AC 2010-1191: THE ATTITUDE OF CONSTRUCTION-RELATED STUDENTS TOWARD SUSTAINABILITY IN SOUTH KOREA

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The Attitude of Construction-Related Students toward Sustainability in the Built Environment in South Korea

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ABSTRACT

Sustainability has become an important consideration in the construction industry, and it must support the triple bottom line of environmental, social and economic benefits. As construction students are becoming leaders and innovators in construction, it is necessary to motivate construction students to learn the concept of sustainability, and to learn the sustainable design and construction skills which can be implemented in their daily activities. This study investigates the level of the construction student's familiarity and interest toward sustainability, their attitude toward sustainability, and the factors influencing student's attitude toward sustainability in Republic of Korea. To accomplish the main objectives, this study employs a piloted survey instrument created and developed by the authors. This is a descriptive and correlation study using responses from architecture and architectural engineering students at four universities in the mid-eastern region of South Korea. Using descriptive statistics and multiple regressions using SPSS version 17, this study measured the level of familiarity with the concept of sustainability and the sustainable design and construction skills. It also identified the factors which affect students' attitude toward sustainability. With this study, it is possible to help educators motivate and teach students to improve their attitude toward sustainability in the built environment.

KEYWORDS

Sustainability, Sustainable Construction, Construction Education, Students' Attitude

INTRODUCTION

Construction is a industry that significantly influences our economy, natural environment, natural resources and health. The construction industry is one of the largest industries in the Republic of Korea, employing over 1.7 million people (7.8% of national employment) and generating over 15.9 % of Gross Domestic Product (GDP), $136 billion in revenue in 2008 [1]. At the same time, the construction industry contributes to major environmental issues and problems including global warming, climate change, ozone depletion, soil erosion, desertification, deforestation, acidification, loss of diversity, land pollution, water pollution, air pollution, and depletion of natural resource and fisheries [2, 3, 4 & 5]. With the recognition of the challenges and issues associated with construction activities, the construction industry has introduced and implemented the concept of "sustainability", green building, and sustainable development. The sustainability movement in the construction industry has the goal implement sustainable design and construction practices and strategies (Figure 1) in construction projects [2 & 6].

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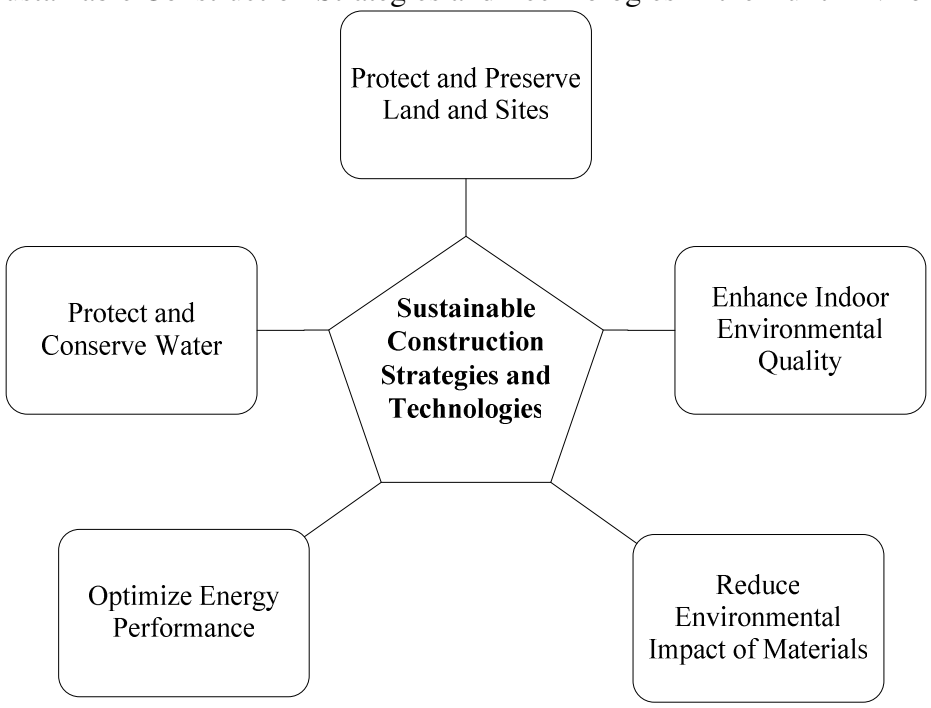
Figure 1. Sustainable Construction Strategies and Technologies in the Built Environment



These sustainable design and construction practices bring many benefits to our society. These benefits include [2, 3, 4, 5, 6, 7 & 8]:

- Decreasing annual energy consumption
- Reducing annual water use
- Increasing health, comfort and well-being of building occupants
- Increasing community and social benefits
- Lowering air, water and soil pollution
- Lowering ecosystem impact caused by construction activities.

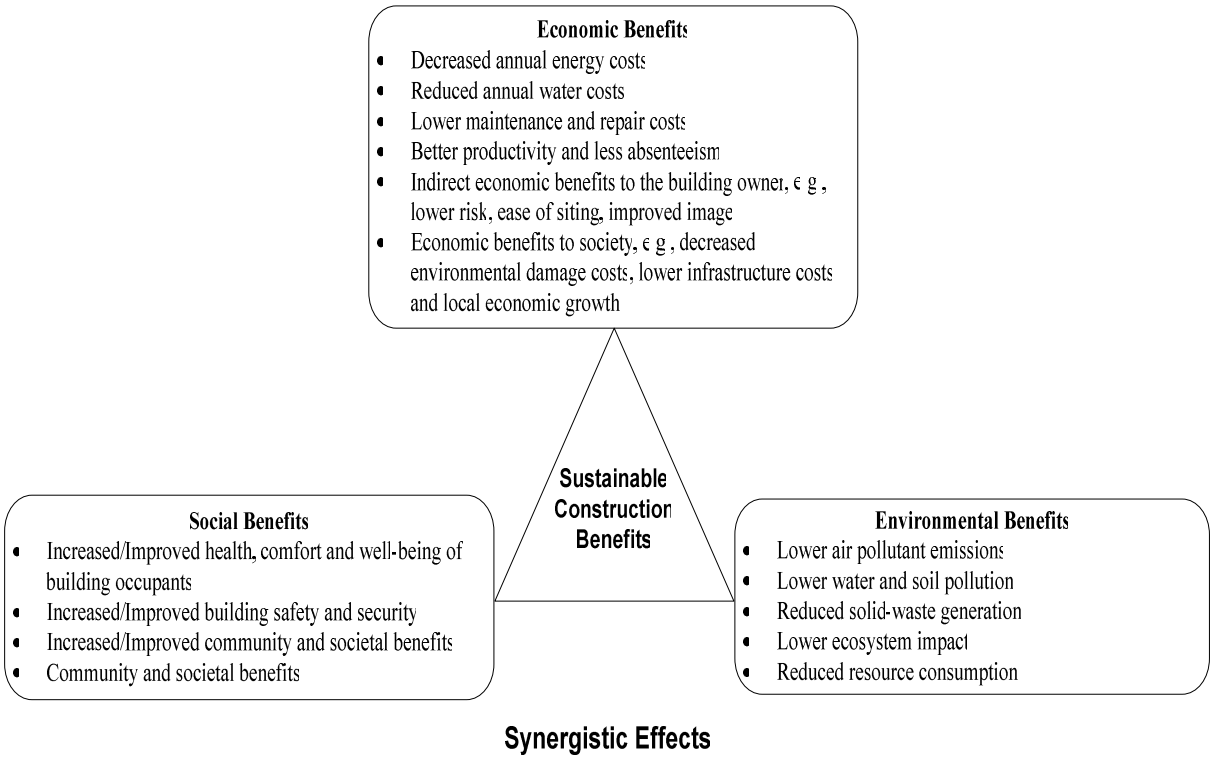
To achieve the above benefits, it is very important that every stake holder on a construction project including designers, engineers, project managers, superintendents, project engineers, and skilled and unskilled laborers have knowledge and skills of sustainable design strategies and technologies. Therefore, it is necessary to educate and change construction stakeholders' attitudes toward sustainability.

Higher education for construction and architecture students is an ideal mechanism for changing the paradigm and practices because the students become the leaders in the construction industry [4, 9, 10 & 11]. Thus, it is necessary to emphasize sustainable education in higher education. Sustainable education is becoming one of the most important subjects areas of construction education along with other key subjects including estimating, planning and scheduling, project management, etc. [4, 11, 12, 13 & 14]. Several scholars have already studied the importance of sustainable education in several countries such as the U.K., the United States, and Australia. Along with presenting the importance of sustainable education, the purpose of this study was to identify factors affecting undergraduate student's attitudes toward sustainability in order to suggest the most efficient way to change construction student's attitude toward sustainability.

THEORETICAL BACKGROUND

To identify factors affecting student's attitudes toward sustainability in the built environment, it is necessary to clearly define the definition of sustainability. The most widely accepted definition of "sustainability" is "Sustainability is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." written by the World Commission on Environment in its report "Our Common Future" [15]. This definition will be integrated into the building industry, because construction processes and practices significantly impact our environment, society and people's health and well-being. Along with the definition of sustainability, sustainable construction can be defined as "Sustainable construction is to construct structures including buildings, bridges and roads which are designed, operated, and demolished in an environmentally and energy efficient manner. " As a result, sustainable construction practices can be beneficial in three domains including environmental stewardship, social responsibility, and economic prosperity (Figure 2) [2, 8, 16 & 17].

Figure2. Benefits of Sustainable Construction



Due to the many benefits associated with the implementation of sustainable construction, many scholars have emphasized the importance of sustainable education because it is an ideal mechanism for achieving the goal of sustainability in the construction industry [9, 4, 11 & 18]. For example Mead (2002) described the status of sustainable construction in the construction industry and suggested the importance of sustainable construction education in construction programs. Ahn and Pearce (2007) investigated the green knowledge expectations from construction graduates by collecting data from construction firms in the United States**.** Kibert (2003) did research on "Sustainable construction at the Start of the 21st century." Hayles, Robson, and Holdsworth (2006) did a case study about how the Royal Melbourne Institute of

Technology (RMIT) incorporates into their undergraduate programs the issues of housing sustainability and affordability. Hayles and Holdsworth (2006) did a case study about how the Royal Melbourne Institute of Technology (RMIT) changed their curriculum for sustainability. Cotgrave and Alkhaddar (2006) examined green curriculum within construction programs in the United Kingdom. Ahn et al. (2008) developed a sustainable construction course designed for university construction programs that used a systematic course development approach. Haselbach and Fiori (2006) explained the importance of developing an appropriate pedagogy, curricula, and accreditation. Graham (2000) did research concerning teaching and learning environmental literacy for the building professions. Even though many scholars have indicated the importance of a sustainable curriculum in construction programs, in reality only a small number of programs from among the members of Associated Schools of Construction offer their students such courses. Those who do, include Colorado State University, University of Florida, Texas A&M University, Virginia Polytechnic Institute and State University, Minnesota State University Moorhead, Alfred State College, and Old Dominion University [24].

In conjunction with a literature review related to sustainability, sustainable education, and the expectation of sustainable education, several scholars indicated that the main aim of sustainable education is the change of student's attitudes that will change their behavior [9]. The extensive literature review in the areas of sustainability, sustainable education, and the change of attitude and behavior toward environmental issues suggests the need for a study method for changing construction student's attitude toward sustainability during their education period. The alteration of their attitude will eventually impact not only themselves, but also the whole construction industry for a more sustainable future.

RESEARCH DESIGN

Research Objectives

The main objective of the study was to identify construction students' attitude toward sustainability in construction, to classify the most recognized sustainable rating system by construction students, to discover the relationship between the attitude toward sustainability and the grade of construction students, and detail factors related to construction student's attitudes toward sustainability in construction programs. Specifically, the study intended to answer the following research questions:

1. What is the level of familiarity of sustainable construction possessed by construction students in a construction program? Are there any differences in the level of familiarity of sustainable construction as related to the student's status of university level?
2. What is the level of student's attitude toward sustainability?
3. What is the best predictive model for the dependent variable of the attitude toward sustainability as related to the following independent variables; sustainable construction and/or environmental class; work experience for sustainable construction; professors who are interested in the areas of sustainability and/or environment; construction industry interest for sustainable construction; the willingness to pursue sustainable projects and thesis?

Survey Instrument

Survey research is the method used to accomplish the main objectives. The survey instrument was created and developed by an author-based review of the literature and other studies such as Cotgrave & Alkhd and Ahn & Pearce's survey questionnaire. The survey instrument is composed of six sub-categories: 1) Attitudinal instrument for construction students toward sustainable construction, 2) potential factors affecting the construction students' attitude toward sustainable construction, and 3) demographic data. The first and second categories in this survey were composed of a five-point Likert-type scale items. To establish the instrument validity, the survey instrument was examined by a research measurement expert and two academic experts in construction department at Virginia Tech. The instrument was translated into Korean by the authors and checked by three Korean English middle school teachers. The complete instrument was pilot tested by 17 construction junior students at Kumoh National Institute of Technology. The reliability of questions regarding attitude toward sustainability was measured using the Cronbach's alpha ($\alpha = 0.904$). The content of attitude questions was considered reliable and was not revised. Several typo errors were corrected and several words in the questions were revised to increase the clarity.

Research Procedure

This was a descriptive/correlation study using responses from 454 undergraduate construction related students at construction related department at four different institutes (Gyeongsan National University, Andong University, Kumoh National Institute of Technology, and Daegu University) located in the mid-eastern region of South Korea. Although the sample size was about 870 building construction undergraduate students, this instrument was targeted to 645 construction students who enrolled in the compulsory major subject. The developed survey instrument was sent to the professors who taught the compulsory major subject in the 2009 fall semester and distributed to the construction students. During the two weeks, the authors sent an additional email to motivate students to participate in the survey and also solicited course instructors to mention the importance of the study. The total response rate was 70.39% (n = 454). The statistical analysis used to interpret the data included descriptive statistics, ANOVA, and multiple regression statistics using SPSS 16. Descriptive statistics were used to determine the self-perceived level of familiarity with sustainable construction in the building construction program, the most recognizable sustainable benchmarking system for construction students, teaching methodologies which were the most preferable to increase student's understanding of sustainable construction, and the mean and measure of variance of the attitude toward sustainability in building construction students. Analysis on Variance (ANOVA) analysis was conducted to identify the relationship between the attitude toward sustainability and the status of student's level (sophomore, junior, senior, and master student). Multiple regression analysis was used to determine the best model for explaining the variance associated with the student attitude toward sustainability in the construction program based on the linear combination of the independent variables.

FINDING AND INTERPRETATION

The participants' demographic data investigated in this survey included the status of year of study, gender, and institute name. The respondents' status of year of study is balanced as first year student (n = 91, 20%), sophomore (n = 127, 28%), junior (n = 134, 29.5%), and senior (n = 102, 22.5%). Also, four institutes are well distributed as Andong University (n = 126, 27.8%),

Daegu University (n = 110, 24.2%), Gyeongsan National University (n = 108, 23.8%), and Kumoh National Institute of Technology (n = 110, 24.2%). Sixty seven percent of respondents were male and thirty three percent of respondents were female.

Students' Attitude toward Sustainable Construction

Construction students' familiarity regarding sustainable construction was measured by two questions which were "I am familiar with sustainability, especially regarding the built environment" and "I am familiar with the *Rating System on the Sustainable Built Environment in South Korea*". The student responses indicated a level of familiarity regarding sustainable construction from 1(vey unfamiliar) to 5 (Very familiar), with averages of 3.024 and 2.449 out of 5 respectively. As a future construction worker, construction students should be familiar with the sustainability and have a knowledge, attitude, and competency regarding sustainability. However, Korean construction students presented a medium level of familiarity regarding sustainability and a below average level of familiarity regarding the rating system on the sustainable built environment in South Korea. The analysis of variance (ANOVA) analysis was run to identify differences among the status in the university. The result indicated a significant difference of the student's familiarity toward sustainable construction and its rating system among the status of university level (first year student, sophomore, junior, and senior), having the F-values of 11.761($p<0.001$) and 14.197(0.001). Through the multiple comparison analysis (Tukey Method), this study found that the average scores of senior is significantly greater than one of first year student in terms of the familiarity toward sustainable construction and its rating system. The construction students' attitude toward sustainability was measured by five questions as Table 1. The individual question was rated by a five point Likert-type scale from "1: definitely not" to "5: definitely yes".

Table 1. Construction Student's Attitude toward Sustainable Construction

Attitudinal Items	N	Mean	Std. Deviation
Think that sustainability is helpful to my future career and experience.	454	3.3965	1.25249
Believe that environmental issues like global warming or climate change are important	454	3.7753	1.28764
Pay additional cost for buying a sustainable house	454	3.4009	1.21528
Think that technological innovation can solve the environmental problems we face	454	3.2181	1.26195
Think public organizations have to incorporate the concept of sustainability into their facilities	454	3.7291	1.26742

Construction students indicated the above average levels of perception toward sustainability and sustainable construction as shown in table 1. In particular they recognized the importance of the environmental issues (i.e. global warming or climate change). In contrast, they showed the medium level of response regarding their personal implementation and practice toward sustainable construction.

2. Factors Affecting the Students' Attitude toward Sustainable Construction

A correlation coefficient (Pearson r) was constructed to identify key factors affecting student's attitude toward sustainability. Based on the review of relevant literature, five potential factors were chosen and the respondents rated them in terms of its importance using a five point Likert scale from 1 (not very important) to 5(very important). Moreover, the mean score of five attitudinal items was used as construction student's attitudinal score.

Table 2. Factors Affecting Construction Student's Attitude toward Sustainability

Factors Items	N	Mean	Std. Deviation
[Class] Sustainable construction and/or environment class	454	3.4978	1.22834
[Integration] Interdisciplinary project and/or class including the concept of sustainability	454	3.4427	1.18677
[Prior Experience] Experience and practice related to sustainable construction	454	3.6784	1.31978
[Facility or Campaign] Sustainable facility or campaign in the university or college	454	3.3612	1.20774
[Faculty] Professor(s) teaching sustainable construction	454	3.4361	1.21765

The correlation coefficients between student's attitude toward sustainability and five potential factors such as class ($r = 0.813$, $p < 0.001$), integration ($r = 0.769$, $p < 0.001$), prior experience ($r = 0.735$, $p < 0.001$), facility or campaign ($r = 0.658$, $p < 0.001$), and faculty ($r = 0.757$, $p < 0.001$) are significantly high (all coefficient values are significant in the significance level of 0.001). Thus, construction student's attitude toward sustainability can be affected by taking their class related to sustainable construction and/or environmental issues, integrated effort for learning the concept of sustainability, prior experience associated with the sustainable construction, facility or campaign for sustainability, and faculty teaching and researching the sustainability.

A regression model for student's attitude toward sustainability is structured by five independent variables (class, integration, prior experience, facility or campaign, and faculty). Through stepwise regression which removes and adds independent variables to the predictive model for the purpose of identifying a useful subset of predictors, four key independent variables (class, integration, prior experience, and faculty) were selected. The overall regression model with the four factors successfully predicted the student's attitude toward sustainability, which was indicated by a F-value of 317.988 ($p < 0.001$) and a R-square of 0.739 ($p < 0.001$) as shown in Table 3.

Table 3. Best Fitting Predictive Model for Student's Attitude toward Sustainability

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.813[a]	.661	.660	3.08240
2	.834[b]	.695	.694	2.92608
3	.849[c]	.721	.719	2.80310
4	.860[d]	.739	.737	2.71327

Thus, the regression equation of this study becomes:

$$\hat{Y} = 1.444Class + 0.885Integration + 0.794\,\mathrm{Pr}\,iorExperience + 0.965Faculty + 3.185$$

This model accounted for nearly 73.9% of the variance in student's attitude toward sustainability. Investigating the individual contribution of four factors, the class regarding sustainable construction and/or environmental issues was a significant predictor in this model ($t = 29.689$, $p < 0.001$). The second factor, the integrative project or class related to the sustainability was a significant predictor in this model ($t = 7.112$, $p < 0.001$). The third factor, the prior experience related to sustainability was a significant predictor in this model ($t = 6.437$, $p < 0.001$). The last factor, the faculty teaching and researching sustainable construction was a significant predictor in this model ($t = 5.594$, $p < 0.001$). These were also verified by the significant Pearson's coefficient between construction student's attitude and key factors.

CONCLUSION AND RECOMMENDATION

This study investigated 454 Korean construction student's attitude toward sustainability in construction, in particular the familiarity level toward sustainable construction and its rating system in South Korea and key factors affecting student's attitude toward sustainability in construction.

Korean construction students seem to have a medium level of familiarity with sustainable construction and a below average level of familiarity with its rating system in South Korea. Since it is necessary for future construction professionals to apply the sustainable rating system for built environment in their work, and since the importance and value of applying the rating system have been increased in the Korean construction industry, the education regarding sustainable rating system for the built environment should be emphasized in the undergraduate level construction education.

The key factors affecting student's attitude toward sustainability in construction were class, integration, prior experience, and faculty. This was verified by a procedure of calculating correlation coefficient and conducting a stepwise multiple regression. The results driven from the statistical analysis showed that the key factors for construction student's attitude toward sustainability in construction were a student's class dealing with the concept of sustainability and sustainable construction, their integrative project for learning the concept of sustainability, their prior experience and practice related to sustainability, and the faculty teaching and researching sustainable construction. Synthesizing these findings, several course(s) related to sustainability and sustainable construction should be implemented for all construction undergraduate and also implemented in several strategies such as their integrative project, experience, and practice. In addition, progressive efforts of construction faculty at the university or college level are required to improve the construction student's attitude toward sustainability in construction

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