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An Exploratory Research Study on a University Directed Co- Teaching Initiative with a Community College, High School, and Industry in Support of Aligned Learning Outcomes

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Research has shown that higher education learning, a transition point to industry for most people, is always challenged in meeting the demands of the multidimensional experiences people in practice demonstrate. A greater part of construction related students lack firsthand experience and the required soft skills for industry practice. Thus, a need for a partnership between industry and academia in training students for better learning outcomes is called for. Other studies also project a 9% decline in high school graduation rate between 2020 and 2030, which calls for the need to instill the interest in construction related professions at the high school level to prevent a decline in construction related programs enrolment. The noted challenge has led to the introduction of a co-teaching platform engaging universities, community colleges and high schools, with input from industry, in support of anticipated aligned learning outcomes. This paper presents an exploratory study: a co-teaching initiative involving three instructors of record, six industry practitioners, with the integration of video conferencing technologies (i.e., Zoom Meeting and Meeting Owl Pro), and the effectiveness measured through Direct as well as Indirect Assessment methods. The results demonstrated that students across the various learning platforms were able to meet the set learning outcomes. Survey responses also indicated a good blend between instructors of record and industry practitioners, thereby laying a foundation for the need to continue and improve the co-teaching platform through the online supporting tools to enhance the competencies of young graduates.

Key Words: Teaching with Industry, Meeting Owl Pro, Co-teaching, Aligned Learning Outcomes, Industry Practitioners

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Introduction

The educational structure of nations across the globe has always seen reforms that look at improving learning and learners' rights. To this effect higher education institutions see the needed improvements as a quality assurance issue (Adeyeye, 2009) - quality in terms of value for money, fitness of purpose, and student transformation (Biggs, 2001). The evaluation of teaching success should ideally feed into enhancing current and future curricula to ensure relevance for both academic and professional goals. Taking a cue from efforts at achieving quality in the knowledge dissemination process to learners in academia, calls for addressing the disconnect between formal education pedagogy and industry expectations in consonance with mentoring students at the high school level for efficient aligned outcomes. This could only be achieved by one of many ways as taking advantage of the surge in the use of virtual technology platforms for multilateral engagements of all learner groups.

Reiterating the U. S. Bureau of Labor Statistics' future employment projections reported for 2021, it is expected that construction jobs will grow by an estimated 11% nationally between the years 2020 and 2030, which in real numerical terms translates to about 11.9 million additional construction jobs yet to be filled (Bureau of Labor Statistics News Release, 2021). These projections serve as a catalyst for carrying out more developmental projects. They also provide an incentive to engage and ~~or~~ train more people who will fill critical positions left vacant or created by the anticipated job growth.

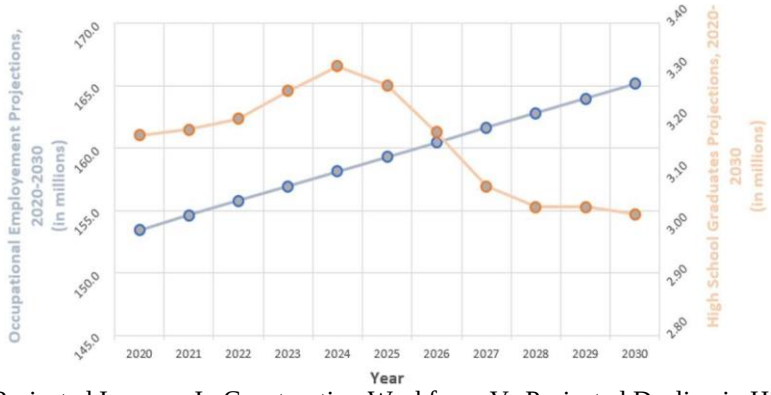

Figure 1. Projected Increase In Construction Workforce Vs Projected Decline in High School Graduation Across the US, 2020 – 2030

Despite the projected positive trend in total employment, the Western Interstate Commission for Higher Education (WICHE) by their 2017 report, is also predicting a 5% rise in the number of high school graduates through year 2025, followed by a sudden 9% drop in 2026 and beyond (see figure 1) (Knocking at the College Door, 2021). This reality raises a lot of concern especially when no measures seem to be in place to meet the demands of the projected boom in construction jobs. To add to this, a 2016 Gallup Student Poll found out that student engagement in school drops swiftly from 5th grade through 12th grade. It suggests that about three quarters of elementary school kids (76%) are found to be engaged in school, while only 44% of high school kids truly get engaged. Which translates to, fewer students getting engaged as they progress through school (Brenneman, 2016). "With each year that these students progress in school, not engaging with their dreams and thus becoming less engaged overall, the more our hopes of long-term economic revival are dashed" (Busteed, 2013). It therefore behooves construction educators to seek a unifying platform that embraces all stakeholders to connect through a common source of information sharing (i.e., a well- planned schedule to engage physically or by videoconferencing modes).

Recent studies into the use of Zoom for course delivery have found out that the Zoom Meeting platform supports the use of a virtual white board with annotation capacity to explain concepts, formation of breakout rooms to create small collaborative group work, solicit feedback from students through polls, and multi-way chat to facilitate class discussions. In addition, Zoom meetings can be recorded and made available for future reference (Vandenberg & Magnuson, 2021). Thereby making it a good fit for administering course content in construction safety requirements (Nnaji & Krachan, 2020). Another positive is it aids co-teaching, which to a larger extent touches many more diverse student groups and is far reaching (Brendle & Lock, 2017).

This paper explores the effectiveness of co-teaching platforms with industry undertaken across University of Wyoming, Casper Community College, and Pathways Innovation Center in support of aligned learning outcomes. The findings of which will justify the need for continuation and improvement of a virtual learning platform (i.e., Zoom Meeting & Meeting Owl Pro); an online tool supporting the need to bridge the disconnect between industry and academia and also meet the expectations of industry when recruiting for open positions.

Literature Review

The concept of co-teaching described in many forms is an enhancing charter for student learning outcomes, and to partner with industry practitioners in this novelty with the supporting medium for information sharing, pushes for a lasting innovation. The themes: "Co-Teaching and its Use across Multiple Teaching Platforms," "Teaching with Industry" (TWI) and Student Learning Outcomes" (SLO's) which sum up the research study are further reviewed in the proceeding sections. Co-Teaching and Its Use across Multiple Teaching Platforms
Co-teaching is defined as having two or more people share the responsibility for teaching some or all of the students assigned to a classroom (Villa et al., 2008). It is one form of teaching where there is diversity in shared knowledge base is, and students benefit a lot from it (Walters & Misra, 2013). A test of this is illustrated in this study, where three instructors of record collaborated with industry practitioners in co-teaching a Construction Safety class.

Different forms of co-teaching models have been identified by several studies and grouped into six main models (Potts & Howard, 2011), which are "One teach, One observe," "One teach, One assist," "Parallel Teaching," "Station Teaching," "Alternative Teaching," and "Team Teaching". Each one of these co-teaching models is driven by its strength and in each case, all instructors are selected certified professionals although each may have their specific areas of expertise. This research study adopted the team-teaching model. In essence seeking to model a collaborative process within the classroom. Through this form of co-teaching, more students appreciate and assimilate better how theories and concepts are shared and or argued differently through several unique perspectives by co-instructors (Harris & Harvey, 2000). The experience influences students' appreciation for collaboration and negotiation in collaborative relationships that form part of their professional workplace training.

Teaching with Industry (TWI)

As introduced above, the missing expected graduate qualities such as their lack of soft/transferable skills, essential in today's labor market is predominantly discussed within current literature. Employers have blamed and criticized higher education institutions for not preparing students adequately for the current labor market, and thus continuously highlight students' lack of transferable skills (Hurrell, 2016). The phenomenon raises the question as to whether the soft/transferable skills gap, identified by employers, should be attributed to higher education institutions, that may be missing

out on the right strategy, or to the graduates and employers themselves who may be adopting inadequate recruitment and graduate development processes (Griffiths et al., 2018). It is acknowledged that academia and industry collaboration is essential to address the challenges both academia and industry are facing in adopting and promoting emerging technology in the construction industry. A successful collaboration between academia and industry can promote the commercialization of emerging technology, and again academia can benefit from the industry, which provides emerging technology research needs and additional funding to researchers (D'Este & Perkmann, 2011). A good innovative collaboration between academia and industry definitely leads to enriching student learning outcomes, and in order to measure this, the study has invited six industry practitioners to help teach the content as it relates to their industry experiences.

Student Learning Outcomes (SLO's)

The effectiveness of every academic program leading to the award of a diploma, or certain student support programs are measured through the use of student learning outcomes (SLO's). These SLO's are described as the knowledge, skills, and abilities that a student attains after going through a particular set of higher education experiences. One significant characteristic of student learning outcomes is that it is very specific and measurable; the results and analysis of the measurable should lead to a continuous chain of improving the taught course of study.

The education system in the USA currently requires that a lot of innovation be implemented to produce the needed learning outcomes at all school levels. The focus of educating future generations should be geared towards a combination of learning theory and practice without ignoring the expectations of the learners and the societies being affected directly. Instructors who will be engaging these students will therefore need to be sensitive to the expectations of students to maximize their learning experiences (Mupinga et al., 2006). The Bloom's Taxonomy scale (see figure 2), developed by Benjamin Bloom and revised by Anderson, Krathwohl puts the development of learning in perspective in that the sequence of learning must follow the Blooms hierarchy. This is required to plan and deliver integrated course content that leads to students operating at more complex levels of thinking (Ferguson, 2002). The information presented in this paper, which is part of a larger research study, follows through a cyclic methodology framework described in detail in the following section.

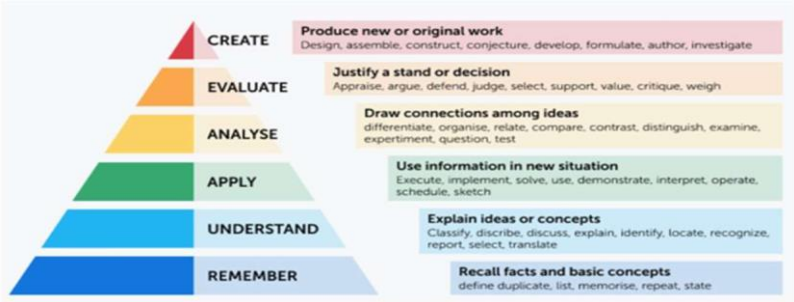

Figure 2. Bloom's Taxonomy Scale(Bloom's Taxonomy, 2022)

Research Methodology

The study, carried out by the newly established Construction Management program at the University of Wyoming, was developed with a methodology framework outlined in four levels (figure 3) and through a 16 week period across three campuses that engaged three instructors of record, their respective students (i.e., University of Wyoming, Casper Community College, and Pathways

Innovation Center) as well as invited industry practitioners.

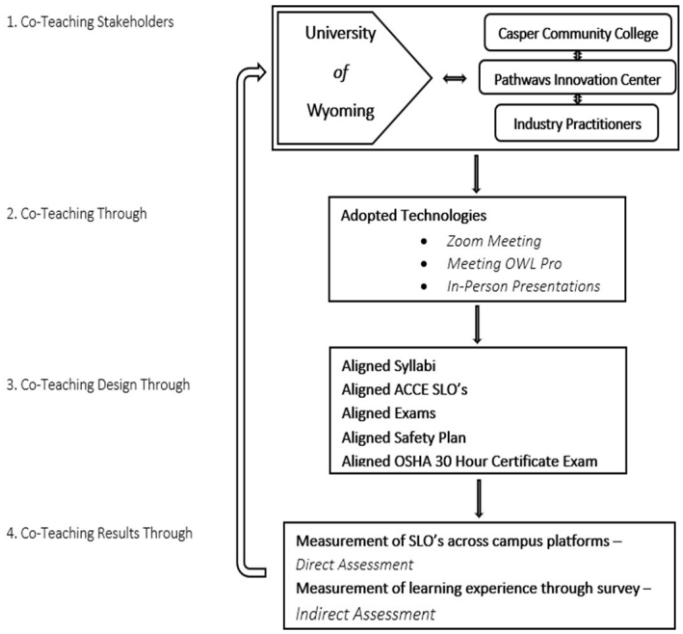

Figure 3. Methodology Framework of Research Study

The enrolled students for the Construction Safety (CM 2300) course, the course used for the study, included 27 students from University of Wyoming, nine students from Casper Community College and 14 students from Pathways Innovation Center (i.e., High School). The expertise of six industry practitioners were sought in aligning to the objectives of the study. Each of the industry practitioners were selected based on their industry specialty as it related to Construction Safety and with help from the Industry Advisory Board (IAB) and statewide industry associations. Two videoconference technologies were identified and integrated as part of the teaching platform: Zoom Meeting and Meeting OWL Pro device. These technologies were used in tandem with the original set up of the classroom which embodied in-person presentations and the flexibility of integrating synchronous communication through audio and visual data. The classroom setup (see figure 4) was laid out with students seated round tables arranged in an array throughout the classroom to enable in-class group activities. Each lecture session had students shuffled to avoid the same students forming clusters. Within each student sitting groups, open-ended questions pertaining to topics delivered by the instructor of record and or the industry practitioner are discussed.

Figure 4. Typical Classroom Setup with an Industry Practitioner during One of the Lecture Presentation Sessions

Study Results

The study results were defined under two categories, Direct and Indirect Assessments. The first category assessed the output of student learning through administered quizzes and safety plans while the second category focused on the analyses of the output data from surveys administered to instructors of record, industry practitioners and students. The data collated for both categories of assessment were analyzed with SPSS and graphs plotted for a better comparison.

Direct Assessment

The first measure of student learning outcomes (i.e., Direct Assessment) was assessed through the administering of three quizzes as well as in-class discussion questions. The quizzes consisted of multiple choice and true or false questions drawn from the textbook chapters for the Construction Safety course. In addition, each student was tasked with developing a Construction Safety Plan and the grades collated and statistically analyzed.

Interpretation of Descriptive Results for Quizzes and Safety Plan

In Quiz 1, the mean grade scored by students at Casper Community College (M = 82.78, SD = 4.66) was the highest compared to the average grade scored by University of Wyoming students (M = 70.7, SD = 6.78) and Pathways Innovation Center (M = 80.25, SD = 11.71) (figure 5). However, the computed standard deviations showed that variability in the graded scores for Casper Community College was low compared to variability in grades recorded for University of Wyoming and Pathways Innovation Center students. Also, Quiz 2 presented about the same trend in the average recorded grades for all three institutions. The mean grade scored by students from Casper Community College (M = 82.88, SD = 8.56) was the highest compared to the average grade scored by University of Wyoming students (M = 65.93, SD = 5.17) and Pathways Innovation Center (M = 80.25, SD = 10.17). Variability in the graded scores was low for University of Wyoming students compared to variability in graded scores for Casper Community College and Pathways Innovation Center.

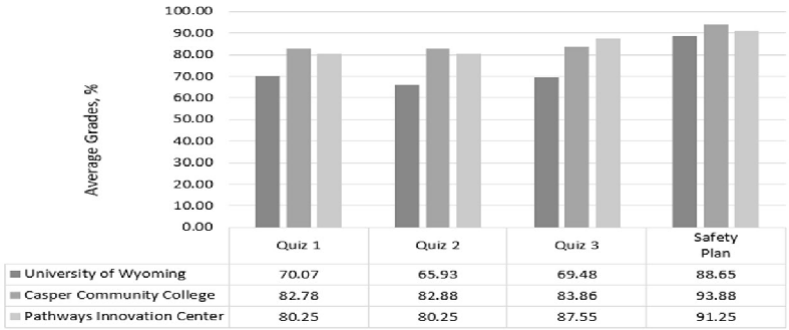

Figure 5. Direct Assessment of Grades of Quizzes and Safety Plan across the Three Campuses

The third and final quiz for the study recorded a different trend in the average grades of students across the three institutions. Pathways Innovation Center (M = 87.55, SD = 11.89) averaged a higher quiz grade relatively to Casper Community College (M = 83.86, SD = 6.07) and University of Wyoming (M = 69.48, SD = 4.09). There was low variability in the graded scores for University of

Wyoming compared to variability in graded scores for Casper Community College and Pathways Innovation Center. The computed standard deviations confirm this. Pathways Innovation Center saw high variability in the graded scores for Quiz 3. On the other hand, grades reported for the developed Safety Plans saw the average grade from students of Pathways Innovation Center (M = 91.25, SD = 2.81) relatively higher than the average grades of students from University of Wyoming (M = 88.65, SD = 6.74) and Casper Community College (M = 83.44, SD = 3.68). There is also relatively high variability in the grades from University of Wyoming compared to the grades from Pathways Innovation Center and Casper Community College.

Indirect Assessment End-Course Survey Administered to Students

Indirect assessment of the co-teaching platform with industry practitioners and how effective it was on the set learning outcomes was done by collecting data that required students' ratings of the "Co-Teaching Platform Technology," "Instructor Support and Collaboration," "Industry Practitioners' Support," and "Students' Learning Outcome". A total of 27 students from University of Wyoming took the survey, thus recording a 100% participation rate; seven students out of the total 9 enrolled students in Casper Community College also took the survey, reporting 77.7% participation rate while eight enrolled students from the recorded 14 from Pathways Innovation Center participated in the survey, giving a participation rate of 57.14%. Two students out of the eight who took the survey in Pathways Innovation Center did not complete the survey. Thus, giving a 75% completion rate. All the students from University of Wyoming and Casper Community College who were engaged in the survey completed fully and successfully, keeping a 100% completion rate for both campuses.

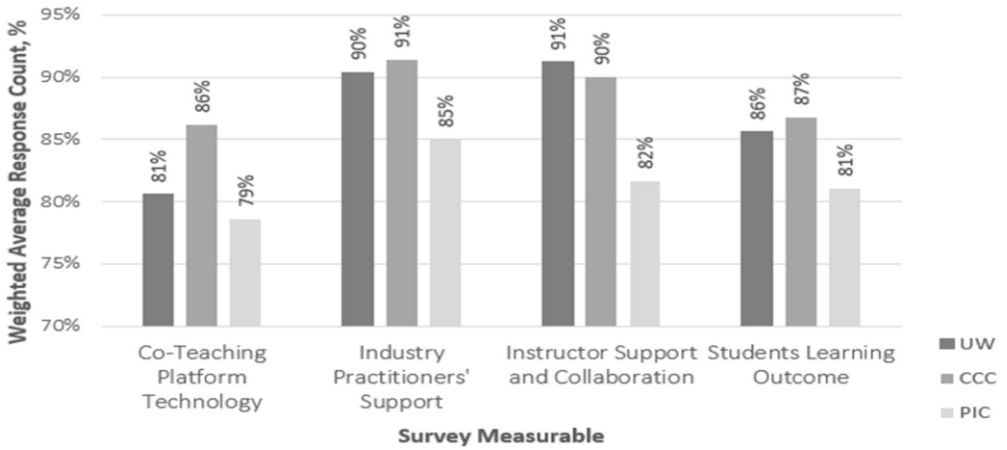

Figure 6. Graphical Representation of Mean Response Count of Survey Measurable (i.e., University of Wyoming, Casper Community College, and Pathways Innovation Center)

According to the graph of collated responses (figure 6), the weighted averaged response count for all the questions asked represented generally positive feedback. For instance, the questions rating "Instructor Support and Collaboration" had a response pattern of 82% for Pathways Innovation Center which suggested positive feedback 91% for University of Wyoming and 90% for Casper Community College, both also representing positive feedback.

Similarly, the response pattern for the questions rating the "Students' Learning Outcome," showed 86% for University of Wyoming, 87% for Casper Community College and 81% for Pathways Innovation Center. These weighted averaged response counts depicted positive feedback also.

End-Course Survey Administered To Instructors of Record

The assessment of the co-teaching platform with industry practitioners for the aligned learning outcome was again done by collecting data that required instructors of record to rate the "Co-Teaching Platform Technology," "Instructor Support and Collaboration," "Industry Practitioners' Support," and "Students' Learning Outcome". Results from the survey administered to instructors of record showed a 100% participation and completion rates.

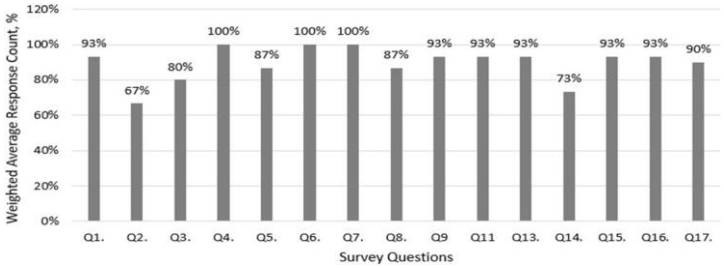

Figure 7. Graphical Representation of Weighted Average Response Count from Instructors of Record

A general overview of the response pattern from the instructors of record (figure 7) illustrated that more than 80% of the survey questions received positive feedback. For example, the weighted averaged response from Questions 4, 6 and 7 were overwhelming positive feedback. Typically Question 4 rated the level of collaboration amongst the instructors and industry practitioners (i.e., Industry Practitioners' Support") and the weighted averaged response count was 100% ("Very easy"), while Question 7 rating the level of contribution industry practitioners introduced to the learning platform (i.e., "Industry Practitioners' Support"). And the weighted averaged response count was 100% ('Excellent"). Again, Questions 9, rated the comfort level with the technology (Zoom Meeting and Meeting Owl Pro) for teaching across campuses (i.e., "Co-Teaching Platform (Technology)"), and the response was that of positive feedback ("Easy" to "Very Easy").

End-Course Survey Administered To Industry Practitioners

Out of the nine Likert-scale questions administered to the industry practitioners, seven questions (i.e., Questions 1, 3, 4, 5, 6, 7 and 9) had positive feedback (figure 8). Each question tested one of the measurable "Co-Teaching Platform (Technology)", "Instructor Support and Collaboration," "Industry Practitioners' Support," and "Students' Learning Outcome". The response to Question 1, rating how well industry practitioners thought they connected with students during their presentation (i.e., "Co-Teaching Platform (Technology)") received a 90% measure ("Extremely well"), showing industry practitioners connected positively with students. There was a 60% measure ("About what I expected") with Question 8, which rated if the class period allowed ample time to teach the prepared lecture content.

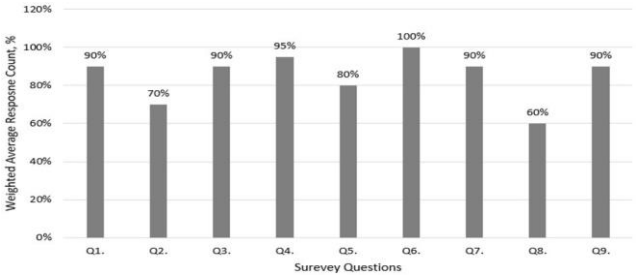

Figure 8. Weighted Average Response Counts from Industry Practitioners

Conclusion

This study explored co-teaching platforms with industry, and its effectiveness on aligned learning outcomes. Direct assessment of the students in the CM 2300: Construction Safety course, showed that the average grades obtained for all three quizzes and safety plans ranged from A to C, showing students understood the knowledge of industry vernacular & construction content, knowledge of OSHA and industry safety standards and were able to develop construction project safety plans, which is a requirement for future industry practice. End-course surveys administered to indirectly assess the "Co-Teaching Platform (Technology)," "Instructor Support and Collaboration," "Industry Practitioners' Support," and "Students' Learning Outcome" all generally polled positive feedback. Instructors of record worked together tirelessly to achieve a good collaborative blend. This teaming effort between University of Wyoming, Casper Community College, Pathways Innovation Center, and industry practitioners could be seen as one of the deciding factors on students' readiness to engage in another co-teaching with industry support in the future (77% for University of Wyoming, 90% for Casper Community College and 80% for Pathways Innovation Center representing "Definitely yes").

Taking into consideration the predicted 9% decline in high school graduates, between year 2026 and 2030, which has the tendency to negatively impact workforce, it is imperative that an initiative was taken now to add more professionals to the pool of construction workers. By diligently following through a well laid out curriculum supported by industry practitioners and sourcing for good technology like Zoom Meeting and Meeting Owl Pro that connects all participants irrespective of where they are located, a lot more successes could be achieved. The authors also acknowledge that the study needs to be expanded to more courses in the curriculum run by the Construction Management programs. Additional direct and indirect assessment data could be collected so that more improvements can be made to the teaching model, as more appropriate measures and methods of assessment are introduced. Also, the study should be generalized to solicit for information from industry experts and educators in other fields apart from those in the construction sector.

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