Learning to Learn: The Trials and Tribulations of CBE Implementation in Technical Training

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ABSTRACT

Competency-Based Education (CBE) has gained popularity in technical trades education. This paper examines the implementation of three CBE programs for technical trades and the challenges encountered during the conversion and implementation processes. While the programs have demonstrated significant benefits for technical training it is apparent that the implementation process presents numerous challenges. This paper presents firsthand experience that has identified challenges that include optimizing scheduling and student learning, curriculum conversation and implementation, learning management systems and learning content management systems (LMS/LCMS) selection, registrations systems that are driven via student progress vice calendar, developing and managing online learning content, transitioning to coaching and mentoring, and motivating learners.

This paper presents insights and lessons learned that can be a valuable resource for instructional designers, educators, administrators, and policymakers interested in building an effective implementation of CBE programs whether it is in an academic institution, within a private corporation, or within DoD training. Implementing CBE programs for technical trades can lead to significant improvements in teaching and learning, provided the challenges identified in this paper are addressed comprehensively. Overcoming these challenges with proper investment and attention to these issues can result in significant improvements in teaching and learning.

Included are discussions regarding opportunities for further research, guidelines for program development, importance of instructors, administrators, and policymakers working as a team, and implications for technical trades education. Lastly, it introduces the idea of Department of Defense (DoD) involvement in CBE-based programs at local academic institutions. We explore how the DoD can invest in college technical CBE programs to help the nationwide workforce and DoD supporting industry while gaining valuable return on investment to improve access to CBE-based technical training for service members.

ABOUT THE AUTHORS

Nate Ferrara is an experienced developer and instructor of Competency-Based Education programs in collegiate technical programs for 10 years. His firsthand experience in the development of multiple CBE programs and in classroom execution of those programs provides a unique perspective that is leveraged in consulting for building more effective solutions. Prior to becoming a CBE program developer and instructor, Mr. Ferrara spent over 15 years working in technical trades which provides a solid foundation as a learner, developer, instructor, and consultant.

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INTRODUCTION

Objective

This paper will show that it is necessary to improve the methodology of the instructors of Competency-Based Education (CBE) and all personnel and systems involved in the process. A substantial advancement in the technology used for the online portion and hands-on simulations of systems will be needed to increase student engagement, retention, program quality, and student progress tracking.

Problem Significance

In today's changing economy, there is a clear shortage of skilled trades workforce, and the Department of Defense (DoD) has a high demand for technical training at faster learning rates (Cohen, 2023). U.S Chamber of Commerce reports over 10 million job openings in the U.S. with a significant portion being in skilled trades (Bloomquist, 2023). National Defense Industrial Association president and CEO David Norquist has reported 40% declines in the defense industrial base (Cordell, 2023). To fulfill the requirements for these positions, employees need only the relevant technical capabilities to get the job done and certifications to maintain industry standards. There is little need for these employees to hold a formal degree. In fact, the positions that need a bachelor's degree or higher are inundated by an overwhelming number of applicants. Career Technical Education (CTE) is the key to readying students to join the workforce in this skilled labor market. Traditional time-based training cannot fulfill this requirement nor provide assurances of quality and often lacks a motivational environment for the learners.

BACKGROUND

Definition and Overview of Competency-Based Education (CBE)

In the Merriam-Webster Dictionary (2023), the first definition of competence is "possession of sufficient knowledge or skill". Competency-Based Education (CBE) takes an approach to education that is based on this definition, requiring learners to demonstrate a specific knowledge or skill in order to progress through educational programs. This is contrary to our traditional education system which, in addition to passing written short-term memory-based exams, requires students to complete several credits or hours of seat time within a semester. To address issues of student engagement, achievement gaps, and workforce readiness, CBE offers a learner-centric approach that allows students to progress at their own pace while emphasizing the mastery of key competencies. The design and implementation of CBE programs must address the problems of standardization and assessment while ensuring the validity and reliability of student learning.

Background of CBE

CBE's roots can be traced back to the early 20th century, but its modern form took shape in the 1960s. In 1968, the US Office of Education launched a series of pilot programs through ten institutions of higher learning focused on creating more effective methods of teaching. As part of this project, the word "competency" was used to describe a specific knowledge or skill to be learned. Focus on these programs was placed on personalized instruction incorporating student evaluation and feedback (Nodine, 2016). During this time, theorist and psychologist, Benjamin

Bloom, developed the "Mastery of Learning" approach to education, which prioritized skills students needed to demonstrate and master before moving on to more advanced topics (Gervais, 2016).

In 1973, the idea of competency-based education became more popular thanks to David McClelland's paper "Testing for competence rather than for intelligence" (Clark, 1999). McClelland believed traditional tests measuring aptitude and intelligence were not reliable in their relation to behaviors of importance. Instead, he believed education should concentrate on developing competencies that directly translate to real-life responsibilities and job performance.

Competency-based education has advanced and is starting to finally become more popular in K-12 and higher education to include large investments such as $110 million for public schools to support enrollment growth and classroom complexities from Alberta Education in 2023 (Ferguson, 2023). The use of digital learning tools has made it easier to create and use CBE models, which often include customized learning plans, adaptable pacing, and assessments that evaluate the mastery of particular skills and information.

The Evolution of CBE in Technical Trades Education

The trades industry has greatly benefited from CBE, which offers a structured and effective approach to skill development, personalized learning, industry alignment, and ongoing professional growth. This ensures that trades professionals possess the necessary competencies to excel in their fields and adapt to changing industry demands. In 1984, the Carl D. Perkins Vocational and Technical Education Act (Perkins Act) was passed in the United States to provide federal support for Career and Technical Education (CTE) programs (Penny, 2018). The Perkins Act has been reauthorized several times since then.

Over the years, CTE has evolved and adapted to meet the changing demands of the workforce by emphasizing industry partnerships, competency-based education, and the integration of emerging technologies and skills such as STEM (Science, Technology, Engineering, and Mathematics) and cybersecurity. The Perkins Act aims to align CTE programs with industry needs, integrate academic and technical skills, and promote high-quality CTE programs. Currently, there is a collective effort at the institutional, state, and federal levels to transition these programs to CBE.

Momentum to Develop CBE Courses

In 2016, the Competency-Based Education Network (C-BEN) was formed by several educational institutions collaborating to drive higher education toward focusing on student competencies. This collaboration now includes many colleges, universities, state systems, and service providers which focus on CBE to steer learning outcomes to employable skills (C-BEN, 2023). Annual C-BEN conferences are held to promote CBE as another pathway for students across the country.

Competency-Based Education has been at the forefront of the educational world for almost ten years. A large push at the federal level was spearheaded by the National Alliance for Partnerships in Equity (NAPE), which held an important conference in Washington DC in 2018. NAPE is an alliance of corporations, national organizations, state agencies, and local agencies which promote student access, educational equity, and workforce diversity (NAPE, 2023). The purpose of this conference was to highlight the need for CBE to address the educational gaps for lower socioeconomic status (SES) and rally support to lobby policymakers for funding.

On October 27th, 2020, The National School Board Association (NSBA) introduced its "Public School Transformation Now!" Campaign (NSBA, 2020). The reoccurring theme of this campaign was how technology would play a key role in the advancement of education. This push by the NSBA to make learning more student-centric has led many educational institutions to try their hand at designing and implementing their own CBE programs. The following sections will examine an independent review of three use cases from a firsthand perspective and will identify lessons learned that can be detrimental to effective CBE.

USE CASES

Marine Engineering Management and Seamanship (MEMS)

Florida Keys Community College (now The College of the Florida Keys), rolled out a CBE program at their Marathon satellite campus for the 2016-17 academic year. The curriculum was disassembled for the Marine Engineering Management and Seamanship (MEMS) certificate program, converting the learning outcomes to competencies and figuring out ways to evaluate them. The program consisted of the first ten classes of the Associate of Applied Science (AAS) degree as well as two "capstone" classes that were taught during the first half of the summer semester, providing an average completion time of nine and a half months. Other logistics included working with the local high school in Marathon to utilize their lab space in exchange for teaching a basic outboard motor class for grade 12. The college classes were held in the evenings so as not to disrupt the normal high school schedule, and a minimum amount of lab equipment needed to teach the certificate program was moved from the Key West Campus to the Marathon Center, approximately 35 miles away.

The college chose this certificate program for two main reasons. The first being the fact that marine engineering is a very hands-on subject, and the second was they employed a professor with the knowledge to teach all 12 classes required for the program. Due to time constraints, very little effort was placed on marketing or online educational resource development of the Learning Content Management System (LCMS). Students enrolled for the program and began the academic year at the start of the fall semester. This would be an “At your own pace” program, however, no further students would be able to enroll, as enrollment was on a semester basis.

Within the first month, student progress had split, with 20% excelling, 40% progressing on schedule, and 40% falling behind. After two months, 20% of the students had dropped out of the program after completing one or fewer of the classes. By the end of the fall semester, 80% were halfway through the program and the remaining 20% were 2/3 towards completion.

The program was put on pause for three weeks in December for the holiday break. After the break, students returned with a loss rate of 40% of the original starting student population. Progress was made with the remaining students through the spring semester, with many attending classes together due to friendship bonds. 40% of the original students enrolled completed ten of the twelve required classes by the end of the semester. However, due to a staffing shortage, the remaining two “capstone” classes would be taught at the Key West Campus during the first six weeks of the summer. Only 20% of the original starting class would go on to attend these classes and receive the certificate. The program was canceled after one year. Keeping enrollment and scheduling tied to semesters and the loss of capable staff was detrimental to this program.

Diesel Service Technician (KDIS)

In 2016, Salt Lake Community College was awarded a grant of $2.5 million from the Department of Labor to expand CBE into multiple CTE programs through their School of Applied Technology (now Salt Lake Technical College). The purpose of the initiative was to decrease program costs and student completion times while focusing on relevant competencies needed to address a severe lack of laborers in the community. A team of program designers, LCMS experts, and subject matter experts worked diligently over the summer to ensure there was adequate online support for the multiple programs. Enrollment was changed from a semester basis to an open enrollment system that would allow new students access to the programs at the beginning of any full week. As these were also “At your own pace programs,” students would enroll in a timed block in which they could add classes that they would like to complete within that block.

One of the programs rolled out by the college for the 2018-19 academic year was Diesel Service Technician. This was a certificate consisting of ten classes, eight of which included hands-on activities in the lab space. Due to the amount of effort that had been put into the LCMS, the first of the classes students were required to complete was a Computer Concepts course designed to prepare them to use the system. They would then move through the eight lab classes, and finish the certificate with a Job Skills class to teach them skills to find employment.

Once again, this program was an ideal candidate for CBE due to its hands-on nature, and an instructor was found that could teach all eight of the lab classes. Also, the classes were taught in the evening so as not to impose on the Diesel Technology Associates of Applied Science (AAS) which utilized the same lab space. The allotted time for completion was slated for eleven months, with the average student finishing in nine months.

Given the open enrollment nature of the program, student progression through the program varied largely. Also, students were allowed to pause the program for up to 45 days without repercussions. The program ran for five years and was affected by Covid shutdowns; however, the final academic year of 2022-23 yielded the following results. Of the students that were enrolled, 41% completed, 21% left the program, and 38% were still actively pursuing the certificate. The Diesel Service Technician Program at Salt Lake Technical College is currently not enrolling new students but is still active. The length of program without achievement milestones and limiting students via block times was detrimental to the effectiveness of this program.

Professional Truck Driving (KPDR)

Another program converted to CBE at Salt Lake Community College is the Commercial Driver's License (CDL). This program leads to state licensing as a truck driver and is not certificate-seeking. Classes are held both during the day and in the evening to accommodate students' work schedules. The total time for the program varies between two to three months, depending on student attendance. As with KDIS, students are required to attend a computer concepts course first to ensure they can utilize the LCMS system. They are also required to obtain a CDL learner's permit and complete scenarios on a simulator before any actual "behind-the-wheel" time occurs.

Students continue through the program until the instructors feel they are ready to attempt the on-road test required by the state for licensing, making for a clear competency. Students are required to enroll in a two-month block, with an additional one-month block available should they require more time to develop the necessary skills for the road test.

This is by far the most hands-on of the programs, and because of the short duration and clear desired outcome, student completion is high. During the academic year of 2022-23, of the students enrolled, 85% completed, 9% dropped, and the remaining 6% were still enrolled. The Professional Truck Driving program is still active and currently has a waiting list for enrollment. The drop rate was primarily due to difficulty in some learners mastering key skills needed to progress; for example, some students that not handle the mental stress of maneuvering a truck and trailer through traffic.

LIMITATIONS

There are limitations in this review that should be considered as caveats. First, this is based on firsthand experience vice scientific rigor of formal analysis. Program data from the final year was analyzed regardless of the total number of years each program ran. Each of these programs were of differing vocations and represent a small number of CTE programs available. The review covers only 2016 through 2023, with one program being developed early on during the higher education push for CBE. All programs had differing average completion times, and varying instructor abilities. Instructor abilities to be coach and mentor vice traditional lecturer has a large impact on effectiveness.

RESULTS

Although the challenges of designing and implementing a CBE program do not vary substantially between vocations, each of these case studies yielded significantly different results. As the desired outcome for any of these programs is the transitioning of students from enrolled to completed, a program can be considered successful should the number of completers be higher than the students still enrolled given a set amount of time. See Figure 1.

MEMS suffered considerably from the lack of a well-designed LCMS, the absence of open enrollment, and scheduling following academic semesters, and the physical distance issue for final courses. In addition, this was the longest program of the three, spanning a 10-month average completion time, and at the end of that time period, 40% were still enrolled with 20% completed. Upon graphing these results, a downward slope is produced towards the end of the graph indicating the program failed to meet completion expectations.

KDIS performed better at meeting completion expectations, with 38% still enrolled and 41% completed. This program's LCMS was designed well, and open enrollment was utilized to facilitate the addition of new students. Although the program did reach positive completion goals, the 9-month average length of this program led to reduced completion rates overall.

KPDR produces a highly successful completion rate. This program transitioned 85% of total enrolled students to completion, with 6% still active. The program benefited from all the advantages of a well-designed LCMS, open enrollment, and a shortened average completion time. In fact, the 2-to-3-month completion time almost completely negated the institution's semester-based scheduling.

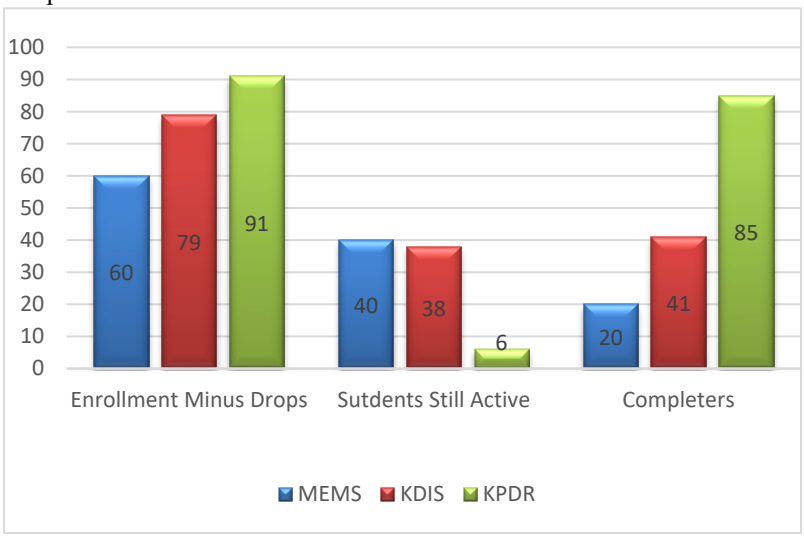

Figure 1 Percentile of Student Enrollment vs. Throughout

LESSONS LEARNED

Optimizing Scheduling and Student Learning

One major advantage of CBE is that it is "At your own pace." This approach is key to ensuring the programs are flexible and complementary to students' lives. Unfortunately, this concept is contradictory to traditional learning, where education has been time blocked into semesters and progress is tracked through seat time in front of a lecturer and the number of hours spent in a lab space. A fundamental shift in how CBE students are enrolled, assessed, tracked, and recorded must occur if these programs are to be successful.

Another advantage of CBE is that competencies are relevant to the skills needed for the desired outcome. This means no fluff and student learning is focused. As seen in the use cases above, there was a clear distinction in completion rates between the three programs, with an 85% completion in the shortest program, with the most flexibility in student access, and with the most clearly defined competency measurement.

Curriculum Conversion and Implementation Processes

When developing a CBE program, it is not simply taking the learning outcomes from an existing lecture/lab program and converting them into competencies. As these programs are "At your own pace" and based on the expectation that students will need to demonstrate the skills necessary to complete each task, competencies must be clearly defined and easy to evaluate. Competencies must progress in a logical order throughout the entire program, not just within each class, and be repeatable should the student not master it on previous attempts.

With these changes throughout the curriculum conversion process, special care should be taken not to violate any articulation agreement, or it may become necessary to write a new agreement. (An articulation agreement allows students to progress into degree-seeking programs post program completion.) Also, maintaining student eligibility for grants and financial aid needs to be taken into account. Grants and financial aid traditionally are dependent on clock hours and/or formal program credits. Concurrent enrollment could also be adversely affected should high school students not be allowed to enroll in CBE courses versus traditional college courses.

By far, the greatest challenge when developing CBE is the addition of a high-quality and engaging online portion to the program. LMS and LCMS selection is just as important as effective and engaging content creation to student success in these programs, as the instructor will be spread thin across students progressing through varying points in the learning process. It may be advantageous for some programs to break away from the institution's preferred LMS

for traditional lecture/lab courses to embrace a LMS that is more student-centric and allows for advanced content creation.

LMS/LCMSs Selection for CBE

Although no LMS and/or LCMS is perfect for all situations, CBE requires certain features from systems that have been overlooked for traditional learning. First and foremost, the system must be student centric as no student will progress at the same pace. The system itself needs to adapt to the pace of the learner, not repeating information that has been already mastered and not moving too quickly to the next concepts. This will ensure students will not become bored or overwhelmed.

Also, the system must be engaging and easily accessible. Traditional education is still reliant on PowerPoint presentations and YouTube style videos. This simply will not do in the age of high-tech cross-platform entertainment in which we live today. The system must be capable of interacting with the student in a detailed graphic environment (preferably real time 3D rendering) and able to run on multiple devices, everything from a personal computer or gaming console to an iOS or Android device.

Registration Systems Driven by Learner Progress Vice Calendar-Based

One of the challenges has been student tracking, as enrollment has followed traditional semester scheduling. The registration process can be a major influence on the student's learning experience and therefore impact the success of the programs. Since CBE is "At your own pace,' any hurdles that impede the individual learner's pace can be detrimental. CBE programs have been broken into many classes, with students spanning over multiple sections of a class due to semester changes or block endings. Additionally, students can also run out of block time but wish to continue in the program. Should this happen, the student is placed in a "Stand Alone" course for the class with a completely different CRN#. This all becomes difficult for the instructor to follow, as progress has been made over multiple LMS sections.

Student assessment and tracking must be tailorable and personalized. Program and course registrations must have the same flexibility. The case studies above have demonstrated that CBE cannot follow a traditional semester-based approach and that open enrollment will not only increase completion rates but improve student learning, as an increase in the number of students creates a favorable learning environment. This means the traditional way of tracking students in a class block becomes impossible, especially when students are carried over into another section due to non-completion or semester/academic year changeover.

Instead, the system must be set up to track the student either by name or student number, and the courses or blocks will be managed by individual profile level. Registration for students needs to be seamless and comprehensive. This is often an area that gets overlooked when designing and implementing CBE programs.

Developing and Managing Online Learning Content

As it has been stated earlier, it is not enough to simply take the learning outcomes from an existing lecture/lab program and convert them into competencies. In our experience, existing certificate programs are just too long for CBE to be effective and need to be carefully laid out in a competency road map and broken down into more manageable sections. Collaboration between registration and CBE instructors is needed to ensure this is done in a way that benefits the student and fulfills the requirements of the institution. All too often, registration adds block time for students which should be adequate for a certain number of classes in the program; however, this creates course registration issues should students not complete the classes in the block. Instead, it is more beneficial to break the course into meaningful segments based on competency roadmaps and enroll students into the classes without a time constraint. The system should make these prerequisites to moving forward in the program. In addition, mini milestones, such as badges towards a certificate, can reinforce a student's sense of accomplishment upon the completion of each section in longer programs.

For each of these sections, CBE instructors must rely on the online portion to be informative, assessment based, and trackable. A considerable amount of effort needs to be invested to develop the most engaging educational content obtainable. In the past this has been achieved utilizing e-books, PowerPoint presentations, and YouTube style videos;

however, the industry is moving towards dynamic interactive digital learning environments, similar to modern video games. With the advancement of technology, it is becoming more difficult for institutions of higher learning to create these online environments in-house.

Simulators have long been a standard for teaching technical trades, such as trucking, aviation, welding, and maritime, especially in the military. However, to expand into CTE programs such as mechanics, composites, construction, etc., instructional design approaches need to develop and utilize real-time 3D environments and modeling tools, such as Omniverse, Unity, Unreal, and others for creating meaningful and effective content. Along with that, the personnel that are offering, managing, and maintaining these courses must develop the ability to create and edit in these environments. As institutions of higher learning do not typically have the budget to outsource program development through a third-party vendor, development teams need to incorporate technical teams with the skills to utilize all existing technology to its greatest potential. Industry providers that want to sell to these schools must provide interfaces and tools for instructors to build their own interactive and immersive content without coding.

Transitioning to Coaching and Mentoring

Teaching Competency-Based Education is not for the faint of heart, however, it does offer some distinct advantages to traditional instruction. There are three core skills required for a CBE instructor. First, they must be a subject matter expert in every sense of the word. There is no opportunity to prepare for a particular lecture as performed by instructors/professors in traditional education. Second, they must be resourceful, patient, and prepared. Lastly, they must be skilled in the use of the technology utilized for the online portion, in the lab space, assessment, and tracking of the program.

Gone are the days of lesson planning. Instead, multiple students will come in on their schedules asking for instruction on whichever lessons they are working on at the time. The instructor must be able to divide the time equally between each student without losing their interest. The instructor acts as a coach, either guiding students to the relevant online content or directing them to the next hands-on activity. Once each student is engaged, the instructor will then mentor the students on an individual basis according to the priority of the subject matter. Individual students may be given a short, personalized lecture, 15 to 20 minutes, on the information on which they are concentrating. These lectures must be concise and accurate with visual aids prepared ahead of time and easily accessible by the instructor. This type of instruction is not recommended for a first-year educator or an educator that is not a subject matter expert.

Many of the skills necessary to be a CBE instructor are honed in the lecture/lab environment. It takes an educator at least one full year of teaching to get familiar with the course content, whether that content has been prepared or the educator will create it from scratch. Also, because CBE is most suited for hands-on programs, lab equipment for each activity should be readily available for each student, as it is often not practical for group work to be done. This becomes particularly hard or impossible as the number of students increases in the program.

One advantage of this teaching method is the utilization of technology to assist the instructor in education, assessment, and tracking. Surprisingly, it is this area that receives the greatest pushback from traditional instructors. As long as the online portion is developed correctly, CBE instructors no longer have to go into great detail while lecturing, grade written assessments, or record student progress. This is all done through the LMS and frees up time for the instructor to transition into the role of coach, mentor, and lab facilitator.

Motivating Learners

It is common in traditional instruction for a class full of students to gather daily to attend either a lecturer or lab activity and for the course to conclude in a specified length of time. This simply is not the case in CBE with much of student knowledge learning occurring online, either at home or in a computer lab. The advantage of this is the availability to course content at any time, allowing students to move through the course at an accelerated pace. However, the disadvantage occurs when a student losses motivation due to the lack of class participation, especially in longer-duration programs. This is where the skills of a CBE instructor as a coach/mentor become invaluable.

It is the CBE instructor's responsibility to create and maintain a detailed student contact log for the program. This log should include a preferred method of contact and at least one backup method of contact for each student, as well as the student's preferred time for contact. The CBE instructor should then schedule times to contact each student to

ensure short-term goals are being achieved and progress is continuing toward completion. These conversations should be kept short and emphasis on accelerating through competencies should be encouraged regardless of student progress, guaranteeing the shortest completion time for each student.

One of the greatest rewards for the instructors once they have made the mental switch from instructor to being a coach and mentor is the ability to connect with the students individually to guide them through the program and for their professions. Some relationships between the instructor and students in these programs resulted in lifetime relationships that continue still.

DISCUSSION

Opportunities for Further Research

CBE continues to be the focus of higher education, with a growing number of CBE programs being made available to students across the country. Similar studies can continue with differing CBE programs in the technical trades to compile data congruent with this study. Also, CBE is expanding in DOD training, and additional data analysis within these programs is relevant to advance the effectiveness of these programs. However, DoD participation in Competency Based Education Network (C-BEN) and other resources is lacking, therefore preventing knowledge sharing between the DoD and academic institutions.

Guidelines for Program Development

A well-organized and skilled program development team is needed to design a curriculum that will be strongly tailored to the program objectives with clear competencies defined. Preferably, the most up-to-date technology should be applied to provide students with an immersive and interactive online learning environment, utilizing non-playable characters (NPCs) for training traditionally carried out by the program instructor. It is understood that this development will be the most time-consuming portion of CBE program design and that frequent updates to the system will be required, making this an ongoing task.

Large programs should be broken into smaller, more manageable sections while maintaining clear program objectives. This is done in order to not overwhelm students who could potentially drop out due to an overwhelming time commitment. Special attention to the requirements for grants, student loans, or concurrent enrollment must be taken into account when splitting these programs up. Something as simple as the distinction between credit, clock, or technical credit hours could disqualify CBE programs for these perks in institutions of higher learning.

It is imperative that CBE programs are removed from semester-based registration and embrace open and comprehensive program enrollment. With open enrollment, programs will benefit from a constant supply of new students who will progress at their own pace. Comprehensive enrollment allows the student to be registered into the complete program, should it be small enough, or a section of a larger program to be completed before continuing, without time constraints. This type of enrollment allows students to progress through the program without creating stressors due to administrative barriers that are not relevant to the learner's needs.

CBE instructor selection is another crucial aspect of implementing these programs, remembering that they will act as a coach, mentor, and lab facilitator. An ideal choice for this person would be an expert in the profession and a veteran instructor with good computer skills. In addition, CBE instructors must be excellent communicators, as they will be performing progress checks, relaying learning expectations, and providing feedback and incentives as students complete competencies. To do this effectively, CBE instructors should be comfortable communicating with students through whichever means is most comfortable for each individual student, whether that be email, text, phone, or within the LMS.

Importance of Instructors, Administrators, and Policymakers as a Team

With the many challenges facing the design and implementation of CBE programs, it is important that everyone involved in the process is dedicated to changing the mentality of education. Instructors must make the change to coach and mentor, which includes guiding students as they progress through the program. This includes realizing when it is

okay to direct a student to online learning instead of teaching the material themselves, especially when instructor time is limited in the lab environment. This can be a very difficult thing to do for traditional educators.

Administrators must navigate the existing policies and fight hard to change them for higher education while keeping the CBE student's best interest at heart. Many or all of the hurdles with registration and time confinements need to be eliminated so that the student can concentrate on moving through the program seamlessly. Policymakers, in turn, need to write legislation that will help the administrators navigate these challenges. An understanding of the steps required to implement these programs successfully should prompt policymakers to allocate the necessary funding required to educational institutions.

Implications for Technical Trades Education

Many consider CBE to be only an additional pathway students may follow to obtain an industry certificate or license. While this is partially true, with the advancement of media technology and artificial intelligence enabled educational tools, CBE has the potential to completely revolutionize CTE. There will always be a need for human interaction in these programs; however, the technology now exists to facilitate a large ratio of students to instructors. This is especially relevant at this time given the current teacher shortage across the nation.

The DOD continues to advance its own educational programs through CBE, incorporating Virtual Reality (VR) and continuing the use of simulators to expedite students through training. One recent example of this is "Project Avenger" implemented by Navy Training Squadron (VT) 28th Corpus Christi, Texas (Blow, Winslow, 2023). Nicknamed the "Rangers", VT-28 has redesigned its flight training curriculum to be student-centric by separating the ties between students' formation, instrument, and contact training. This allows students to progress through the program quickly, checking off their individual boxes or competencies while taking full advantage of flight time no matter the weather. Utilizing this approach, high-quality Naval Aviators are completing the program at an increased rate, in less time, and at a lower cost than traditional instruction.

In 2022, Steam released an awe-inspiring 10,963 games for the PC (Clement, 2023), and currently, there are 560 PlayStation 5 (Wikipedia, 2023 June 14) and 397 Xbox (Wikipedia, 2023 June 19) titles available for purchase to gaming console users. With the small number of CTE vocations, the development of CBE programs utilizing similar technology incorporated by our entertainment industry should be easily achieved. Funding for the educational system across the country should continue to be allocated for the advancement of these programs and distributed to those dedicated to incorporating advanced technology into LMCSs.

DoD Direct Role in Collegiate CBE

As these programs continue to develop and become more widely available, the DoD and the industry base should be able to leverage these programs at a significantly reduced cost compared to providing all training in-house, especially as education moves towards open enrollment through CBE, no longer following the semester-based academic schedule. The DoD and industrial base should consider taking a leading role in guiding CBE development to tailor program outcomes to educate desired skills of entry-level enlisted personnel and DoD supporting industry. Furthermore, the DOD could recruit from these programs directly into technical military occupational specialties (MOSs), thereby recruiting a highly skilled workforce that would drastically accelerate advanced technical training.

Due to the success of CBE in college and military environments, the DoD should consider leveraging collegiate CBE programs while investing capital and resources into them. Investment from the DoD and industrial base could facilitate the development and implementation of these programs across the nation while increasing the technical capability of young, enlisted personnel and national workforce. The capital infusion and direct support from the DoD and industrial base could drastically improve the programs with access to training simulation and resources that are not currently available to these college programs while simultaneously reducing the DoD costs of skill training and increasing flexibility in locations for skill training. DoD would still need to manage their own advanced platform specific training, but basic skills could be learned anywhere at a reduced cost by embracing flexibility in location while still leveraging the benefits of CBE. Similar results have been seen in Naval helicopter training where pilots conducted their initial training in commercial helicopters prior to military specific and advanced training. DoD should pursue developing these programs and sharing resources with local colleges and training institutions for technical trades, STEM, and cyber domains.

CONCLUSION

There is much to be considered for the successful implementation of CBE programs moving forward. It is very apparent that meaningful, memorable, motivational, and measurable online content development is critical to the success of these programs. But just as important is the structuring of the programs into short manageable sections will increase student retention and completion rates. Focus on removing time constraints that could hinder student progression. Students should know the program roadmap upfront. Student progress checks and mentoring should be frequent, and student incentives for finishing milestones within programs will contribute to student completion rates.

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