present ratings for the prevention of noise transmission in the design of building shells and dividing walls, sound insulation is required in certain standards set by CHPS in order to provide an environment in which teachers can teach without having to raise their voice during lessons and students can easily communicate with each other.

As a result of this current study, the following conclusions have been reached regarding the mutual aims of and standards set by green school certification systems:

- The first and foremost aim is to protect and preserve the environment while constructing or using a green school;
- Natural light should be made use of as far as possible. This affects the physical and mental health of the building's users positively by increasing their performance and success;
- Non-destructive methods should be employed in order to increase indoor air quality. Good indoor air quality may prevent building users from being afflicted by asthma or allergy-related disorders;
- It is important to equip the building with top-quality water-saving devices;
- It is essential to minimize energy consumption and utilize renewable energy sources effectively;
- Noise coming from the outside should be prevented;
- Noise level in class should be within acceptable limits;
- Equipment to be used in the school building and in classes should be selected from material that will not harm student-teacher health or the environment;
- The green school building as a whole and its new atmosphere should discourage student/teacher absences;
- The green school is expected to enable future generations to be raised with an awareness of sustainability.

In brief, green schools are aimed at providing qualified environmental education for students so that a permanent solution to environmental problems could be found in the future. Another aim is to make them conscious about efficiently using such energy resources

in schools as water, electricity and natural gas. A third aim is to give education to students in a healthier environment. As far as some green school examples in Turkey are concerned, it can be asserted that the concept of sustainable architecture is not well understood. It is a general assumption in Turkey that a sustainable building has advanced technology, it consumes less energy and/or it is simply an intelligent structure. That is to say, the relationship of a building with the social, cultural, environmental and economic realities of the place of its construction are not particularly considered. Lack of appropriate architectural and planning policies for a sustainable development approach is one of the factors that causes the green school concept not to be understood sufficiently. Because Turkey is a developing country and dependent on non-domestic energy sources, it should focus on green schools that have healthier physical conditions and should raise awareness for the protection of the environment. It would be a good start if Turkish schools were provided with some technical and architectural knowledge that can be made use of in the renewal of existing school buildings. This could provide present and future generations with the opportunity to achieve environmental targets.

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Notes

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