

## **Full Paper: An Immersive Approach for First-Year Engineering Students**

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## **Abstract**

The concept of utilizing interdisciplinary, multidisciplinary, and cross-disciplinary approaches for first-year engineering students has been increasingly studied over recent years. However, many of these studies examine the use of general engineering concepts and subsequently provide a connection of how they apply to engineering design. As an example, a program may present an engineering project and then discuss how mathematics and physics fit within the context of the project. While it is imperative that first-year engineering students understand the relationship between these fields and their role within engineering, there are limited studies which examine immersing first-year engineering students into a teaching environment that is centered around the understanding of another closely related major.

This paper will present an overview and assessment of immersing first-year Architectural Engineering students into a beginning architecture design studio that is instructed by both Architecture faculty members and an Architectural Engineering faculty member.

## **Introduction**

The utilization of interdisciplinary, multidisciplinary, and cross-disciplinary approaches in engineering curriculum is not a unique concept and has been widely used and accepted within undergraduate engineering curriculums for decades. In 1997, the Accreditation Board for Engineering and Technology (ABET) adopted Engineering Criteria 2000 (EC2000), which further emphasized that accredited engineering programs need to consider the ability to function on multidisciplinary teams within their curriculums [1]. Since this time, there has been an increasing number of studies on interdisciplinary, multidisciplinary, and cross-disciplinary educational approaches.

However, some university programs reserve these types of collaborative approaches for senior capstone projects. This approach is reasonable since studies suggest that positive multidisciplinary team outcomes are more likely when each individual team member has prior experience demonstrating interdisciplinary thinking and working in teams with interdisciplinary goals [2]. But what if a student is immersed in a teaching environment that is centered around another closely related major during their first year in an engineering program? Would this immersive approach allow students to develop a better appreciation and understanding of other disciplines early in their educational career? While this study offers an overview and assessment of immersing first-year Architectural Engineering students into a beginning architecture design studio, the intention is for programs with similarly related majors to have the ability to also apply concepts presented.

For the purpose of this paper, interdisciplinary is defined as integrating knowledge and methods from different majors using a synthesis of approaches, multidisciplinary is defined as students from different majors working together where they each draw on their knowledge from their

chosen major, and cross-disciplinary is defined as viewing a major from the perspective of another.

## **Overview of the School of Architecture at Oklahoma State University**

The School of Architecture at Oklahoma State University was founded in 1909 with professional programs in both Architectural Engineering (ARCHE) and Architecture (ARCH). Both degrees are accredited by ABET and the National Architectural Accrediting Board (NAAB) respectively. The ARCHE program at Oklahoma State University is uniquely a part of the School of Architecture and requires as a part of the curriculum for ARCHE students to take an Introduction to Architecture course in their first-year fall semester, an architecture design studio in the first-year spring semester, and another architecture design studio in their second-year spring semester. The ARCHE students then concentrate on program specific courses until their final semester, during which they enroll in a capstone design course that utilizes multidisciplinary groups of ARCHE and ARCH students to design and analyze a building project over the course of a semester. While the capstone portion of the program is not unique to Oklahoma State University, the immersion of first-year Architectural Engineering students into the architectural design studio is and forms the basis of this paper.

## **Literature Review**

Marino, Cross, Feinaur, McCusker, and Casale noticed first-year engineering students often identify themselves as one particular type of engineer, for example “I’m an Electrical Engineer,” without understanding the multidisciplinary nature of both engineering and engineering projects [3]. The authors suggest that students are not likely to have developed discipline-specific knowledge that differentiates them from their peers during their first year, and it is unlikely that team projects will lead to first semester students building an appreciation for working with someone from a different professional background and skillset. In order to impress upon the students that multidisciplinary interaction is an essential part of engineering, while also realizing first-year engineering students may lack the knowledge to work in multidisciplinary teams, the authors incorporated lectures and experiences for first year engineering students centered around helping the students appreciate the multidisciplinary nature of engineering [3].

The School of Architecture at Oklahoma State University has also attempted to mitigate the potential issue of their ARCHE students not understanding the multidisciplinary nature of architecture and architectural engineering. However, instead of incorporating lectures into an introductory engineering course, the students are immersed in the beginning architectural design studio. The idea of immersing first-year engineering students into a teaching environment that is centered around the understanding of another closely related major is to help bridge the divide between these students in understanding the relationship between these fields more intimately and their role within engineering early on in their educational career. The desired outcome is that students may anticipate issues that their decisions may make for other disciplines and how to mitigate those issues early in the design process. It is this critical thinking skill that may benefit a project as a whole and provide more respect for colleagues within closely related fields.

McPherson, Troy, and Baker also attempted to address the challenge of introducing students to discipline related skills at the beginning of a student's educational career instead of waiting until they are enrolled in upper-level courses. Their approach was to provide students with an engineering experience during their first semester that is centered around a lecture course, a lab course covering mechanical engineering, and a lab course covering electrical and computer engineering [4]. Although students are inserted into these lab courses that introduce concepts from other disciplines, this approach appears to differ from the immersive approach used for the ARCHE students at Oklahoma State University. The immersive approach is centered around the concept that students are inserted into a core class of a closely related program that is unaltered based on having students from another discipline enrolled in the course.

### **Discussion on Immersive Approach Results**

In senior capstone projects which utilize multidisciplinary collaboration, it is common for students to only contribute ideas from their chosen major on a project and are limited in understanding their teammates work since they have not completed the same coursework as those students. While this is what students can expect upon graduation and provides valuable experience for students, this type of collaboration may not afford students the opportunity to specifically relate to students from other majors and they may not fully understand or appreciate some of the challenges those students may face on a given project.

As mentioned previously, the ARCHE students at Oklahoma State University enroll in a capstone design course that utilizes multidisciplinary groups of ARCHE and ARCH students to design and analyze a building project in their last semester. It has been repeatedly observed during the capstone design course that the ARCHE students are well equipped to contribute to the architectural design of the project. This observation challenges the notion that students in multidisciplinary collaboration can only contribute ideas from their chosen major on a project.

Additionally, the ability for ARCHE students to provide value to the architectural design on the project appears to be well received by the ARCH students. Since the ARCH and ARCHE students begin in the same architectural design studios, there appears to be a sense of understanding from both majors that they have gone through similar experiences and therefore are not hesitant to accept ideas or contributions from one another. For additional context, the ARCH students also complete introductory structural courses as a part of their curriculum, such as Steel I and Concrete I, which could help to contribute to the ARCHE students also having an appreciation for the contributions made by the ARCH students regarding the structural components of the capstone project.

### **Challenges and Lessons Learned from the Immersive Approach**

One of the main challenges encountered by immersing students into a core class that is outside their chosen major is trying to make the students understand the relationship and the purpose of inserting them into the course. In a survey sent to students within the School of Architecture at the beginning of the 2023 spring semester, the ARCHE students were asked if they have ever considered switching majors during their undergraduate career, what year they considered

switching majors, and their primary reason for considering switching majors. Of the 49 ARCHE respondents, 44% of those students stated they had considered switching their major. A breakdown of the survey demographics for the ARCHE students based on the year they are in is provided in Table 1.

**Table 1: Initial Survey Demographics on Year in ARCHE Program**

<b>Year in ARCHE Program</b>	<b>Number of Respondents</b>	<b>Number of ARCHE Students</b>	<b>Percentage of Total ARCHE Students</b>
1 <sup>st</sup> Year	6	35	17%
2 <sup>nd</sup> Year	8	24	33%
3 <sup>rd</sup> Year	13	19	68%
4 <sup>th</sup> Year	10	15	67%
5 <sup>th</sup> Year	12	18	67%
Total	49	111	44%

Since a large percentage of students considered switching majors, an investigation was warranted into why these students are considering leaving the ARCHE major. The survey asked the ARCHE students their primary reason for considering switching majors and utilized four of the top responses from a report by The Structural Engineering, Engagement, and Equity Committee (SE3) of the Structural Engineers Association of Northern California [5]. Table 2 provides a summary of survey responses for the primary reason ARCHE students considered changing their major.

**Table 2: Initial Survey Response for Considering Leaving the ARCHE Program**

<b>Question: What was the primary reason for switching majors?</b>	<b>Number of ARCHE Students</b>	<b>Percentage of Total ARCHE Students</b>
Other majors are less challenging	2	10%
I am more interested in a different career	3	15%
I am not enjoying the courses in my chosen major of study	3	15%
I would have better career opportunities with a different degree	0	0%
Other	12	60%

For those ARCHE students that chose other as their response, they were then asked to provide a text response. Of the 12 respondents that responded “other”, only eight provided text responses. Three of those eight respondents stated they did not enjoy the studio course and felt like they were an Architecture student and not an Architectural Engineering student, three other respondents became more interested in architecture or becoming a dual major in ARCH and ARCHE, and two stated they were considering a different career path.

Based on this feedback, a possible challenge arose. The survey suggested 15% of the ARCHE respondents that considered switching their major did not enjoy the studio course they were immersed in and began to question if the ARCHE major was the right choice. In order to address this challenge, an ARCHE faculty member was placed into the first-year architecture design studio in an attempt to try and make the ARCHE students discover their belonging in the design studio.

A second survey was sent at the end of the semester to the first-year ARCHE students who had the beginning architectural design studio with the ARCHE faculty member and while seven of the 13 respondents responded they still considered switching majors, none of the students stated the primary reason for considering the switch was due to not enjoying the architecture design studio. This may suggest that the inclusion of the ARCHE faculty member helped students to understand the connection between the ARCHE and ARCH courses better than solely having the studio course instructed by ARCH faculty members. A summary of the survey responses for the second survey is provided in Table 3.

**Table 3: Second Survey Response to for Considering Leaving the ARCHE Program**

<b>Question: What was the primary reason for switching majors?</b>	<b>Number of ARCHE Respondents</b>	<b>Percentage of Total ARCHE Respondents</b>
Other majors are less challenging	3	47%
I am more interested in a different career	1	13%
I am not enjoying the courses in my chosen major of study	1	7%
I would have better career opportunities with a different degree	0	0%
Other	2	33%

### **Discussion on Other Closely Related Majors**

Although this paper specifically addresses the relationship between the fields of architecture and architectural engineering, the concepts can be utilized for various other disciplines where close relationships between fields are essential for the success of a project. As a few examples, mechanical and electrical engineering, civil and environmental engineering, and computer science and software engineering all share similar characteristics as the relationship between architecture and architectural engineering.

### **Conclusions**

The School of Architecture at Oklahoma State University has historically and uniquely included Architectural Engineering students in the beginning architecture design studios. By immersing these students into a teaching environment centered around another closely related major, it is believed that students have developed a better appreciation of Architects and a deeper understanding into the thought processes and techniques used by Architects.

As a consequence of immersing students in a course that is centered around another closely related major, the survey results suggest that students may feel a lack of belonging within the course and could even contemplate switching majors. The use of having a faculty member from their major of choice involved in the course may help to provide students with a better understanding of belonging within the immersed course.

An initial review of the immersive approach for Architectural Engineering students at Oklahoma State University appears to suggest that immersing students into the beginning architectural design studios has been successful for the program and should be continued.

## References

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