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Work-in-Progress: Effect of Instructional Practices on Students' Engagement and Performance

Mr. Umer Farooq, Texas A&M University

Umer Farooq is a Ph.D. student in the Multidisciplinary Engineering Department at Texas A&M University, with a focus on Engineering Education. Umer is part of the Learning Enhancement and Applications Development Lab (LEAD Lab). Umer contributes to research initiatives centered on educational, instructional, and workforce development in the manufacturing sector. His efforts align with the mission of the Texas A&M University Gulf Coast Center of Excellence (GCCoE), where he collaborates on diverse projects aimed at enhancing learning experiences for students, trainees, and professionals.

Dr. Saira Anwar, Texas A and M University

Saira Anwar is an Assistant Professor at the Department of Multidisciplinary Engineering, Texas A and M University, College Station. She received her Ph.D. in Engineering Education from the School of Engineering Education, Purdue University, USA. The Department of Energy, National Science Foundation, and industry sponsors fund her research. Her research potential and the implication of her work are recognized through national and international awards, including the 2023 NSTA/NARST Research Worth Reading award for her publication in the Journal of Research in Science Teaching, 2023 New Faculty Fellow award by IEEE ASEE Frontiers in Education Conference, 2022 Apprentice Faculty Grant award by the ERM Division, ASEE, and 2020 outstanding researcher award by the School of Engineering Education, Purdue University. Dr. Anwar has over 20 years of teaching experience at various national and international universities, including the Texas A and M University - USA, University of Florida - USA, and Forman Christian College University - Pakistan. She also received outstanding teacher awards in 2013 and 2006. Also she received the "President of Pakistan Merit and Talent Scholarship" for her undergraduate studies.

Work-in-Progress: Effect of Instructional Practices on Students' Engagement and Performance – A Study Design

Abstract

Prior research has focused on examining the effectiveness of student-centered instructional practices in conceptually hard STEM courses. However, the effectiveness was measured mainly by comparing the improvements in students' learning outcomes in new practice against the traditional approach. Since instructional practices are at the heart of effective teaching, a lack of student-based investigation may lead to critical but often neglected research dimensions. These dimensions include: 1) Understanding students' perceptions of new practices. 2) real-time accounts of class that could influence students' perceptions 3) Understanding the impact of these perceptions on students' engagement and performance. Drawing from the ICAP (Interactive, Constructive, Active, and Passive) framework, this work-in-progress study provides the research design to comprehend how students' perspective affects their learning and engagement. We propose an investigation using two research questions: 1) how do real-time accounts of the instructional practices in the classroom relate to students' perceptions? And 2) How do student perceptions of instructional practices affect their engagement and performance? This work-in-progress study explains the design using a cross-sectional quantitative approach. More specifically, we suggest the methodologies for data collection and analysis. We also describe the future directions for the future full paper.

Introduction

Research studies on engineering education have focused on introducing student-centered instructional practices to engineering students [1], [2]. These instructional practices have been emphasized due to their ability to keep the students engaged, i.e., active participation of students in classroom activities throughout the learning process [3]. While traditional approaches (teacher-centered) involve students just participating passively, student-centered instructional practices include students in their learning process. In student-centered practices, students learn by constructing knowledge [4], collaborating with other students [5], and providing solutions to real-world, authentic problems [6]. While research acknowledges the potential benefits of these student-centric instructional practices [3], [7], [8], a critical dimension often remains under-explored, which is understanding students' perceptions of these instructional practices and understanding the impact of these practices on students' engagement and performance.

The interactive, constructive, active, and passive (ICAP) framework offers a valuable lens to examine the understudied dimension of the impact of instructional practices on students' engagement and performance using students' perceptions [9]. The ICAP framework suggests that students' engagement with instructional practices evolves from passive reception to active participation and, ultimately, to interactive construction of knowledge [10]. As lecture moves along this spectrum, instructional practices also change. ICAP has shown that students learn and perform better if actively engaged [11], [12], [13]. However, the focus on objective measures of learning often needs to pay more attention to the vital role of student perceptions.

In this work-in-progress study, we present the research design to explore how real-time accounts of instructional practices relate to students' perceptions. Additionally, following the guidelines of existing research [14], we suggest investigating how these perceptions influence students' performance and engagement. This research design allows us to examine the interplay between instructional practices, students' perceptions, students' engagement, and students' learning. The following research questions are guiding this study:

1. How do real-time accounts of the instructional practices in the classroom relate to students' perceptions?

2. How do students' perception of instructional practices affect their engagement and performance?

Literature Review

Prior literature supports using student-centered instructional practices for effective education, supporting student engagement and collaborative learning [15], [16], [17], [18]. Consequently, the literature suggests that such practices have many potential advantages related to students learning and engagement [19].

The notable advantages suggest that students got better grades and understood STEM concepts taught in the classroom [12], [20], [21]. Also, these student-centered practices developed curiosity, intrinsic motivation, and positive attitudes in students toward STEM [22], [23]. Another advantage of student-centered instructional practices is the development of critical thinking and better problem-solving skills. Students applied, synthesized, and analyzed knowledge better in the classroom, actively learning to solve real-world problems [24].

Although student-centered approaches and active learning classrooms have shown compelling advantages over traditional teacher-centered approaches, a critical dimension of how students think and perceive these different instructional practices used in classrooms and how they feel it impacts their overall learning, especially engagement and academic performance, needs to be explored. However, previous studies have emphasized the importance of students' perceptions in such evaluations. For example, Cho and colleagues highlighted the importance of students' perceptions and experiences as the central component of their learning [25]. They highlighted the significant change in students' perceptions after the controlled teaching sessions. These perceptions are primarily outside conversations about instructional practices, and only a handful of studies have considered them. For example, Julie and colleagues in their study [26] examined the effects of student engagement in online learning environments. The study results indicated that students who thought their science classrooms were more student-centered reported higher classroom engagement.

Drawing from the principles of the Interactive, Constructive, Active, and Passive (ICAP) framework, instructional practices play a fundamental role in students' learning outcomes. ICAP framework provides a valuable lens for understanding student learning and engagement during different instructional practices in a classroom [10], [27]. The built-in ICAP hypothesis helps to examine learning on a spectrum, starting from passive to interactive engagement. Although prior research studies have used the ICAP framework for various purposes and settings, such as validation of the ICAP framework hypothesis in real classroom settings [14], [28] or informal lab settings [29] or use of ICAP framework as a theoretical or analytical lens to measure the role of different instructional practices [30], more studies are needed to capture the essence of the ICAP framework in an actual classroom setting with students perception. Researchers have designed various instruments for this purpose, which include the Teaching Dimensions Observation

Protocol (TDOP) [31] and Students' Response to Instructional Practices (StRIP) [32]. TDOP provides support in systematically observing the classroom [33]. StRIP helps gather data on students' emotional, cognitive, and social aspects in response to multiple instructional practices.

Considering the scarcity of existing literature on using ICAP to evaluate instructional practices and studies considering students' perspectives as part of the investigation, this work-in-progress paper proposes a research design that uses these mechanisms.

Research Design

This work-in-progress paper is designed with a quantitative methodology and cross-sectional research design. The cross-sectional quantitative approach allows the sample collected from the same students to be compared for single comparisons.

Site and Participants

The proposed research will be conducted at Texas A&M University, a large R1 University in the United States. The data will be collected from three faculty members and approximately 150 students enrolled in three courses. The courses will be selected through convenience sampling from the STEM courses offered during the Spring and Fall of 2024. The study will follow the ethical considerations of taking participants' (faculty and students) consent whose instructors have consented to the classroom observations.

Measures and Data Collections

In this research, we propose to collect data on three aspects: 1) real-time classroom accounts of instructional practices, 2) students' perceptions of instructional practices, and 3) students' performance.

For real-time classroom accounts, we will use classroom observation. For this purpose, we will use the structured and already validated observation protocol: Teaching Dimensions Observation Protocol (TDOP) [27]. The TDOP protocol was designed using the ICAP framework, allowing data collection on six dimensions. These dimensions are instructional practices (teacher-focused), instructional practices (student-focused), student-teacher interaction (teacher-led), student-teacher interaction (student-led), instructional technology, and potential cognitive demand. For this study, we will consider the first two dimensions of the protocol, which focuses on teaching methods and activities. We plan to observe each class at least four times in the semester. In addition to TDOP protocol dimensions, we will collect field notes to report any over-arching incident or activity in the classroom.

Observation training is a mandatory requirement for using the TDOP protocol [33]. The training process involves a thorough review and discussion of selected codes. For this purpose, observers will be trained on the protocol using existing recorded accounts of actual classrooms. Observers must practice coding in at least two such lectures. Following the practice, observer researchers must take an inter-rater reliability (IRR) test using the TDOP website. In this IRR test, observer researchers will independently code a class to assess agreement levels. The process will be repeated to ensure the data collection reliability until a desirable level of 0.85 is achieved, as recommended by the protocol guidelines.

A survey will be disseminated in pre- and post-manner to assess students' perceptions of instructional practices being used in the classroom and how they think they impact their engagement. For the instructional practices perception, we used an existing validated instrument designed using an ICAP lens titled Students' Response to Instruction Practices (StRIP) [28]. The StRIP instrument collects student responses to instructional practices and engagement. The instrument has four engagement constructs: value, positivity, participation, and distraction. There are three items each for value and positivity, four for participation, and five for distraction. Additionally, the instrument has four constructs for students' responses to instructional practices. These constructs are interactive, constructive, active, and passive. There are six items, each for interactive, constructive, and active construct, and three for passive. Also, the data is collected on a 1-5 Likert scale, where one means almost never, and five means very often (>90% of the time). The pre-survey will focus on understanding students' prior experiences and perceptions of instructional practices of previous STEM courses. However, the post-survey administered at the end of the course will capture their perception of the current STEM class.

For students' performance, students will self-report their cumulative GPA before the start of the semester and the expected grade in the selected STEM course.

Proposed Data Analysis

The data will be analyzed using quantitative approaches. For the first research question, the linear regression method will be used to understand the relationship between real-time accounts of classroom observation and students' perceptions. The real-time class accounts will be converted from codes to numeric values for each observation. Additionally, the average of the items will be calculated for each student's perception constructs (i.e., interactive, constructive, active, and passive). The simple linear regression will examine the relationship between the two variables, i.e., the numeric code of classroom observations and student perception constructs.

Similarly, multiple regression analysis will be conducted for the second research question to understand the relationship between students' perceptions of instructional practices, engagement, and performances. For engagement, the StRIP instrument has four constructs of engagement (i.e., value, positivity, participation, and distraction) and four constructs of instructional practice (i.e., interactive, constructive, active, and passive). Within this study, we propose to use the average of all items within each construct. The data will be analyzed using multiple regressions between each construct of engagement, performance, and student's perception of instructional practices to get the relationship.

Limitations

The proposed research design has several limitations. First, this study is designed to examine the current classroom instructional practices and does not account for generalizable results for which instructional practice may be better than the other. Second, the sampling strategy is based on convenience sampling, and the absence of a randomized control sample limits the interpretation of results in the context of selected courses only. Third, the proposed methods consider combining the data collected from various classes and don't account for class-based variations. Fourth, the data collection approach includes students' self-reported evidence and classroom observations. However, other process measures, such as sensory measures and faculty perception, may provide more insightful data.

Final Thoughts

This work-in-progress paper proposed a quantitative cross-sectional approach to understanding instructional practices using real-time classroom observations and students' perceptions of instructional practices used in STEM classrooms. Also, the study proposes to investigate how these perceptions may impact students' engagement and performance. Using various multiple regression techniques on StRIP survey responses and real-time classroom accounts, the study sets the base for a thorough investigation. The results of this investigation will help educators and research for the design and use of effective instructional practices. Future studies in the same realm may consider overcoming this design limitation for more generalizable results.

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