The Impact of Internships on Civil Engineering Students' Exploration of Learning Styles

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Abstract

The undergraduate experience is important for developing competencies for the civil engineering workforce. In addition to the classroom experience, internships can be impactful for students' learning opportunities to have hands-on experience, to apply their skills and knowledge, to experience a work environment, and to develop relationships with professionals. While internships have been studied in various disciplines, few studies have tried to understand how civil engineering students demonstrate their learning behaviors during an internship. Previous studies used Kolb's experiential learning model as a theoretical framework to explore students' learning styles as part of an internship experience. This study extends the use of Kolb's model as a theoretical framework by focusing on civil engineering students to examine their internship experiences and apparent patterns of learning styles. Kolb's experiential learning theory involves four learning modes: concrete experience, reflective observation, abstract conceptualization, active experimentation; and four learning styles: diverging, assimilating, converging, and accommodating. Taking a deductive qualitative approach, *a priori* codes from Kolb's theory were used to analyze transcripts from interviews with 14 civil engineering students from four different US universities. This study contributes to an understanding of civil engineering students' demonstration of learning behaviors in an internship. Internships provide a different context than classrooms, which can be valuable for student learning. Therefore, faculty members are encouraged to support students in seeking out internships to facilitate students' exploration of learning styles in various learning contexts.

Introduction

Civil and construction engineering is a dynamic, complex, and practice-oriented profession [1]. To meet the high expectations of the industry, students must learn and apply different knowledge and skills in college. To better prepare students for industry, many studies emphasized the importance of students' exposure to various learning environments [2]-[4]. Internships provide a learning environment that helps students gain different learning opportunities than those afforded in the traditional classroom. By exploring a different learning environment in an internship, students have a broader range of opportunities for professional preparation [2].

Benefits of Internship

Student internship experience provides various learning opportunities for students to cross the boundaries of classroom and industry [1]. For example, internships leverage student learning outcomes by encouraging continuous learning opportunities outside the classroom, enhancing students' application of knowledge gained in the academic program [1]. The bi-directional learning opportunities between class and internship help student to apply knowledge they learned in class to their job, and knowledge they learned in the job to their class [5].

Applying abstract knowledge in an internship

A college internship often provides students with their first experience in the field. Through an internship experience, students gain an opportunity to apply their skills learned in class and draw abstract knowledge to develop their performance during an internship. By applying skills and knowledge in an internship, students better understand the concepts and ideas through hands-on experience [1]. Internship experience provides student with valuable field experience and the students use internship opportunities to blend the class materials with work practices.

Bringing internship experience to class

The benefits of an internship include a contribution to academic success. Hauck, Allen, and Rondinelli [6] found that students who previously had an internship achieved slightly higher academic performance as observed by their overall GPA and grades on higher-level construction courses. Floyd, Johnson, and Rabb [5] also found that students had a higher appreciation of their learning experience in the workplace, which led a fuller comprehension of the class materials. They recalled knowledge and skills learned from an internship and improved academic performance. These students were more motivated to learn class materials and were more engaged to develop expertise in the field.

Theoretical Framework

Kolb's experiential learning theory

This study utilized Kolb's experiential learning theory as the theoretical framework [7]. Kolb's theory suggests that effective learning outcomes can be obtained by spanning all four learning modes [3]. These learning modes include concrete experience, reflective observation, abstract conceptualization, and active experimentation. Kolb defined concrete experience as learners' direct observation and response to an immediate situation in which learners are immersed. Reflective observation is defined as learners' reflection on the experience and ability to draw provisional perspectives while considering alternatives to find a solution. Abstract conceptualization allows learners to distill and analyze information from the reflection and organize and comprehend complex concepts and theories. Active experimentation highlights learners' participation in learning activity that tests previously generated ideas and alternatives.

Kolb captured these non-fixed, dynamic states of learning modes into four learning styles: diverging, assimilating, converging, and accommodating styles. The diverging style is defined as a way of exploring different perspectives to understand the situation better. This style is observed in learners who use concrete experience and reflective observation as their learning modes. They prefer sense-making and grasping a broader concept of the environment or tasks and working in groups to generate ideas and gather information. These learners are interested in people and like to explore different perspectives. The assimilating style describes learners who use abstract conceptualization and reflective observation. They like to utilize inductive reasoning and formulate a hypothesis to understand the environment or task. They are less interested in people but more interested in taking analytical and theoretical approaches to organize information in a "concise and logical form" [3, p. 196]. The converging style involves learners using abstract conceptualization and active experimentation. They prefer deductive reasoning and testing a hypothesis by evaluating themselves to their goals and standards. They like to examine practical application of ideas and theories. They also prefer working with technical tasks rather than relational and social issues. The accommodating style is observed in learners who use concrete experience and active experimentation. These learners effectively learn through hands-on experience and by putting their skills/strategies in practice. They like to work with others and to take different approaches to accomplish tasks. Kolb suggested that each individual has a preference over a learning style that is responsive to a learning environment.

These learning styles are influenced by various factors. For example, Kolb [3] found that genealogical features, personality traits, and learning context shape students' learning styles. Because genealogical features and personality traits are difficult to change, students take different learning styles by exploring diverse learning contexts. As student explore various learning contexts, they find better strategies and solutions to the problems and challenges in a given context by taking different learning styles [3]. This study used Kolb's theory to understand and identify civil engineering students' learning styles in an internship.

To explore civil/construction engineering students' learning styles in an internship, we extend the work by Tener, Winstead, and Smaglik [8]. Our work contributes to identifying civil engineering students' learning behaviors as they pertain to the four learning styles. As a result of contextual changes in newly advanced technology and continuously changing industry demands, students may have taken different approaches and learning behaviors in an internship, which warrants a new exploration of this context since the 19 years their work was published. Further, Tener, Winstead, and Smaglik [8] used reflection notes of internships from students at a single institution. This study, on the other hand, collected data from interviews that allowed the researchers to explore students' perceptions and experiences, and gain richer insights through lively communication and interaction. Plus, because Tener, Winstead, and Smaglik [8] recruited the students at a single institution that required them to complete three internships, a lack of transferability of the findings may cause discrepancies in other studies. Also, they suggest future

research to investigate students' learning styles in an internship. Therefore, this study extends the prior work [8] and describes different learning styles and approaches students took during the internship.

Research Question: How do civil engineering students demonstrate learning styles in an internship?

Methods

Data collection

This study initially recruited 15 civil engineering students at four academic institutions in the United States. As part of larger study on engineering leadership, which was funded by National Science Foundation, students across four different universities were invited to complete a survey on leadership development and professional preparation. On the survey, participants were invited to provide their contact information if they were interested in completing a follow-up interview. The interview explored leadership development, professional preparation, and out-of-class engagement, including participation in internships. The students voluntarily participated in this study and consented to complete an interview with a researcher. Each interview was semi-structured and conducted on a virtual platform (e.g., Zoom) in less than an hour. Interview participants were asked to select their own pseudonym at the start of the interview. The present analysis included 14 transcripts; one student who had extensive industry experience before enrolling in the engineering program was excluded.

Participants

During the interview, the interviewer asked participants to identify their gender and academic standing. Seven participants identified their gender as female and the rest (n=7) identified as male. The academic standing of the participants ranged from 2nd year to recent graduate. The participants who are defined as graduates were either recently graduated from college or starting graduate school. Their internships were mostly taken during summer. While the majority of internships were related to civil and construction engineering, some students had internships since high school, and some were outside of their major such as community service and electrical engineering at NASA. A summary of their gender, academic standing, and internship experience is illustrated in Table 1.

Table 1. Interview participant information

Pseudonyms of Participants	Gender	Academic standing	Number of Internships
Shelby	Female	4th year	2
Becca	Female	5th year	2
Alex	Female	3rd year	1
Albert	Male	4th year	2
Riley	Male	Graduate	3
Max	Male	2nd year	1

Kaitlyn	Female	3rd year	1
John	Male	3rd year	4
Charles	Male	3rd year	5
Lily	Female	5th year	2
Kim	Female	Graduate	5
Phil	Male	5th year	3
Tobias	Male	5th year	3
Luna	Female	2nd year	1

Data Analysis

This study utilized a qualitative, deductive analysis approach [9], [10] to explore students' experiential learning styles in an internship. The analytical process in this study captured students' reflections from the internship experience. This study used Kolb's experiential learning theory to understand students' learning styles and behaviors. Each code was generated based on the four learning styles of Kolb's theoretical framework. This process was iterative and involved checking with another researcher to increase the validity and transferability of the data. Once the participants' responses were analyzed by the four styles, the researcher thematically and more finely coded the responses. This process of "fine coding" enables the researcher to classify similar concepts and ideas together [11]. These fine codes were captured as student learning behaviors in an internship and portrayed the characteristics of each learning style.

For example, the diverging style captured the learning behaviors of using internship experience as students' primary source of information (concrete experience) and understanding the information by reflecting on their experience (reflective observation). Converging style captured student learning behaviors such as gaining information in class (abstract conceptualization) and using the knowledge in the work setting (active experimentation). Accommodating style captured students' learnings behaviors such as using prior work experience (concrete experience) to try different approaches (active experimentation).

Findings and Discussion

This section presents students' learning behaviors pertaining to Kolb's three learning styles (i.e., diverging, converging, and accommodating) alongside the participants' descriptions in the interviews. Assimilating learning style was not observed from students' internship experiences in this study. Each learning style is influenced by learning context and the context of internship was less conducive to "readings, lectures, and exploring analytical models" [3, p. 197], which are associated with assimilating. Although abstract conceptualization and reflective observation (the two modes associated with the assimilating style) were demonstrated in other learning styles, the synergy between the two (which informs the style) was not present. Tener et al. [8] found evidence of the assimilating style in their study, but their analysis looked at the modes additively instead of synergistically, which was acknowledged as a potential limitation. Therefore, it is not entirely surprising that assimilating style was not observed in our study. All students (100%)

demonstrated the diverging style to generate an initial idea about the field and eight (57%) students applied accommodating style to employ the knowledge and skills they acquired in class and during the prior internships. Lastly, five (36%) students used converging style to test different career options and establish criteria to fulfill the employment requirement for their field. A detailed description of student' learning behaviors pertaining to the learning styles of Kolb's theory are shown in Table 2. The number in parentheses indicates the number of participants who demonstrated the learning behavior during an internship.

Table 2. Civil engineering students experiential learning through internship (Redeveloped from Kolb [7])

	Concrete Experience	Abstract Conceptualization
Reflective Observation	**Diverging (n=14)** Using own observation to understand the profession (13) Understanding what it means to be a professional (12) Developing a career plan by reflecting on experience (11) Learning from a role model (8)	**Assimilating (n=0)** No assimilating styles was observed
Active Experimentation	**Accommodating (n=8)** Trying different positions to be prepared at work (6) Learning from error and trial (5) Trying skills acquired in prior work experience (3)	**Converging (n=5)** Seeking work opportunities to define their interest in the field (4) Applying knowledge gained in class (2)

Diverging

All student participants demonstrated learning behaviors of diverging style, as previously identified as a fundamental internship learning style by Tener et al [8]. In this study, the fine codes underlying the two modes of diverging style (concrete experience and reflective observation) were 1) using own observation to understand the profession (n=13), 2) understanding what it means to be a professional (n=12), 3) developing a career plan by reflecting on experience (n=11), and 4) learning from a role model (n=8). Students with diverging style gathered information by working with other people and talking about various field experiences. They used these perspectives to build a better idea of the work environment and the type of work they are going to be doing. For example, Kaitlyn shared a story about one of her internship experiences and how she learned about work environment through interaction with professionals stating, "there are things and opportunities for me to kind of get out in the field and look at something to actually see it, to measure it, those kinds of stuff. But I guess knowing that comes from talking with professionals and asking what their day to day kind of life

is. Or what is a day of work like. So I think it mostly comes from that..." Lily also reflected on her internship and shared a benefit stating, "you are using these people as future references and future experiences. So there's a line of professionalism because they your superiors and then also befriended them to where you can ask them for advice and favors in the future..." These types of responses were captured in and represented by *using own observation to understand the profession* and *learning from role model*.

Students particularly had two processes in mind of searching for the "right" career path. Outwardly, they learned the tasks and familiarized themselves with the work environment (i.e., concrete experience). Inwardly, they evaluated their path into the field or organization and sorted problems through their involvement in, and investigation of, the organization (i.e., reflective observation). Students with diverging style could draw their career paths through working in groups of professionals and envisioning different aspects of their career.

Converging

Converging style was observed from students who defined personal interests and applied knowledge in an internship. The learning behaviors of the converging code were identified in two ways: 1) seeking work opportunities to define their interest in the field (n=4) and 2) applying knowledge gained in class (n=2). These learning behaviors were mostly found from students who sought opportunities to engage in various activities to test their knowledge gained in class to work environment. For example, Charles demonstrated his interest in building sustainable infrastructures and sought opportunities to get an internship in related field. Charles stated, "this past term I was doing energy efficiency and sustainability internship and I really understood on a much broader level so at the city, at the local government or state government level how do we design, or how do we dictate to people to design sustainably." Kim also shared a similar experience on her first internship stating,

> *My first real internship, it was just solidifying like, "This is what I want to do when I grow up," you know? That was my first big "aha' moment, but I guess after the last couple, it was more where I wanted to end up in the construction industry. I've had the opportunity, like I got a couple interviews and I got a couple offers the last year from different companies, different styles of companies and all that, but I did really think that my home is within the general contracting world, and I do think after my last couple experiences that I kind of want to lean more towards a superintendent role, being out in the field, seeing what's going on as it's happening instead of going out just to update the schedule, you know?*

Kim "solidified" her limited understanding of the field (abstract conceptualization) by trying different opportunities to progress toward becoming a superintendent for her next field experience (active experimentation). Kim brought her conceptual interest in the field to define her career path through an internship.

Accommodating

Three learning behaviors of the accommodating style were identified. These behaviors demonstrated students gaining a wide range of perspectives through working with other people and making practical approaches to shaping their career. Accommodating learning behaviors include 1) trying different positions to be prepared at work (n=6), 2) learning from trial and error (n=5), and 3) trying skills acquired in prior work experience (n=3). In this style of learning, students confirmed their career paths and practiced their skills acquired before. Six students responded that internships helped to try different positions that they were interested in. For example, Max shared his story about working with other people stating, "I think my biggest responsibility was learning how to manage people and keeping them where I can have them working with me, not for me but working with me." Max learned about the responsibility of a manager by trying a supervisory role in an internship as captured by *Trying different positions to be prepared at work*. These students could plan for what kinds of skills would be expected and required for the job. Also, students learned through trial and error in an internship. Tobias stated, "I think that's the best way of learning, making mistakes for sure. I've made plenty of mistakes and I will own up to them and I think they're all great learning experiences….I understand making mistakes is okay in industry but if I can help it and not make the major ones, that would be really beneficial I guess." Similarly, Alex had a similar attitude. She stated, "So when I came into college, I kept doing trial and error of things that I can do. I slowly started getting better and better. So, my first semester I only joined one organization, kinda [*sic*] got my feet wet, how do I manage that time and then started adding it from there." These students were less afraid of trial and error (active experimentation) and learned from a prior work experience to be better prepared for their career.

Students also used skills learned from prior work experience in an internship. For example, Alex identified some problems during an internship and applied her skills to resolve the issue. She stated, "seeing the problems that I saw in the field and then I was like all the skills that I know and the skills that I've learned can totally be applied in this situation…" Along the same line, Tobias recalled the lessons that his father taught in a construction project to address workplace challenges. He explained that, "I guess through my internships or just through life. My dad, he is a manager and he kind of taught me how to deal with certain situations, how to deal with like, I guess how to live a very high stress life whilst staying levelheaded. So, he gave me some advice throughout the years and I applied it throughout my work experiences." These students reflected on their past work experience (concrete experience) and used knowledge to improve their work performance.

The findings of this study suggest that internships encourage students' continuous learning behaviors by allowing them to explore three learning styles. By using each style of Kolb's experiential learning, this study identified students' learning behaviors in an internship. Particularly, this study found that diverging learning style was used by all student participants as

they explored and conceptualized their future career through an internship. As we found three major learning styles used in student internship experiences, this study highlights students' preferred learning styles in different contexts. Kolb [3] emphasized that a learning context influences student learning styles because each learning context entails a different learning style to elicit the best learning outcome. Students did not demonstrate assimilating style because an internship is less conducive to creating theoretical models. The findings of this study suggest that students switch among diverging, converging, and accommodating learning style to obtain effective learning outcomes in an internship.

Preferred learning styles by other variables

Kolb suggested that students explore diverse learning styles as they advance personal development and adapt to a new learning context. Our findings did not show any apparent patterns by gender, academic standing, and the number of internships. These results are demonstrated in Figure 1. The vertical axis indicates the total number of learning behaviors (or fine codes) demonstrated in an internship and each bar indicates the number of learning behaviors under each style. In this study, three learning styles dictated students' internship experiences as demonstrated by subordinating learning behaviors.

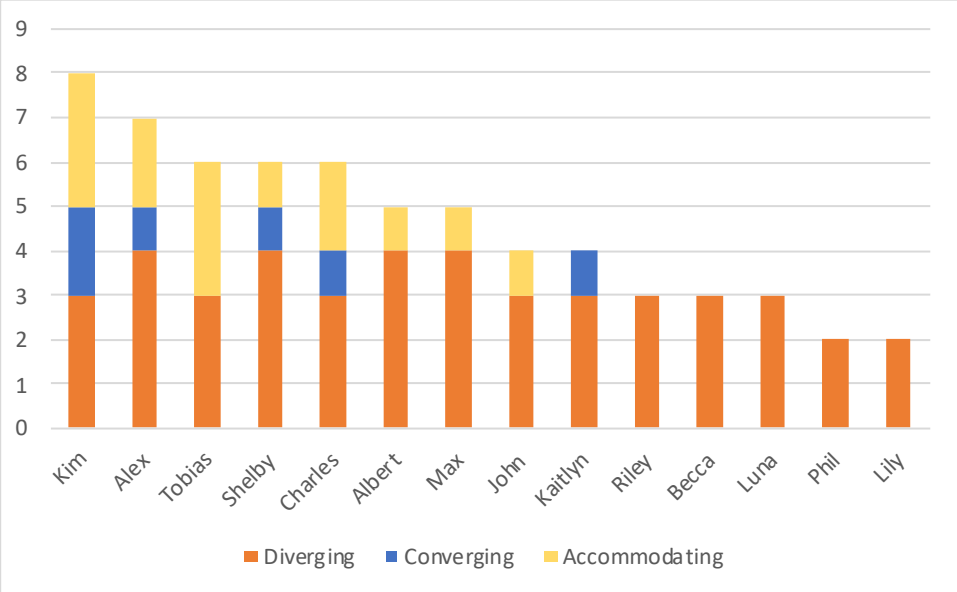

Figure 1. Preferred learning style by gender

While the findings of this study allude to an apparent prevalence of the diverging style in an internship, this study lacked sufficient number of participants to make a statistical judgement. Future study is needed to understand statistical significance of student learning style in an internship.

Future Work

To leverage the benefits and learning behaviors through internship, future work is warranted. Future studies may look into any differences by other variable (e.g., demography, age, number of internship, academic standing) that may arise by analyzing a higher number of civil engineering students. This study also found that civil engineering student take various learning styles and behaviors to leverage the learning outcome. Future study may investigate what other learning contexts can foster students' exploration of learning styles (e.g., cocurricular or extracurricular activities) [12]-[13]. Such opportunities will help students explore different learning contexts and be better equipped with various learning styles for their life-long development.

Conclusion

This paper provided findings of how students demonstrate learning behaviors in an internship through the lens of Kolb's experiential learning theory. This paper sheds light on the civil engineering students' experiential learning styles in an internship. Three learning styles were observed in this study: diverging, converging, and accommodating. Kolb suggested that learning should be conceived and experienced as a process as opposed to an outcome [7], [14]. By using Kolb's experiential theory, this study provided a redeveloped model of Kolb's theory contextualized in civil engineering education. Each learning style is supported by students' learning behaviors that were observed and analyzed in this study. These learning behaviors pinpoint the importance of student internship experience as providing different learning contexts. As students develop their learning styles through exploring different learning contexts, the study suggests that civil and construction engineering education should provide more opportunities for student industry experience.

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