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## **Curricular and Non- Curricular Factors Impacting Development of Leadership Competencies in Undergraduate Civil Engineering and Construction Students**

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# Curricular and Noncurricular Factors Impacting Development of Leadership Competencies in Undergraduate Civil Engineering and Construction Students

## Abstract

The construction industry is experiencing challenges in developing specific and necessary competencies; leadership is one known deficiency. Other reasons, including rising complexity and the rapidly changing nature of construction projects, have called for improved leadership development in the construction industry. The purpose of this paper is to first identify and synthesize the curricular components (i.e., course experiences) and noncurricular factors (e.g., mentoring networks) that impact the development of leadership competencies for civil engineering and construction undergraduate students. A critical review and qualitative synthesis of the literature was employed to gather known components and factors relating to students' leadership development resulting from undergraduate coursework. Findings indicate that the curricular components and noncurricular factors impacting development of leadership competencies include course assignments and activities, course content (e.g., emphasis on the development of technical competencies versus development of emotional intelligence skills), access to resources (e.g., new technologies, guest speakers), and the ability to enroll in courses outside of required curriculum [e.g., courses that prepare student groups to participate in Associated Schools of Construction (ASC) and National Association of Home Builders (NAHB) annual competitions]. By using information provided in this study, future steps may be taken by faculty members to bridge and, in particular, improve their students' development of leadership competencies.

## Introduction

The Institute of Civil Engineers defines leadership as an ability to set the direction of a project and guide people through that direction.<sup>1</sup> In addition, according to Allen and Roberts (2011), leadership development is defined as a constant and systemic procedure created to increase the abilities and competencies of individuals, groups, and organizations in order to satisfy the shared objectives and requirements.<sup>2</sup> Leadership development is a process that helps students to understand their leadership capabilities, rather than a series of training interventions such as courses or lectures.<sup>2,3</sup>

Leadership competencies such as teamwork, problem solving, ethics, and communications<sup>4</sup> are vital for the accomplishment of any construction project.<sup>5</sup> According to the ASCE Vision 2025, civil engineers will have to command the multidisciplinary and leadership facets of their work in order to implement complex projects that include various stakeholders.<sup>6</sup> Similarly, it is stated in the ASCE BOK (2008) that 21st-century engineers must possess leadership competencies in addition to technical competencies as the industry moves forward.<sup>7</sup> Other reasons, including rising complexity and the rapidly changing nature of construction projects, have called for improved leadership development in the construction industry.<sup>8</sup> But the construction industry is experiencing challenges in developing specific and necessary competencies; leadership is a competency known to be deficient. A survey conducted by Russell and Stouffer (2005) with 90 out of 213 civil engineering programs in the United States demonstrated that professional skills including leadership and teamwork are not consistently present in civil engineering curricula, as only 3.33% of studied programs required an individual course in leadership or teambuilding.<sup>9</sup> Furthermore,

although leadership should be an essential educational outcome for construction management programs,<sup>10</sup> leadership content is not adequate within construction management curricula.<sup>3</sup>

University and college faculty can play a pivotal role in helping undergraduate civil engineering and construction students develop leadership competencies.<sup>11</sup> Leadership skills can be gained through courses in existing civil engineering curricula or other types of educational experiences.

### **Purpose of the research**

Some empirical studies have investigated the relationship between student experiences and leadership development. These studies either focused on a single component of student experience or a single component of leadership competency.<sup>12,13,14,15,16,17</sup> In order to have a broad understanding of the supporting factors of student leadership development, we conducted a critical review of the most recent literature on this topic. The purpose of this paper is to first identify and synthesize the curricular components (i.e., course experiences) and noncurricular factors that impact the development of leadership competencies for civil engineering and construction undergraduate students. The paper then discusses suggestions that can be implemented to improve the development of leadership competencies for undergraduate civil engineering and construction students.

### **Methodology**

A critical review and qualitative synthesis of the literature was undertaken to gather known factors relating to students' leadership development resulting from undergraduate coursework. According to Holliday (2007), in a qualitative approach, data are gathered from various sources and evaluated in a hierarchy to provide new concepts.<sup>18</sup> In addition, the nature of this type of research is exploratory and open-ended.<sup>19</sup> In the review of ASEE papers it was found that the range of references used in literature review papers was between 30 to 40 papers.<sup>20,21</sup> Therefore, more than 30 peer-reviewed research papers published after the year 2000 were extracted from four databases: Web of Science, Scopus, Engineering Village, and ASCE Library. The key words used in search engines include: leadership development in civil engineering, leadership in civil engineering, leadership in construction education, leadership and civil engineering curriculum. We narrowed the search results by languages, text availability, article type and publication dates. Articles in peer-reviewed journals and conference papers constitute a major part of reviewed materials. We provide an overview of results, followed by critical points to be drawn out of the review. We finish with a section presenting recommendations for enhancing development of leadership competencies in undergraduate civil engineering and construction students.

### **Results**

In this section, we divide factors impacting the development of leadership skills into two categories—curricular and noncurricular—and then review the literature related to each category.

#### ***Curricular components***

Leadership skill development has been demonstrated as enhancing during the college education experience, and in order for undergraduate education programs to be consistent and relate to civil

engineering vocations, it is imperative for instructors to embed leadership training into college curricula.<sup>22</sup> The following paragraphs describe the curricular components that influence the development of leadership competencies in civil engineering and construction students.

Communication skills are expected qualities from construction professionals. Communication skills are crucial for both winning projects and the phases of procurement and project execution. Communication skills have two forms: verbal and nonverbal skills.<sup>23</sup> According to the 7% - 38% - 55% rule established by Albert Mehrabian, a face-to-face communication includes 7% words, 38% vocal tone, and 55% body language.<sup>24</sup> The construction profession is not excluded from this rule.<sup>25</sup> Communication skills for civil engineering and construction students can be enhanced through team-based and collaborative study. The teamwork approach provides the chance for students to interact, improves communication, and eventually develops leadership skills. Bowman and Farr (2000) mention that leadership skills are developed when students embarking on a project are “evaluated on their ability to lead a team and tasked to give oral presentations” (16).<sup>22</sup> In addition, a study by Gunhaan (2014) shows that team-based collaborative learning provides the opportunity for students to “interact, communicate, listen and present as a team” (6).<sup>23</sup>

Research has supported that capstone courses help students develop teamwork skills and increase communication skills and technical competencies. A nationwide survey conducted in 2011 among 57 members of the ASCE Department Heads Council demonstrates that when the participants were asked, “Where does your department include/plan to include management, business, public policy, and leadership into the curriculum?”, 68% of respondents chose “Capstone/senior design,” which means that the majority of leadership skills are obtained through capstone courses and design project activities.<sup>26</sup> In order to develop nontechnical skills such as leadership, the objectives of a capstone course should encompass many items, including improvement of team formation, skills for leading a team, and enhancement of students’ understanding of the “big picture,” such as ethical and social concerns relevant to the engineering field.<sup>13</sup> In addition, Nelson et al. (2014) state that learning and practicing how to collaborate with other students and working in teams is a main objective of the capstone program.<sup>15</sup> Regular team meetings every week are seen to be effective in improving the team functions, eventually resulting in developing leadership skills.<sup>27</sup> The objectives of team meetings are to better monitor the fulfillment of assignments and work tasks, argue ideas and thoughts for questions associated with team projects and responsibilities, and authorize team members to provide work plans for the upcoming week.<sup>27</sup>

Other literature shows that utilizing new technologies other than calling or texting can assist the students in actively participating in a team project and can provide better monitoring of other team members’ performance and completion of the tasks.<sup>26</sup> For instance, enhancing students’ access by centralizing work logs can be implemented using cloud storage such as GoogleDrive and Dropbox. These tools enable students to access to the teams’ documents from separate computers at the same time.<sup>28</sup>

Another possible component that can improve the development of leadership skills and enhance team functions is utilizing graduate mentors in capstone courses. Graduate students, such as teaching assistants, can serve as mentors, although they may not have technical knowledge about the team projects.<sup>29</sup> The role of the graduate mentor is to encourage the team members to perform effectively, help them to meet the project’s expectations, and guide them in how to enhance their

oral presentation, rather than getting involved in the technical aspects of the project.<sup>29</sup> In addition, weekly meetings with team members can assist the progress of individual task reports and are beneficial for both the mentor and their team.<sup>29</sup>

One of the major components identified in literature on leadership skills development is the significance of emotional intelligence as a key feature of success and leadership.<sup>30</sup> Emotional intelligence is composed of the following key aspects: self-awareness, self-regulation, motivation, empathy, and social skills.<sup>31</sup> According to Riley et al. (2008), “emotional intelligence has emerged as the science behind leadership and a much more accurate predictor of success than other forms of measure.”<sup>30</sup> But a study by Chinowsky and Brown (2004) shows that there is an emphasis on the development of technical competencies versus development of emotional intelligence skills in courses for civil engineering and management students, which constitutes a barrier for leadership skills development.<sup>32</sup>

Many civil engineering programs are developing leadership skills without the explicit use of the word “leadership”.<sup>33</sup> For example, systems engineering (CE 201) and engineering risk and uncertainty (CE 202) are compulsory courses for all civil engineering students at the University of Illinois; while neither of the two courses explicitly includes the word “leadership,” implicit leadership capabilities are developed by the material covered in the classes.<sup>34</sup>

### *Noncurricular factors*

In addition to curricular components, research shows that undergraduate students who participated in a variety of noncurricular activities reported having more leadership opportunities.<sup>28</sup> The next few paragraphs will discuss the noncurricular factors that impact the development of leadership competencies in civil engineering and construction students.

Literature shows that experiential learning is one of the factors contributing to the leadership development of civil engineering students.<sup>3</sup> Riley (2008) found that hands-on experience is a primary element that should be considered in fostering leadership development. One method to obtain leadership skills is students’ engagement in extracurricular activities.<sup>30</sup> Participation in student organizations such as ASCE and the American Concrete Institute (ACI) is one type of extracurricular activity and can provide opportunities for students to obtain leadership competencies required for implementing engineering practices in their future professional career.<sup>3</sup> These leadership competencies include managing an organization, leading and supervising individuals, and teamwork.<sup>32</sup> Moreover, meeting and interacting with guest speakers from the industry can provide a further advantage for students by improving their networking skills. In addition, Kumar (2012) states numerous reasons that students should engage in organizational activities: attaining social skills, leadership skills, and organization and management skills.<sup>33</sup> In addition, Zoghi et al. (2012) demonstrate that structured courses for preparing student groups to participate in annual ASC and NAHB competitions can assist students in improving their presentation, communication, and leadership skills.<sup>36</sup>

In addition to organizational participation as extracurricular activities, a study by Pascarella and Terenzini (2005) shows that interaction with faculty members has a constructive impact on students’ leadership skills development.<sup>37</sup> Other scholarly work mentions that the effect of interacting with peers may be twice greater than interacting with faculty outside the classroom.

Additionally, many scholars have emphasized that establishment of a mentoring program is another key factor affecting leadership development for civil engineering students. Selection of mentors is one of the essential facets of the mentoring process.<sup>38</sup> According to Nadim and Singh (2008), mentors should be selected from people with sufficient knowledge and experience in the desired areas.<sup>39</sup> The mentors can be industry advisory board members.<sup>40</sup> According to the literature, extracurricular activities support leadership development for civil engineering and construction students.

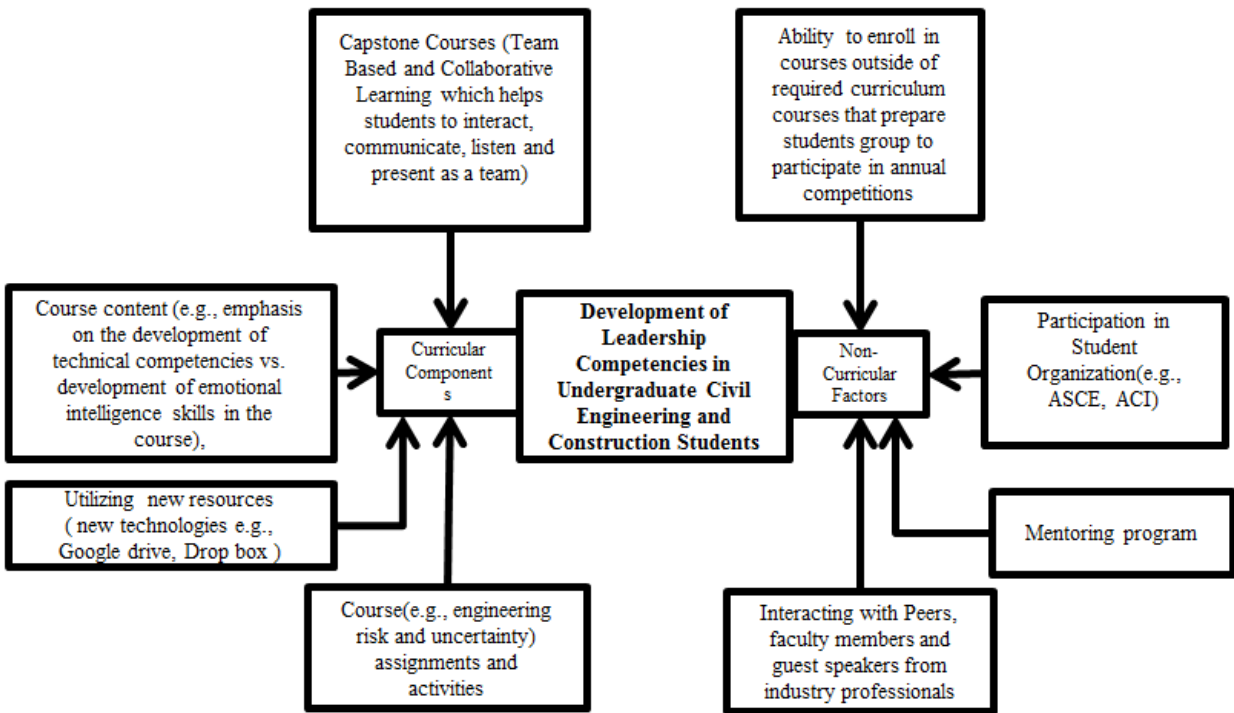
## **Discussion of findings**

The results of curricular components show that there is an emphasis on the development of technical competencies in civil engineering curricula in comparison to the development of emotional intelligence skills. In addition, while improving communication and professional skills is an integral part of leadership development, much of this skill development is postponed until the capstone course.<sup>41</sup> In capstone courses, students learn and practice how to collaborate with other students and perform in teams. Capstone courses enhance students' communication skills, such as presentation skills, and improve their understanding of ethical and social concerns associated with the engineering field. The findings show that the existence of a graduate mentor in capstone courses is another component that can improve leadership skills. The graduate mentor can help the students advance their professional skills (e.g., oral presentation). Moreover, the literature demonstrates that leadership competencies can be embedded into the existing engineering curriculum (e.g., systems engineering and engineering risk and uncertainty) without adding new courses to the curriculum. Additionally, the literature states that communication skills are essential for effective leadership development for construction students.

Utilizing new technology (e.g., GoogleDrive and Dropbox), along with using other technologies for communication, such as texting and calling, can help the students to better monitor other team members' performance.

The findings of the review show that noncurricular factors can occur in various ways. Leadership skills development for civil engineering students can be accomplished by their participation in student organizations, which can help them learn how to lead and manage an organization and improve their ability to perform on a team. Furthermore, interacting with teachers and peers outside the classroom, along with interacting and exchanging contact with guest speakers from the industry, can enable students to enhance their networking skills. The ability to enroll in courses outside of required curriculum, such as courses that prepare student groups to participate in annual ASC and NAHB annual competitions, influences leadership development for undergraduate civil engineering students. In addition, the literature states that establishment of a mentoring program is a central factor for developing leadership competencies. According to Schuhmann et al. (2014), mentoring future leaders is a mean that provides the highest level of outcomes for development programs.<sup>42</sup>

The findings of the literature are presented in Fig.1.



**Fig. 1.** Factors impacting the development of leadership competencies in undergraduate civil engineering and construction students.

### Suggestions and conclusions

The findings of the study provide a clearer understanding about the factors impacting leadership skills development. Previous literatures have identified curricular components and noncurricular factors that serve as triggers or barriers to developing leadership skills in undergraduate civil engineering and construction students—separately. To our knowledge no systematic review has been conducted to synthesize the findings from these empirical studies. This paper reviews the content of journal and conference papers published in civil engineering and construction education field and combines those factors. In addition, with the information gathered and studied, we hope to initiate a new area of discussion associated with the development of leadership skills for civil engineering and construction undergraduate students.

This study suggests some directions for future study. First, future research on prioritization of the curricular and noncurricular factors is recommended based on the study findings related to leadership skills development for civil engineering and construction undergraduate students. Future research should explore which of these factors has the strongest impact and should propose a means to improve or attenuate its effects through the possible sources in order to enhance leadership skills among the students. Furthermore, other in-depth reviews of literature on curricular components impacting leadership competencies development can be performed using university and institutional data. Assessment of the data can help educators and faculty members

revise the effectiveness and content of civil engineering and construction curricula and improve the courses regarding leadership skills. There may be facets of leadership skills unique to civil engineering and construction science compared to other majors, which would be worthy of research attention.

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