

***Sustainable Design Practices, Analysis and Assessment Tools for Students Using
Openstudio***

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The European Conference on Technology in the Classroom 2015
Official Conference Proceedings

Abstract

Integration of sustainability and its vision across multiple disciplines has become standard in many industries. The vision for sustainability embraces the goals of environmental, social, and economic vitality with the understanding that the needs of the present be met without compromising the ability of future generations to meet their own needs. Sustainability promotes interconnectivity of sources and communities, diversity, relationships between global environmental and economic trends, and holistic thinking which are key ingredients for success in many economic arenas. The author teaches a studio in the department of engineering technology surveying and digital media. The course requires the student to synthesize and apply subject matter studies in previous required courses and apply them to a realistic design problem solving effort. Typically students identify a design problem in their area of expertise and design a solution by working in a team. Sustainability is a key learning outcome of the course and students are required to develop a sustainable solution of the problem identified. The author identified a sustainability design, analysis and assessment tool named OpenStudio (<https://openstudio.nrel.gov/>). The tool is developed by National Renewable Energy Laboratory (NREL) and the US Department of Energy. OpenStudio is a cross-platform (Windows, Mac, and Linux) collection of software tools to support whole building energy modeling using EnergyPlus and advanced daylight analysis using Radiance. OpenStudio is an open source tool i.e. free to download and use. Students were exposed to OpenStudio's capabilities both for creating custom energy conservation measures and for generating useful summary and detailed output.

Keywords: Innovation, technology, research projects, OpenStudio, sustainability, interdisciplinary engagement

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Introduction

Integration of sustainability and its vision across multiple disciplines has become standard in many industries. The vision for sustainability embraces the goals of environmental, social, and economic vitality with the understanding that the needs of the present be met without compromising the ability of future generations to meet their own needs. Sustainability promotes interconnectivity of sources and communities, diversity, relationships between global environmental and economic trends, and holistic thinking which are key ingredients for success in many economic arenas. As educators, therefore, we need to integrate sustainability across curriculum and equip our students with sustainability skills and competencies.

The author teaches a junior and senior level required course in the department of engineering technology surveying and digital media. The course requires the student to synthesize and apply subject matter studies in previous required courses and apply them to a realistic design and engineering problem solving effort. Typically students identify a design problem in their area of expertise and design a solution by working in a team. Sustainability is a key learning outcome of the course and students are required to develop a sustainable solution of the problem identified. Even though students incorporate sustainable practices in their design processes they are unable to assess them. This is mainly due to limited availability of tools, subscription based tools and software that department can't afford, and lack of expertise among faculties. But without proper assessment and evaluation of sustainability in design and engineering solutions there is less value of such practices and limited learning and applications.

As a professional designer and educator, the author has extensive knowledge on design, development and project management, however, has limited expertise on sustainability assessment tools. These tools are relatively new and highly specialized. There are few commercial vendors who offer such tools and training but they are very expensive. The author identified a sustainability design, analysis and assessment tool named OpenStudio (<https://openstudio.nrel.gov/>). The tool is developed by National Renewable Energy Laboratory (NREL) and the US Department of Energy. OpenStudio is a cross-platform (Windows, Mac, and Linux) collection of software tools to support whole building energy modeling using EnergyPlus and advanced daylight analysis using Radiance. OpenStudio is an open source tool i.e. free to download and use. The author incorporated this tool for ENTC 4900 and INTD 3215 in the spring of 2015 for sustainable design practices, analysis, and assessment of student projects.

The OpenStudio Application integrates with NREL's Building Component Library (BCL), providing libraries of pre-defined configurable energy conservation measures for easily modifying energy models. PAT (Parametric Analysis Tool) will be used to demonstrate how model variants can be configured to run in cloud computing environments (Amazon EC2). Students were exposed to OpenStudio's capabilities for extension through Ruby Scripting, both for creating custom energy conservation

measures and for generating useful summary and detailed output with a basic exercise.

Open Studio Exercise

Students were required to use a small project from facilities design drawing. They were required to model the building envelope, customize the envelope, fenestration and add site shading, assign building activities and thermal zones and run a basic simulation in OpenStudio application. Students were instructed to adjust the internal load and construction values, use energy conservation measure to shift operating hours for the building and then run simulations in the parametric analysis tool.

Conclusion

The exercise brought three fold benefits:

- 1) The exercise helped the students and author to develop a module for sustainability design, analysis and assessment for INTD 3215 and ENTC 4900 (new skills for students that industries require).
- 2) The exercise helped the students and author to engage in sustainability related undergraduate and graduate research with regional and national organizations such as Tennessee Valley Authority, Tennessee Department of Environmental Conservation and Department of Energy (faculty development in teaching and research).
- 3) The students and author shared the experiences with Facilities Management and Department of Sustainability to incorporate sustainable design practices, analysis and assessment to improve life, quality, and health of ETSU community and built environment (contribution to ETSU community).

References

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