From Green Libraries to Green Information Literacy

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Abstract. The amount of information available on green libraries and green library practices, seems to be growing, however, very little has been written about green information literacy. The aim of this paper is to discuss how information literacy and its instruction can be transformed into green and contribute to the green library movement. With this aim, relevant recent and past publications have been analyzed. A green information literacy concept is introduced and a multi-faceted approach towards green information literacy instruction is presented. Conclusions and recommendations are drawn for practice and further studies.

Keywords: Green libraries, green information literacy, environmentalism, sustainability, sustainability literacy, sustainable thinking, green information literacy instruction.

1 Introduction

Scientists agree that our planet is in jeopardy because of the threat of environmental challenges such as air and water pollution; destruction and depletion of the ozone layer, forests, soil, oil fields, energy and water, accumulation and distribution of toxic wastes, and emission of *greenhouse gases*, which altogether can change our lifestyle drastically. Environmental changes and challenges are mainly caused by human activities, however, they impact the survival of all living species, the integrity of the earth, the security of nations, and the heritage of future generations. Consequently, there is a need for urgent action to address these problems by changing people's and institutions' behaviors to reverse the trend and repair the damage. Environmental issues have become a major area of research and also concern in the twenty-first century [1-3].

Today, as awareness and interest have increased towards environmental problems, discussion of environmental sustainability has become widespread in many governments and organizations. Organizations, including libraries [4], are taking measures to reduce their damage on the environment. As a result of libraries' involvement with environmental issues, the *Green Library Movement*, whose main concern is reducing libraries' environmental impact, emerged in the early 1990s [2].

The amount of information available on green and environmentally sustainable libraries and library practices seems to be growing. However, very little has been written about how information literacy can contribute to this greening trend. The aim of this paper is firstly to examine how environmental issues can be incorporated into libraries, secondly to make an attempt to highlight how information literacy and information literacy instruction can be transformed into green, and lastly, to discuss how information literacy instruction can embrace environmental sustainability and contribute to the green library movement. With this aim, relevant recent and past publications have been analyzed. Based on an in-depth literature review, a definition for green information literacy is proposed and a multi-faceted approach towards environmentally sustainable information literacy instruction is presented. Conclusions and recommendations are drawn for practice and further study.

2   Terminology

Sustainability is not a synonym for environmentalism. Conserving natural resources for future generations is only one of the three components of the sustainable development concept. Although the other two components, namely social equity and economic growth, are equally important [5-6], in this paper the focus will be on the environmental dimension of sustainability, in other words *environmental sustainability.*

Although often used interchangeably, as Mulford and Himmel [7] indicate, there is a difference between *green* and *sustainable*. *Environmental sustainability* means using resources and interacting with the natural world in ways that will not reduce what is available to future generations [8]. On the other hand, *going green* means to "pursue knowledge and practices that can lead to more environmentally friendly and ecologically responsible decisions and lifestyles, which can help protect the environment" [9]. Sustainability is a broader concept, and being green is an element of being sustainable. Green practices such as reducing, recycling, reusing, minimizing pollution and waste can contribute to sustainability by mitigating the use of finite resources; however they do not address their replenishment [7]. In other words, "being green is taking environmental issues into account when making choices, being sustainable is to consume resources at a rate no faster than they can renew themselves, and generate waste at a rate no faster than can be assimilated by the environment" [7].

A *green information system* is a system "designed to minimize GHG [green-house gas] emission throughout its lifecycle from content creation to distribution, access, use, and disposal" [3, p. 635].

The term *green library* refers to a library that is environmentally conscious in many ways which include a wide range of actions such as,

- using nontoxic, and therefore, environmentally friendly cleaning products instead of toxic chemical cleaners,
- reducing energy use,
- collecting and promoting materials with environmental themes,

- adopting green practices such as recycling
- developing information services that can produce fewer carbon footprints throughout the lifecycle of the generation, publication, organization, distribution, access, use and disposal of information [2], [7], [10-12].

Environmental literacy has been defined as "the degree of our capacity to perceive and interpret the relative health of environmental systems and to take appropriate action to maintain, restore, or improve the health of those systems" [13, p. 5]. Environmentally literate individuals have a basic comprehension of the environment, and the concepts of sustainability. Today, it has been designated as a core competency [4].

Carbon footprint is "the total amount of greenhouse gases produced to directly and indirectly support human activities, usually expressed in equivalent tons of carbon dioxide (CO_2)" [14].

3   Green Libraries

Libraries practiced sustainability long before the concept of sustainability gained a wider acceptance, by maintaining knowledge and information from one generation to the next. The environment has benefited largely from libraries' lending practices which *reuse* the same materials extensively and reduce the number of trees harvested [15], [6].

The Green Library Movement, greening libraries and reducing their environmental impact emerged in the early 1990s and gained popularity in the beginning of this century [2]. The Talloires Declaration, the first official statement for a commitment to environmental sustainability in higher education - composed in 1990 and signed by over 40 countries - had an important impact on this movement. As an action plan for educating for environmentally responsible citizenship, fostering environmental literacy for all and incorporating sustainability and environmental literacy in the operations of universities [1], this Declaration forced academic libraries to start going green [5].

Greening of libraries is now pervasive, as evidenced by the many publications on the subject. Libraries of all sorts, today, are finding ways to incorporate green thinking into action [4] by working on reducing the waste -ecological/carbon footprints- resulting from library operations and adding more environmentally responsible practices in their daily operations and services [6].

Libraries today are taking a more proactive role in *green* practices [6] by helping communities they serve to become green and sustainable. They lead by setting an example of, and acting as role models for sustainability.

The green library is a multi-faceted concept with several components, such as green buildings, green operations and practices, green programs and services, green information systems and green collections.

3.1   Green Buildings

A green library building is, generally, the first thing that comes to minds when talking about green libraries. A green or sustainable building is "a structure that is designed, built, renovated, operated, or reused in an ecological and resource efficient manner" [16].

Green buildings not only help in using finite energy resources prudently, but also reduce the carbon footprints of these buildings. Buildings are known as one of the heaviest consumers of natural resources and produce a significant portion of greenhouse gas emissions. For instance, in the U.S., buildings consume about 70 percent of the electricity and produce about 40 percent of all CO_2 emissions [17].

Sustainable aspects of library buildings include features such as lighting, ventilation, heating and cooling, the interior fittings, installing solar or geothermal energy systems, use of water-harvesting systems, double-paned windows, low-flush and dual-flush, all for electricity and water efficiency. The use of sustainable materials and resources, utilizing building materials, furnishings, and fixtures with recycled content, use of refurbished materials and products, using products (building materials, furniture and consumables) made from natural materials, all help the preservation of natural resources and lessen depletion of resources that require a long time to renew themselves [7], [11].

3.2   Green Operations and Practices

Green operations and practices in libraries include but are not limited to the following [6-7], [2], [11], [15], [18-19]:

- reusing or donating the items instead of disposing of them,
- separating waste and providing onsite-recycling collection
- reducing or reusing paper
- eliminating use of plastics and instead providing and encouraging use of real plates/mugs/utensils
- using recycled, chlorine-free, FSC certified paper
- setting the copier/printer default to duplex
- minimizing printing
- routing print materials rather than making multiple copies
- using shared network and public e-mail folders as searchable repositories for information and content
- using electronically completed/submitted forms
- using electronic/digital communication
- using products/consumables with recyclable content
- procuring refurbished items when possible
- purchasing locally
- using environmentally friendly cleaning products instead of toxic chemical cleaners
- using stairs rather than elevators

- having every-other light off where possible
- re-filling toner cartridges rather than buying new
- installing energy-efficient lighting
- using motion sensors
- shutting down computers when the library is closed to the public
- using LCD monitors
- using natural lighting and ventilation
- choosing and using Energy Star compliant computer components
- consolidating servers in large institutions
- using virtualization so that multiple patrons can share a single machine's computing power
- managing equipment replacement cycles mindfully and having older computers repaired
- finding reputable recyclers of e-waste
- recycling toner cartridges and choosing "green" inks

3.3   Green Programs and Services

The green Library Movement pushed libraries to offer new services. In addition to the efforts of creating sustainable libraries, librarians have started to offer creative and unusual green programs to their communities for broadening awareness not only by providing resources and information on green living and environmental issues but also organizing educational outreach programs and workshops on adopting green practices such as recycling and food security to help others achieve greening of their own lives, facilities, and operations [15], [2], [7].

Libraries, especially public libraries, started to become known as the center for *green education* [7]. Librarians today, provide information about growing food and alternative medicines [2]. Some libraries have created community gardens to educate patrons about successful gardening practices, some even have maintained tool-lending (for gardening); some became archival depositories for genetic material like seeds and started to serve as depository for local seeds [2], [15].

Lending *watt meters* at a library is another good example for creative and unusual green services. The Pennsylvania State University Libraries provide watt meters to be checked out by users to measure at home or office how much electricity an electronic appliance consumes (in use and not in use). The main aim of this green service is to help individuals become aware of their consumption and reduce their electric footprint, as well as save money and become energy smart [20].

3.4   Green Information Systems

Information systems are important parts of libraries and library services. Information systems and services make extensive use of ICT (information and communication technologies) and increased use of ICT has a significant impact on energy consumption and greenhouse gas emission.

Current reports and publications have focused on the amount of energy consumed in ICT use and Internet searches. Figures might help to understand the environmental impact of information systems and services: It is estimated that a Google search causes between 1g-10g (gram) CO_2 emissions depending on the time involved and the equipment used as well as whether the equipment/computer is started or not [21]. Google estimates that several billions of searches (about 6 billion in 2013) are done per day [22]. Billions of searches are conducted daily to find information not only on the web, but also in library catalogs, databases, institutional repositories, and e-resources such as books and journals. As Chowdhury [24] indicates there is an information retrieval system behind every search that provides access to the information, and in return, consumes energy and generates CO_2 emission. In 2010 Google's total electricity consumption was 2.26 million MWh [23]. "It is estimated that the Internet consumes between 170 and 307 GW (Giga Watt) of electricity which is equivalent to 11-19 percent of the total energy usage of the humanity." [23, p. 614]. A typical computer running for a day (24 hours) creates 494 kg CO_2 [25]. Hosting a mere 10MB of data produces 2-1/2 kilos of CO_2 [8]. The energy consumed by servers and data centers is doubled over five year's time [15] and the infrastructure for these data centers requires electricity for power and cooling, and they "can be more than 40 times as energy intensive as conventional office buildings" [10].

Research shows that appropriate use of ICT can reduce the overall greenhouse gas emissions of these systems and services. Use of cloud computing (mainly based on reduced server energy consumption) and Green IT is one example [23]. Chowdhury [24] proposes four key enablers of green information retrieval: standardization in processes and practices, sharing resources, reusing content and tools, and green user behavior with regard to energy usage, business practices, and lifestyle.

3.5   Green Collections and Collection Development

Connell [15] presents three facets of green collection development: selection of materials whose content informs and assesses green practices, de-selection processes that emphasize reusing and recycling materials, and selection of a material format (print or electronic) which generates less CO_2 emission.

Selection. This is about building up green collections by selecting green resources on issues such as environment, green computing, organic gardening, energy conservation, etc., to add to the library's collection, including reference works, serials, books, DVDs, and websites [15]. It is all about facilitating access to green information.

De-selection. Collection development includes de-selection/weeding of outdated or worn library materials. Green de-selection is about recycling and reusing weeded materials. Instead of throwing them away, selling, giving-away or recycling weeded and unneeded printed resources became a standard green practice. While it is easy to recycle printed material, it is more difficult to recycle multi-media waste products such as CDs, DVDs, audiobooks -all come with plastic cases- [15].

Material Format. Sustainability of library collections is generally addressed with regard to environmental impact of print resources versus electronic resources.

There are numerous studies that compare the two formats by listing the benefits each type brings, along with cost, accessibility, archiving, and processing. From an environmental impact point of view, the carbon footprint of resource formats is the main focus.

"The problem of reducing a library's carbon footprints is perhaps the most complex and most contentious when it comes to the format of the collection" [15]. There are contradictory opinions about the environmental friendliness of printed resources vs electronic resources. Emphasis is generally on reducing paper use but there is little awareness of the impact of digital technologies [8]. In evaluating the environmental impacts of different formats, Connell [15] finds printed resources more earth friendly. Christinsen [8] claims that we need electricity to power eBook readers, so eBooks might in some cases kill more trees than print books. On the other hand, Chowdhury [26] indicates that the environmental costs of production and distribution of electronic resources are negligible compared to print resources, because the amount of $CO2$ generated by the production and distribution of print resources is much greater than electronic resources.

The environmental impact of the publishing industry is substantial. The impact of print publishing is mostly in the production of the paper itself [8]. For instance, in the U.S., paper manufacturing consumes over 15 percent of all the energy used by all types of manufacturing processes [27]. The impact is multifaceted. Cutting and processing trees, producing paper, publishing and transporting published materials, all require energy consumption. However the largest portion of the publishing industry's carbon footprint is in harvesting trees that would otherwise serve as $CO2$ storage [19]. Publishers today try to reduce the paper impact by participating in the Green Print Initiative by using recycled paper and harvesting fewer trees [15].

Electronic publishing, on the other hand, is more complicated. The impact comes from storage and distribution of data, energy consumption, e-waste disposal, and toxic clean-up. Today, we let digital copies multiply and there is an environmental cost of this uncontrolled proliferation. The environmental impact of printing, forwarding, and storing digital data should also be taken into account. "Going paperless isn't necessarily green." [8]

The carbon footprint of e-resources is generally determined by the electricity they use. It is not only the electricity used at users' sites (the use of ICT to access and use these sources) but also the electricity used by data centers and servers of commercial search engines, commercial databases and publishers due to the massive amount of data they store and the massive amount of search traffic they accommodate [15]. Based on an estimate, the world's ICT ecosystem "uses about 1,500 TWh of electricity annually, equal to all the electric generation of Japan and Germany combined.… The zettabyte era already uses about 50 percent more energy than global aviation." [28, p. 45].

The environmental impact of e-resources does not stop with electricity use. E-resources are also associated with increased paper use, as library patrons and staff print out articles for in-house use [29-30], [18], [15].

Other facets of computer use and disposal, such as recycling, reuse, and toxic e-waste (which contains lead, mercury, and cadmium) are also important in determining the environmental impacts of e-resources [15].

There has long been a debate about print versus electronic, however it still is not fully resolved in regard to their environmental impacts. The popular opinions that delivering information electronically is greener and paperless libraries are more environmentally friendly are not fully proven [31]. Print and electronic media both have positive and negative impacts on the environment [32]. There is no doubt that the amount of databases, electronic journals, eBooks, digital repositories, archives, and digitally-born collections will continue to grow. Both print and e-resources will each remain a significant portion of most libraries' collections. As Carli [32] notes, both can be sustainable, but both will need to become far more eco-efficient over the next years.

4   Green Information Literacy

Although there is a large body of literature on green libraries and the green library movement, exploration of the connection between information literacy, environmental sustainability and going green has been very limited.

Information literacy is, in fact, closely linked to environmental literacy and has a positive impact on the environment. First of all, with its meta-literacy characteristic, information literacy skills help to develop and improve environmental literacy skills. Information literacy simply facilitates accessing and selecting the most relevant, current and reliable information sources to make well informed decisions on environmental issues. Critical thinking, another important component of the information literacy skills set, helps not only to critically evaluate information available on environmental issues but also helps to perceive and understand the relative health of environmental systems. Secondly, although environmental sustainability is not the ultimate target, there is no doubt that advanced search skills – a part of information literacy skills- help to develop better search strategies, which, in turn, bring better results in a shorter time span, and leave fewer carbon footprints. Furthermore, advanced computer literacy skills, a prerequisite for information literacy, help in many ways to shorten the amount of time computers are used while searching as well as using and communicating information. Thus, carbon dioxide emission is reduced.

We can conclude that, even unintentionally, information literacy skills facilitate going green by pursuing knowledge and practices that can lead to more environmentally friendly actions. At this point, one can pose a question about whether or not information literacy is intentionally linked to environmental sustainability. This seems to be the key question which enables us to define green information literacy. Green information literacy is a set of conventional skills, as addressed in almost all information literacy definitions, which is expanded to include sustainable thinking. In other words, sustainable thinking--considering how our information behavior, information choices and information actions (search, use, and communicate

information) affect the environment--is the most important, indispensable and additional component of green information literacy.

In today's world, where our planet is under the threat of environmental problems, sustainable thinking is as important as critical thinking. Placing it among the core components of information literacy materializes transformation towards green information literacy. Once this is realized, individuals will be more aware of the impact of their information behaviors on ecological, economic, and social systems and this will lead to more ecologically responsible actions, which can help protect the environment.

The emergence of the green information literacy concept will certainly require a new approach to information literacy instruction. Information literacy instruction can be bonded with environmental sustainability and contribute to the green library movement in several ways. Greening information literacy instruction is two-fold. On one hand, instruction sessions can embrace green operations and practices. It is about using resources (materials and energy) prudently and reducing carbon footprints (the amount of greenhouse gases) produced during instructional activities. This can be realized in many ways, such as reduced distribution of printed flyers and training materials (printing on-demand), using both sides of paper, and using recycled paper. In addition to reduced paper use, the following practices would also help:

• using re-usable mugs/beverage containers rather than disposable during the breaks
• collecting and re-using training materials at the end of the sessions
• switching off lights when the instruction session ends
• switching off computers and monitors following instruction
• using natural lighting and ventilation when possible
• collecting recyclable waste which is produced during the sessions and making sure they are recycled.

On the other hand, information literacy instruction can be engaged with environmental sustainability by embedding sustainable thinking into it. It is about making users conscious about how to go green while searching, selecting, using and communicating information. According to Stark [4], information literacy instruction is a good opportunity for libraries to help users to shift their thinking towards sustainability. This can be carried out by demonstrating factual figures, and drawing their attention to the environmental impacts of their information behaviors and actions. For instance, presenting figures on CO_2 emission generated by a web search while teaching how to develop efficient search strategies might help in this direction. It will certainly help users develop sustainable thinking and sustainable attitudes in their information literacy actions if they know that the Internet's carbon footprints now exceed those of air travel [33], [28]. The environmental impact of paper vs electronic sources, the use of information and communication technologies, and information systems can be referred in information literacy instruction programs. This will, no doubt, increase the awareness and motivation of users to act responsibly in all activities where they use their information literacy skills. As Stark [4] suggests "thinking about sustainability should not be confused with thinking sustainably."

Teaching how to think sustainably while using information literacy skills (searching, accessing, using, and communicating information) should become an integral part of information literacy instruction. Link [34], also suggests using green topics and resources as the basis for information literacy instruction sessions. This will also help increasing awareness in an indirect way.

Understanding the impact of everyday information choices on the environment becomes more and more important and libraries, especially instruction librarians can play a key role here. As Miller [35] states, "libraries are challenged with the new role of connecting the public with environmental awareness and education." However, according to Stark [4] they "have not fully approached the role they could play in embedding sustainability into information literacy". It is their responsibility to foster sustainable thinking in information literacy instruction and fully engage environmental sustainability in their teaching mission. Embedding sustainable thinking can make information literacy instruction much more interesting and rich.

5   Conclusions and Recommendations

There are many opportunities for information literacy to contribute to environmental sustainability. Reducing the ecological footprint of our information behavior, choices and actions is possible by developing sustainable thinking skills as part of our information literacy skills repertoire. We need to recognize the need for more information on the concept of green information literacy, which is neglected, and requires attention, and how sustainable thinking can be embedded into information literacy instruction. Up until now, very little written has been on this issue and further research is needed to elaborate more on possible practices in this area.

It is expected that this study will be helpful to further develop the concept of green information literacy and will pave the way for further research. We would like to invite information literacy experts, instructors and researchers to think about it and discover new dimensions to its definition and practice.

Following are some recommendations for greening information literacy and information literacy instruction:

- promoting scholarly research
- developing expertise in environmental issues and green library practices
- embedding sustainable thinking into information literacy concepts and instruction
- adapting information literacy standards to embrace environmental viewpoints and sustainable thinking
- writing reports on how information literacy instruction can support environmental sustainability and sharing them with the decision makers
- embedding sustainability in information literacy policy documents as well as library policy and strategic planning
- collaborating for information literacy instruction with faculty in disciplinary areas which touch on studies of the environment and sustainability

- compiling factual information on the impact of information behaviors and actions on the environment and presenting and sharing this information widely with users
- exploring means of sharing ideas on going green in information literacy activities.

We can conclude that green information literacy and the greening of information literacy instructional initiatives can contribute, in different ways, to the creation of a greener environment, and should be seen as an important component of the Green Library Movement.

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