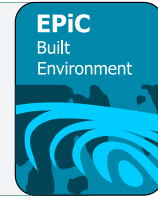




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## **Addressing the Construction Labor Shortage Through Connected Secondary and Post- Secondary Construction Education Pathways: A Descriptive Case Study in Wyoming**

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Despite a total population under 600,000, Wyoming's jobs increased by 5,672 positions in 2018. Notably, more than 50% of this job growth was in the construction industry. Until 2019, there were no formal secondary construction education and training programs able to supply the necessary workforce to meet industry needs. Since 2019, Wyoming has been fortunate to build strong construction programs within their high school Career and Technical Education curricula and Community College programs. With the support of the Associated General Contractors of Wyoming, educators at each level have partnered with the University of Wyoming to pilot several collaborative efforts to increase curricular consistency and credit articulation that can culminate in a bachelor's degree in Construction Management. A unique and major focus of the connected secondary to post-secondary construction education program is that it affords students the ability to exit and rejoin the educational pathway while concurrently gaining construction industry experience. This paper describes two programs piloted across educational levels in Wyoming. The use of the Zoom Meetings and Owl Pro technologies worked well to cultivate educational synergy between the classrooms located at each of the institutions across the state. Thus, the findings are helpful to those interested in connecting secondary and post-secondary construction education and training programs to address employment demand.

**Key Words:** Construction Labor Shortage, College Credit Articulation, Secondary Education, Post- Secondary Education, Skills Training

## Introduction and Literature Review

Nearly 91% of more than 1000 US construction firms that responded to a survey distributed by the Associated General Contractors of America (AGC) and Autodesk, report that difficulty in ‘finding workers’ is driving up construction cost and contributing to project delays (AGC, 2022). Wyoming’s construction training and education programs, similar to many other states, have been unable to keep pace with the demand and supply the necessary workforce to meet industry needs. Research reveals that the perceived differences between industry practitioners and academia may be a core cause of a current and future training shortfall (Moore et al., 2011). Industry members, training practitioners and educators lay claim to engaging some positive impact on labor supply while occasionally downplaying the efforts of the other groups. It is paramount that all the players in the construction-education space work together in support of providing opportunities to engage, educate and train more people to fill critical positions in the industry. Collaborative engagement is a necessity especially given the Bureau of Labor Statistics prediction of 11% growth in construction-related employment between 2020 and 2030.

This prediction should be especially concerning for western US states, in light of the projected high school graduation plateau in 2024, followed by sharp and then steady decline from 2025 to 2030 (Bransberger, 2017).

According to the Research and Planning Office of the Wyoming Department of Workforce Services, employment in Wyoming increased by 5,679 jobs (2.2%) and total payroll increased by \$192.1 million (6.2%) between the first quarters of 2018 and 2019.

Construction, which added 2,867 jobs during this period, accounted for nearly half of these job gains. Figure 1 illustrates the positive construction workforce growth and contradicting declining high school graduation between years 2020 and 2030.

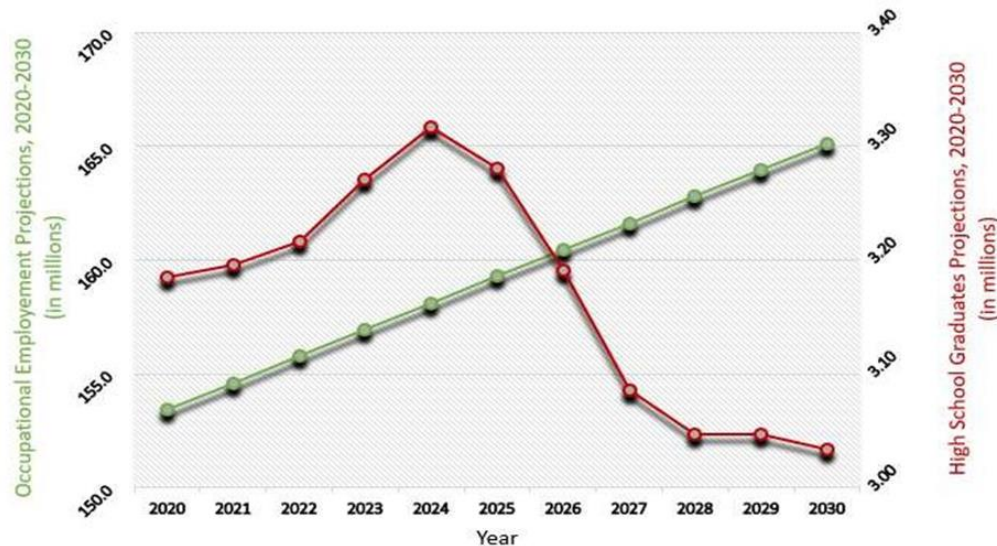


Figure 1. Occupation Growth Versus Anticipated High School Graduation

The positive growth figures recorded and projected for the construction industry require increased efforts to not only maintain but increase the number of individuals entering the

construction workforce. Notably, the onset of the COVID 19 pandemic temporarily reversed the observed trajectory with a national decline in all jobs from 162.8 to 153.5 million between 2019 and 2020 (see Figure 2). However, data analysis by the Associated Builders and Contractors show that the construction industry has bounced back faster than the U. S. Bureau of Labor Statistics' (BLS) prediction, with an increase of 311,000 construction jobs nationally between July of 2021 and July of 2022, indicating the ongoing importance of training and recruiting skilled trade's people and construction managers.

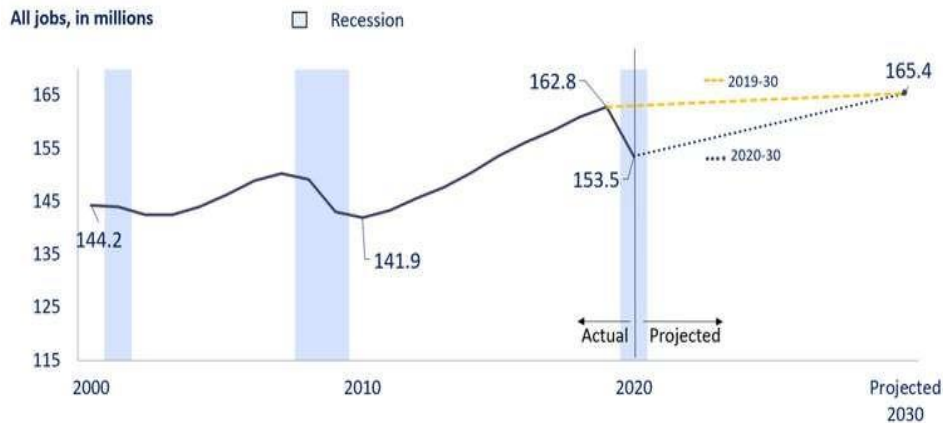


Figure 2. Construction Workforce Offset due to COVID 19

### A Call for Innovation in Education

In a report by the Organization for Economic Cooperation and Development (OECD), it is noted that “the pressure to increase equity and improve educational outcomes for students is growing around the world” (Vieluf et al., 2012). Many in the USA seem to recognize that education at all levels critically needs renewal. Wildavsky et al. (2011) state that higher education has to change to include more innovation. An enhanced educational setting therefore produces the needed learning outcomes at all school levels. Jim Shelton, a former assistant deputy secretary of the Office of Innovation and Improvement in the US Department of Education, also posits that “Whether for reasons of economic growth, competitiveness, social justice, or return on tax-payer investment, there is little rational argument over the need for significant improvement in U.S. educational outcomes.” Furthermore, it is undeniable that the US has only slightly improved on the majority of educational outcomes over the past few decades, especially when there has been a tremendous increase in investment over the same time period. In fact, rather than decreasing over time, the overall cost of producing each successful high school and college graduate has increased significantly, leading to what some refer to as an “inverted learning curve,” (Shelton, 2011).

Today’s education systems are required to be both effective and efficient, or in other words, to reach the goals set forth while making the best use of available resources” (Cornali, 2012, p. 255). This requires that the focus of educating future generations is geared towards a

combination of learning theory and practice without ignoring the expectations of the learners, the communities, and societies being affected directly, and the impact on their way of life. As stated by Serdyukov (2017), “every technology application demands a solid theoretical foundation which will be hinged on a well-focused, logical research and sound training.” Therefore, instructors engaging with students will need to be sensitive to the expectations of students to maximize their learning experiences (Mupinga et al., 2006).

Blokker, et al. (2019) emphasized that “career competencies are positively related to perceived employability and that the relationship between career competencies and career success mediates perceived employability.” For educators seeking 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), one of the many possibilities is to take advantage of the surge in the use of virtual technology platforms for multilateral engagements. The innovative virtual platforms, the use of a virtual white board with annotation capacity to explain concepts, forming breakout rooms to create small collaborative group work, soliciting feedback from students through polls, and chatting to facilitate class discussions develops and enhances learners’ engagement in the process.

### **Wyoming’s Construction Education Systems**

The construction sector plays a central role in the State of Wyoming’s economic security. The lack of formal training causes construction skill attainment, income potential, and future career development to fall behind other states and impacts the profitability of local Wyoming construction companies. Construction careers have many opportunities that do not require a formal college degree but mandate the achievement of a postsecondary non-degree award before employment, a raise in pay, or an elevated position. Research shows that 15.6% of all construction employment in Wyoming requires a postsecondary non-degree award in the construction sector. Compared to 5.8% in the US and 2.3% in Colorado, Wyoming has the most significant percentage requirement at this level and category of education (Kofoed, 2021). The postsecondary non-degree award refers to a specialized program teaching focused content and skill knowledge to meet the criteria of this type of certification or license, along with completing high school education. After earning a postsecondary non-degree award, certified participants are qualified to work in their chosen field. The Wyoming Department of Education (2021) leverages the Carl D. Perkins Career and Technical Education Act of 2006 to support Wyoming CTE development. The express purpose of the Perkins Act is to provide tangible opportunities to follow, obtain, and elevate CTE positions by earning relevant credentials without requiring a college degree (PCRN: Work-Based Learning, 2020).

### **Description of the Overarching Educational Vision**

The educational attainment level for the majority (53%) of construction employees is a high school diploma or less, with 29% obtaining some college, and 18% possessing a college degree or post-bachelor education. There needs to be an education program and provisions to bridge the gap for the majority of individuals working in the construction industry. The

overarching vision, in support of creating a secondary and post- secondary construction education pathway, is to open the door for high school students to internship possibilities, and or full-time employment after graduating from high school. This vision is depicted in figure 3, where construction training at a high school level will allow a student to enter the construction workforce upon graduating from high school. A student can then re-enter the post-secondary education system at one of nine community colleges across the state in either

a fulltime or part time capacity. A student can then transfer to a four-year institution to pursue a bachelor’s degree. The educational platform will allow students to enter and re-enter the workforce platform at different entry points during their education journey. The overarching training model has been implemented at both high school and community colleges across the state of Wyoming.

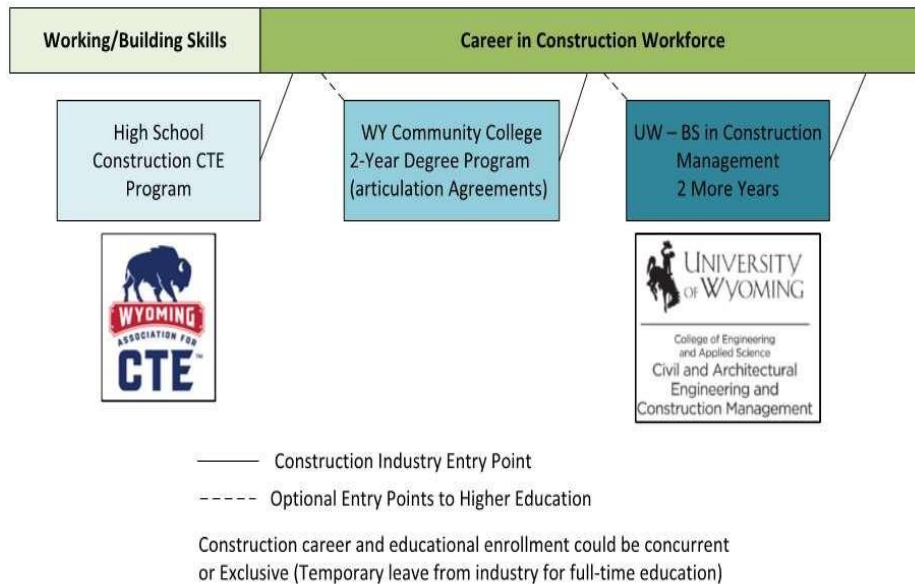


Figure 3. Construction Workforce Entry Platform

## Construction Education Pathway Interventions

### *High School Content and Credentialing*

The Construction Management program at the University of Wyoming has developed a high school training curriculum that allows high school Career and Technical Education (CTE) teachers to introduce students in their respective CTE programs to construction theories and concepts. Figure 4 represents the stackable structure of these training modules.

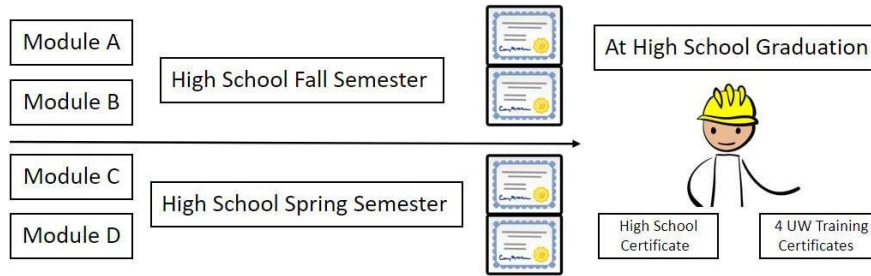


Figure 4. Stackable Construction Training Modules at High Schools

The modules are introduced to students during their high school senior year. Given the high school student employment prospects and the level of construction industry exposure, the modules focus on single family residential construction practice, with connected commercial construction content and examples interwoven throughout the curricula. The four modules comprise an introduction to construction plan reading (Module A), materials and methods (Module B), determining material quantities and costs (Module C) and project coordination and management (Module D). Modules A & B are administered during the fall and Modules C & D are administered during the spring of the high school student’s senior year. The modules were designed to be administered on a bi-weekly basis as seen fit by the high school instructors of record. Each training module, both theoretical and practical, is made up of four sessions with each session comprising a one-hour university faculty directed pre-recorded lecture engagement, followed with group discussion and a guided classroom exercise.

All sessions have a one-hour homework assignment which is administered on the Canvas online platform, which is used by high schools across the state of Wyoming. These modules reflect partnerships developed with trade associations and business entities, who assisted in designing this training to provide all enrollees (high school students) with an estimated total of 32 contact hours, divided between the senior fall and spring semesters. Figure 5 illustrates the stackable module credential, which all students will be awarded after successfully completing each module.



Figure 5. Stackable Module Credentials

Upon the completion of all four modules, students receive a University of Wyoming construction certificate of accomplishment, which adds a certificate to the already pre-programmed high school certificate awarded by the high schools upon graduation. Every module is associated with an online exam, which students take under the supervision of the University of Wyoming to ensure the quality of the issued credential.

An additional key component of this training is an internship, which provides real world experience, under the guidance of a mentor, sponsored by the company who provides the internship. Through this mentored experience, high school students who participate in this opportunity will have a head start in the employment realm. In fact, most students already work summer jobs, but an internship provides a clearer direction in the world of work when students graduate in May of each year. Sponsoring companies offer internships which best suit their needs. The partnership companies understand the value of such opportunities and have agreed to provide at least one internship that will lead to permanent employment for the protégé. The internship is the culmination of the training and provides individuals with the information needed in order to make decisions about life after graduation to either enter the workforce, attend a community college, or enroll in a four-year university degree program.

Data from the Wyoming Department of Workforce Services Research Office provides an indication of what an entry level in the construction workforce can earn. All categories of positions in the construction industry can benefit from the UW High School construction module training because the modules are structured around industry required skills. Figure 6 presents the wages of a selected few construction related positions.

Considering that the federal minimum wage for general employment is currently \$7.25 per hour (Wyoming Department of Labor & Employment, 2022), this training and the internships provide opportunities for higher wages overall. In addition, all four construction training modules are connected to transferable high school CTE credits to a community college, in support of the following post-secondary intervention.



Figure 6. Construction and Extraction Occupations – Sep 2021 Wyoming Wage Survey

#### *High-School, Community College, and University Safety Class Intervention*

The Construction Management program at the University of Wyoming has further engaged with two institutions, Casper Community College, and Pathways Innovation Center, with the

respective instructors of record and invited industry practitioners to co-teach a construction safety course. The focus of this intervention was to provide construction safety training to students at the respective institutions regardless of the different education level. The inclusion of industry practitioners was to bring the lived experiences in the field of practice to the classroom and to bridge the gap between the theoretically based coursework and required industry skills. The enrolled students for each of the participating institutions comprised 27 University of Wyoming students, nine Casper Community College and 14 Pathways Innovation Center high school students. Zoom Meeting and the Meeting Owl Pro technology were the two videoconferencing technologies used during this teaching endeavor. With its improved functionality, the Meeting Owl Pro device, built to integrate easily with the Zoom Meeting platform, allows for multi-party virtual conferences by remotely detecting each speaker at any moment. The instructors of record were each stationed with their students and connected with the other two campuses via the Zoom Meeting and Meeting Owl Pro platforms. The use of these live-intervention technologies worked well to cultivate educational synergy between the classrooms located at each of the institutions across the state.

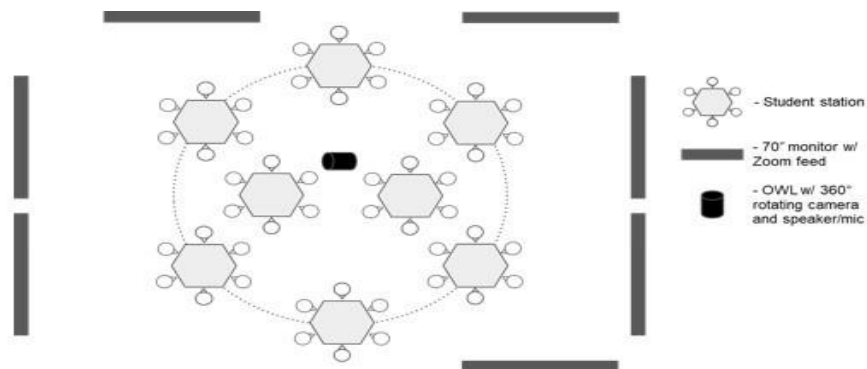


Figure 7. Schematic Classroom Setup in the Lecture Presentation Sessions

One challenge that was observed is the tendency for student to seek the same groups by sitting together during all lecture sessions. To avoid this concern and promote mixing of students from different educational levels, a ballot system was devised where students were located at a station base on random selection. The ballot process was repeated for all three learning stations to fully randomize student groups. Open-ended questions on the chapters covered by the delegated instructor of record and industry practitioner were discussed among students within each randomized group.

### **Conclusion and Considerations for Educators**

This study provides construction educators with an exemplary framework that is currently being applied in Wyoming to address construction training and education from, and across, the High School, College and University systems. Given the anticipated 9% drop in high school graduates between 2026 and 2030, which is expected to have a detrimental impact on the construction workforce, it is critical that a rigorous training of professionals in the



construction workforce is implemented. Many more triumphs could be attained by carefully adhering to a well-designed curriculum supported by industry professionals and sourcing for good technology like Zoom Meeting and Meeting Owl Pro that links all participants regardless of where they are located.

The application of these educational methods were utilized to underpin the current case study wherein connected secondary and post-secondary construction education initiatives were piloted to bridge the current, and anticipated, construction workforce skills shortage in the state of Wyoming. The results of these pilot programs proved to be the springboard needed to provide the kind of workforce training and skills enhancement being called for by the industry.

Wyoming is unique in that the state's educational system leads to a singular state university. While this, in many cases, is an advantage for Wyoming as it promotes a simpler articulation pathway, the small population that exists in the given land area of the state also poses challenges due to many communities having extremely limited resources, while also being geographically isolated from other educational institutions. Educators who are interested in connecting high-school, community college and university programs in their own state need to investigate and understand their state-specific educational landscape. Generally, the more colleges and universities in a state, the more articulation pathways, and educational standards there are to manage and maintain. One potential means to promote uniformity across the high school to community college to university transition is to use the American Council for Construction Education's (ACCE) student learning outcomes (SLOs) as standards for the development of connected curricula. The promotion of SLO-based curricula and student performance assessment-based testing provided a level of consistency and standardized metrics for knowledge gained as a construction-interested student progresses from high school to a community college and/or university while on the connected articulation pathway.

The development of this framework through industry and academic collaboration is an ongoing process. However, we believe it is well worth the time and energy it has taken to build it. The experiences of the learners and instructors speak volumes about the way to move forward in meeting the needs of both industry and future employees. As this program continues to be administered to a larger sample, further research will comprise the analysis of the data collected to empirically explore the impact of this program on student learning and desire in pursuing a career in the construction industry.

## References

- Associated Builders and Contractors (2022, August 5) ABC: Construction Employment Increases By 32,000 in July. Retrieved 10/18/22 from: <https://www.abc.org/News-Media/News-Releases/entryid/19539/abc-construction-employment-increases-by-32000-in-july>
- Associated General Contractors. (2022, August 31) Construction Workforce Shortages Risk Undermining Infrastructure Projects as Most Contractors Struggle To Fill Open

- Positions. Retrieved October 12, 2022, from:  
<https://www.agc.org/news/2022/08/31/construction-workforce-shortages-risk-undermining-infrastructure-projects-most-contractors-struggle>
- Blokker, R., Akkermans, J., Tims, M., Jansen, P., (2019) Building a sustainable start: The role of career competencies, career success, and career shocks in young professionals' employability. *Journal of Vocational Behaviour*. Volume 112, Page 172-184.
- Bransberger, P. (2017). Wiche Insights. <https://www.wiche.edu/wp-content/uploads/2018/10/ReportandDataTablesFINALrev10-17.pdf>. Retrieved October 26, 2022, from <https://www.wiche.edu/wp-content/uploads/2018/10/ReportandDataTablesFINALrev10-17.pdf>
- Wyoming Department of Labor and Employment (2022). Minimum Wage. Retrieved 10/25/2022 from <https://cdle.colorado.gov/wage-and-hour-law/minimum-wage#:~:text=Federal%20minimum%20wage%20is%20currently,law%20beginning%20January%201%2C%202022>.
- Cornali, F. (2012). Effectiveness and efficiency of educational measures: Evaluation practices, indicators and rhetoric. *Sociology Mind*, 02(03), 255–260.  
<https://doi.org/10.4236/sm.2012.23034>
- Kofoed, A., (2021). Does Wyoming Reward a Postsecondary Education? 2021 Wyoming Workforce Annual Report, 55-54.  
[https://www.dol.gov/sites/dolgov/files/eta/Performance/pdfs/annual\\_economic\\_reports/2021](https://www.dol.gov/sites/dolgov/files/eta/Performance/pdfs/annual_economic_reports/2021)
- Moore, J. L., Dickson-Deane, C., & Galyen, K. (2011). e-Learning, online learning, and distance learning environments: Are they the same? *The Internet and Higher Education*, 14(2), 129-135. <https://doi.org/10.1016/j.iheduc.2010.10.001>
- Mupinga, D. M., Nora, R. T., & Yaw, D. C. (2006). The learning styles, expectations, and needs of online students. *College Teaching*, 54(1), 185–189.  
<https://doi.org/10.3200/ctch.54.1.185-189>
- Perkins Collaborative Resource Network. (2020) Work Base Learning  
<https://cte.ed.gov/initiatives/work-based-learning>
- Serdyukov, P. (2017). Innovation in education: What works, what doesn't, and what to do about it? *Journal of Research in Innovative Teaching & Learning*, 10(1), 4–33.  
<https://doi.org/10.1108/jrit-10-2016-0007>
- Shelton, J. (2011, September 28). Education innovation: What it is and why we need more of it (opinion). *Education Week*. <https://www.edweek.org/education/opinion-education-innovation-what-it-is-and-why-we-need-more-of-it/2011/09>
- United States Bureau of Labor Statistics. (2021, October). Projections Overview and Highlights, 2020–30: Monthly Labor Review.” Retrieved on 10/18/2022  
<https://www.bls.gov/opub/mlr/2021/article/projections-overview-and-highlights-2020-30.htm>.
- United States Bureau of Labor Statistics. (2022, September). Employment projections -- 2020-2030. Retrieved 10/18/2022 from:  
<https://www.bls.gov/news.release/pdf/ecopro.pdf>
- Vieluf, S., Kaplan, D., Klieme, E., Bayer, S. (2012). *Teaching Practices and Pedagogical Innovations: Evidence from Talis*. OECD Publishing.

[https://www.oecd.org/education/school/TalisCeri%202012%20\(tppi\)--Ebook.pdf](https://www.oecd.org/education/school/TalisCeri%202012%20(tppi)--Ebook.pdf)

Wildavsky, B., Kelly, A., & Carey, K. (2011). Reinventing higher education: The promise of Innovation. *The Review of Higher Education*, 37(1), 137–140.

<https://doi.org/10.1353/rhe.2013.0058>

Wyoming Department on Education. (2020). 2021 Perkins V Plan. Retrieved 10/25/2022 from: <https://edu.wyoming.gov/wp-content/uploads/2020/08/2020-2021-ADA-Verified-Perkins-Plan-With-Attachments-1.pdf>