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Training for Better Transfer in an Online Competency-Based Higher Education Program: Using Enhanced Technology-Based Instruction to Improve Student Learning And Assessment Outcomes

Sean P. Gyll* **and Heather Hayes**

Western Governors University, UT 84107, United States; sean.gyll@wgu.edu

Abstract

Online Competency-Based Higher Education (OCBHE) programs offer students an innovative way to navigate the traditional education landscape. Within OCBHE, learning is an active process acquired through various instructional and media types. While little has been written on the technology-based methods underlying OCBHE's success, learning science has indicated which instructional practices will likely lead to superior performance. This paper investigates some key technology-based principles currently being incorporated into Western Governors University's teaching science. We investigated two different technology methods, and their effect on learning outcomes: (1) traditional online instruction, whereby students access the content through a mix of video lectures supplemented with learning resource materials, and (2) enhanced online instruction, whereby students access the content through a variety of innovative technology types. Results showed that students in enhanced online instruction courses achieved higher summative assessment scores, demonstrated significantly higher course completion rates, and completed their studies faster than in traditional online classes. These findings have profound implications for optimizing student outcomes using enhanced technology, especially in OCBHE.

Keywords: Technology-based instruction, Instructional design, Training transfer, Skill acquisition, Learning science, Cognitive science, Workforce readiness

1. Introduction

Somewhere at the intersection between competency-based instruction and workforce demand exists an opportunity to apply what we currently know about how students learn to build competency-based credentials supported by practice scholarship. Science supports learning that builds from and inextricably links to the environment, the situations, and the working culture in which students will eventually find themselves (Schumacher *et al.*, 2013). Within OCBHE, learning is no longer viewed as a process of transmitting knowledge from instructor to student (e.g., sitting passively, listening to a lecture, taking notes, and applying concepts) but as an active process acquired through a variety of instructional and media types. As a result, students' capacity to develop a particular domain's competency and then transfer that knowledge to future job performance improves.

At a fundamental level, the term transfer of training refers to the influence of prior learning on later activity (Holding, 1991). Initial research began in the early 20th century, when Woodrow (1927) claimed, for example, that "improvement resulting from almost any sort of practice yields, as a rule, some transference" (p. 159). He suggested that *any* practice on a given task produces improvement (i.e., positive transfer) in several related functions. This paper reviews some of the key learning science principles currently being incorporated into the

**Author for correspondence*

science of teaching from the nation's largest competency-based university (Western Governors University (WGU)) and explores their usefulness in an online context. These fundamental principles are summarized:

- *Skill acquisition is specific to the conditions practised during training, and many training programs are only effective to the extent that training will transfer to new situations.* Inefficiently developed training programs can interfere with developing flexible solutions to problem-solving. Programs that train students using various techniques are more likely to maximize learning transfer.
- *Training that promotes attention flexibility improves learning.* Lessons from dual-task studies suggest that compared to learning single tasks alone, when tasks are practised together, the cognitive system can coordinate task performance and minimize interference, thus, maximizing learning.
- *Learning complex tasks requires variability in training to maximize learning.* The most robust learning is likely to result from a combination of many experiences that allow students to engage in multiple attention processes when planning and executing solutions from memory.

It is worth noting that less than a decade ago, terms like *learning*, *memory*, and *cognition* were hardly uttered within competency-based circles. Those less versed in learning theory and cognitive science found phrases like "training for transfer," "skill acquisition," and "memory processing components" rather jargon-laced and somewhat confusing in the context of OCBHE purpose. Moreover, understanding the teaching mechanisms involved in online instruction was contextually different and unrelated to institutions' primary goal of educating and graduating students. Since then, seminal publications like "Make it Stick" by Brown *et al.* (2014) on successful learning science have altered this view. They provided everyday examples with straightforward explanations about why learning science principles work in an online environment.

Today, OCBHE programs' criticality in training the next generation's workforce has become a force in education now that employers focus on identifying, recruiting, and retaining transferable skills. Particularly in times of economic challenge, American employers need a skilled, adaptable, creative, and equipped workforce that can adapt to the global marketplace. In addition, advances in learning science and institutions' ability to track their student's progress over time have provided rich data sources to build a new learning paradigm's desired outcome.

This paper's remaining sections examine key learning science principles supporting integrated learning and student success. We investigated two different instructional methods and their effect on learning outcomes: (1) *Traditional* online instruction, whereby students access the content through a mix of video recordings and lectures supplemented with learning resource materials, and (2) *Enhanced* online instruction, whereby students access the content through a variety of innovative instructional and media types. These principles are reviewed in the context of OCBHE, which offers students new and novel ways to interact with a course's content using advanced technology. Sub-sections demonstrate the benefit to students when engaged in more inclusive, collective, and interactive experiences compared to conventional learning methods in the traditional sense.

Next, we review our research results, which showed that students in enhanced online instruction courses achieved higher summative assessment scores, demonstrated significantly higher course completion rates, and completed their studies faster than traditional online courses. These findings have profound implications for optimizing teaching practices in an OCBHE program. Finally, concluding remarks offer insights and observations from our research to iterate further and develop the next generation's workforce.

2. Literature Review

2.1 Traditional versus Online Competency-Based Methods of Instruction

Competency-based credentials have become another way to demonstrate the flexibility and talent required to learn and grow in an evolving labor market. Consider the differences between traditional higher education and OCBHE programs' approach to learning. In traditional higher education (i.e., full-time, brick-and-mortar, 4-yr degree programs), students are awarded credit hours per "seat time" of instruction, and the transmission of knowledge is passed from teacher to student through some lecture or discourse (Johnston, 2011). As participants in this system, students are taught the same materials simultaneously and progress at the same pace, leading some to argue that student learning is one of the least sophisticated aspects of the teaching and learning process (James, 2003).

In contrast, OCBHE programs strive to balance various learning approaches requiring students to master critical concepts before graduating. Students learn at their own pace and earn degrees by demonstrating knowledge and skill in required subject areas through carefully designed competency-based assessments (Gyll & Ragland, 2018). As the popularity of OCBHE programs continues to rise, they will be scrutinized by students and employers alike. Their credibility depends mainly on the instruction's quality (McClarty & Gaertner, 2015).

Within OCBHE programs, methods associated with traditional instructor-led training are no longer a sufficient means of instruction, as curriculum designers must now develop learning tasks that represent skilled "competency" based performance, especially those designed to generalize to the world of work. For example, at WGU, students learn at their own pace. All course content is organized, so students navigate different competencies and lectures throughout the learning process. While students are paired with a course instructor, they only receive individualized help from their instructor when needed. Instead, students access the content within the learning management system and navigate freely throughout the course with suggested learning pathways.

Thus, the question, "competent for (doing) what?" is essential to any competence definition. Successful businesses are looking for employees who can adapt to changing needs, juggle multiple responsibilities, and independently make decisions. Competencies can be acquired through experience, gained from relevant contextual situations, or influenced by training or other external interventions. For OCBHE institutions to confirm that learners have developed the Knowledge, Skills, and Abilities (KSAs) to demonstrate successful performance on the job, the definition of competence requires shifting from the conceptual paradigm of an evaluative stance to assuming responsibility for endorsing future performance. Forces that might aid this conceptual transformation include the growing acceptance of *competency-based credentials*, which are quickly becoming a way of life in many occupations and professions.

Once student competence has been concretely defined in ways that hinge on quantifiable student achievement, it can be measured and operationalized. Put somewhat differently, and despite the current lack of consensus regarding the definition of competence, it is justifiable and productive to furnish an operational, albeit limited and contestable, definition of competence validated via sound design principles and empirical data. In doing so, employers have a tool that will increase the likelihood that they will successfully hire competent students of a particular type than they would otherwise be able to do sans the validation of those skills.

For this paper, competence is defined as "an outcome-based approach to education that incorporates modes of instructional delivery and assessment efforts designed to evaluate mastery of learning by students through their demonstration of the knowledge, attitudes, values, skills, and behaviors required for the degree sought" (Gervais, 2016, p. 99). This definition was chosen because it highlights the importance of using *multi-modes of instructional delivery* throughout the learning process, a key theme central to the concepts described in this paper. Furthermore, demonstrating those KSAs within a competency-based framework is the first step toward ensuring the validity of educational programs and the generalizability of their outcomes. As such, an evaluation of competence should foretell a student's effectiveness in prospective job situations in a manner that will be fully explored throughout the remainder of this paper.

2.2 Designing Learning: Suggestions for Innovative Institutions

The goal of instructional design is to create learning experiences that result in students acquiring and applying knowledge and skills. The discipline follows a system of assessing needs, designing processes, developing materials, and evaluating them against learning outcomes. Compared to traditional instructor-led methods, research suggests that competency-based skills are improved when learning is integrated into the educational experience rather than delivered in a compartmentalized fashion

(Ford & Gopher, 2015; Hoogveld, 2003; Van Merrienboer & Kirschner, 2013; Merrill, 2002). Furthermore, when content and learning strategies meet accepted education standards, technology increases mastery and helps better prepare students when emphasized as a learning tool (Penuel & Cohen, 1999). While the literature has produced a sizable amount of evidence in this regard, very little attention has been given to the more complex and essential learning components involved in supporting improved outcomes. The following theories represent a few early and more recent ones, and their discussion is not meant to be comprehensive. Instead, the intent is to provide an overview of the selected theoretical issues supporting this paper's central themes.

2.2.1 Skill Acquisition

In general, skill acquisition follows a predictable pattern, which begins with very slow and effortful problem solving that leads to fast and automatic problem-solving. Fitts (1964), for example, proposed that skill acquisition progresses through three stages. During the early and intermediate stages, problem-solving is slow and effortful as learners acquire general rules about a task. Then, over time, and after repeated practice, problem-solving in the late stage becomes faster and more automatic as they begin to proceduralize prior learning into action. It is at this point that learners become "expert" problem solvers.

Another skill acquisition model, Adaptive Control of Thought (ACT-R), also suggests that *cognitive* skill acquisition follows a sequence of learning activities that eventually leads to the automization of the skill (Anderson, 1993). In this theory, all knowledge begins in declarative form (i.e., learning what, rather than knowing how). During the initial stages, the learner commits to memory a declarative representation of how rules work. Like Fitts's model, early acquisition of a skill is slow and effortful, as the learner has not yet achieved an efficient means for solving problems. Instead, learners apply declarative rules that help them solve a problem. Then, through repeated practice, the learner begins to develop a procedural understanding of how rules work. This occurs because knowledge for solving problems is read from the declarative and written to procedural memory. At this point, problem-solving becomes very fast, requires little attention, and can be accomplished while the learner is engaged in other mental activities.

These theories promote a general skill acquisition process, from slow and effortful to faster and more routine. As skills become proceduralized, they lend themselves to faster processing, and the learner is more likely to apply that information to solve complex problems. This is important for guiding our understanding of training procedures within online environments; *training highly competent students may require learning procedures that gradually introduce students to course content while increasing their proficiency in using that information over time.*

2.2.2 Learning and Transfer: Lessons from Dual-task Studies

The purpose of OCBHE is to develop students' capacity to acquire competency or mastery of a domain and then transfer that knowledge to new conditions (e.g., solving problems on the job). One possible method for demonstrating transfer in an online environment was derived from dual-task studies, which suggests that when tasks are practiced together, learners have more opportunities to minimize interference between task demands and interlace memory processing components into a single flow of mental operations (Kramer et al., 1995). In a conventional dual-task, learners work simultaneously on two different tasks, for example, working on a math problem while learning a spreadsheet function. In general, these studies suggest that compared to learning single tasks alone, when tasks are practiced together, the information processing system can coordinate task performance and minimize interference between them, thus, maximizing learning.

According to Brown and Carr (1989), three general methods for acquiring dual-task skills are *restructuring*, *intratask automaticity*, and *task-combination strategies*. The latter of these mechanisms, task-combination strategies, considers dual-task learning and decreases in cognitive interference in the changing relations between two tasks (e.g., solving an accounting problem while entering the formula into a spreadsheet). Although the functions are performed independently, they can be combined into one processing sequence by interlacing their separate components into a single flow of mental operations. This is important within the context of online learning because students in an online environment are often required to combine bits and pieces of information from overlapping information sources and, when called upon to apply that information, incorporate them into a single problem-solving activity. Taken together, lessons from dual-task studies suggest that *training, which promotes an attention flexibility strategy, improves student learning.*

2.2.3 Variable Priority Training

Research in variability training also proposes that irregularity during training may improve learning. For instance, Johnston *et al.* (1998) suggest that narrow-minded practice leads to an overspecialized network that performs well under specific conditions but transfers poorly to new environments. Broad-minded networks (i.e., ones trained on a variety of task components), on the other hand, adapt better to new patterns of learning under changed conditions. The learning mechanism responsible for the effectiveness of variable priority training is significant for understanding the mechanisms involved in online learning because it provides evidence to suggest that flexibility in attention strategies during training increases performance on different tasks:

"It appears that systematically altering practice to encourage additional, or at least different, information processing activities can degrade performance during practice, but can at the same time have the effect of generating greater performance capabilities in retention on transfer tests" (p. 215).

Although the principles involving dual-task studies and flexibility training are different from the situated learning represented in an online environment, the learning mechanism responsible for their effectiveness is noteworthy; it provides evidence to suggest that *integrated training during the learning process may increase the application of those skills under new conditions.* Support for these techniques rests in the proposition that flexibility within the cognitive system solves the flexibility dilemma (Johnston et al., 1998). Chiefly, that flexibility within training promotes lasting relationships that allow information to be used in many ways during the skill transfer (Spiro *et al.*, 1991).

2.2.4 Constructivist Theory of Learning and Instruction

Education research has also looked at the training dilemma in learning. For example, according to the constructivist theory of learning and instruction (also referred to in their article as cognitive flexibility theory), Spiro *et al.* (1991) propose that:

"The remedy for learning deficiencies related to domain complexity and irregularity requires the inculcation of learning processes that afford greater *cognitive flexibility*: This includes the ability to represent knowledge from different conceptual and case perspectives and then, when the knowledge must later be used, the ability to construct from those different conceptual and case representations a knowledge *ensemble* tailored to the needs of the understanding or problem-solving situations at hand" (p. 24).

A key element to this theory is that reviewing the same materials at different times and using reorganized contexts from other objectives and perspectives is essential for attaining advanced knowledge acquisition goals. The knowledge that will eventually be used in many ways must be represented, organized, and used in many ways during training. The alternative is knowledge that is only usable in situations under which learners acquire the skill.

3. Theory Meets Practice

Within OCBHE programs, learning is no longer viewed as transmitting information from instructor to student but as an active process acquired through various instructional and media types. What does this mean for students? Let's consider one. Meet Janelle, a student in WGUs Health Professions College. By building a system with various instructional strategies and media types, Janelle has multiple opportunities to process information in new and novel ways. When she engages with her online course, Janelle finds:

Knowledge Retrieval: Her course has regular learning checks. Distributing formative assessment throughout the content delivery helps Janelle begin to actively construct her understanding of the content. Students who participate in active knowledge retrieval in their learning experience can have 6X improvement in outcomes (Dollár & Steif, 2008). This is more than a correlative effect. Frequently testing retrieval is one of the best ways to retain new concepts in memory.

Varied Practice: Janelle's learning checks are varied in type (e.g., multiple-choice, multiple-select, fill-in-the-blank, and drag and drop) and also varied in style (e.g., scenarios, reading checks, and "apply what you know" activities). When a student grows accustomed to one type of question, they start to digest content with a particular lens toward that question style instead of developing a more well-rounded perspective of the content. These varied practice knowledge checks are also interspersed throughout the learning experience rather than collected in an end-of-unit quiz, which provides a more exciting and "sticky" learning experience.

Chunking: The content of Janelle's course is arranged as distributed learning modules in short blocks, each taking a slightly different amount of time to complete. This helps Janelle plan for a steady pace and provides right-sized blocks to consume in a one- to two-hour session. Students tend to remember content that is presented first and last. This is known as the primacy/recency effect (Morrison, 2015). Through effective chunking, all of Janelle's content is presented either first or last._

Relevance: To increase Janelle's interest and engagement, well-produced videos integrating real-world expertise are incorporated into the learning experience. Short bursts of relevant content help to maintain attention and motivation.

Visual Anchors: The cognitive system is not built for remembering text. We remember by tagging what we learn to visual imagery. Especially in digital environments, the images on a page provide visual anchors to the student's content and improve retrieval. Janelle's course content has been paired with visuals throughout so the brain can tag and connect content.

Variable Priority: The course content is designed so that Janelle can get through some of it quickly, while other sections may take much more time. Variable priority training means practicing at a varied pace rather than learning at the same pace.

4. Method

This study's purpose was to better understand which instructional methods are most strongly related to student learning as measured by two different instructional strategies.

In Course of Study A (CosA), students received *traditional* online instruction and accessed the content through video recordings and lectures supplemented with learning resource materials. In Course of Study B (CosB), students received *enhanced* online instruction and accessed the content through various innovative instructional and media types. We hypothesized that students in CosB courses would *outperform* students in CosA courses on summative assessments due to the more flexible, in-depth, and cognitive science-based methods of instruction. Moreover, we expected more CosB students to complete the course *quicker* than CosA students due to increased efficiency and streamlining in the instructional materials and processes associated with CosB.

5. Participants

Participants were 89,549 students enrolled in five

Table 1. Years active by the number of students enrolled for each course

Course of study	Course name	Years active	N size
CosA	Introduction to Information Technology	2014-2017	13,449
	Data Management - Applications	2014-2019	7,204
	Data Management - Foundations	2014-2021	13,089
	Science, Technology, and Society (Undergrad)	2015-2016	298
	Science, Technology, and Society (Grad)	2015-2016	1,025
CosB	Introduction to Information Technology	2017-2022	31,143
	Data Management - Applications	2019-2022	14,170
	Data Management - Foundations	2021-2022	7,073
	Science, Technology, and Society (Undergrad)	2016-2022	942
	Science, Technology, and Society (Grad)	2016-2022	1,156

undergraduate and graduate courses at Western Governors University. The five courses included two science courses from WGUs Teachers College and three information technology courses from WGUs College of Information Technology. For each of the five courses, online delivery followed a CosA format for the first two to three years the course was active and switched to a CosB format for another one to two years before data collection and analysis. However, the course content and the summative assessments were kept the same, making the performance measures comparable across the two versions of the courses. In total, 35,065 students were enrolled in CosA courses, and 54,484 students were enrolled in CosB courses. The CosB sample was larger than the CosA due to a general increase in the overall student population. Table 1 shows, for each course, the years each course was active and the number of students enrolled.

6. Design

This study used a historical control group design. A historical control group is a cohort selected from pre-treatment archival data and matched to a subsequent cohort currently receiving treatment. Using a historical control group design provides a viable option for conducting quasi-experiments in education-based outcome evaluation when experiments can neither be adequately designed nor statistically controlled. Although prone to the same threats to study validity as any quasi-experiment, selection, history, and maturation issues can be particularly challenging. However, using a historical control group can reduce the non-comparability of treatment and control conditions through local matching or matching on student-level variables. In addition, a historical control group design can alleviate concerns about denying program access to students in the control group and minimize requirements in designing study variables while using archival data to help make informed decisions (Walser, 2014).

7. Measures

7.1 Independent Variables

The independent variable was the Course of Study: CosA versus CosB.

Course of Study A (CosA). Very few (if any) instructional design concepts were built into the learning process.

- The content was organized hierarchically by competency: Learners followed a prescriptive path through the course, beginning with the first competency and ending with the final competency.
- Learners accessed the course materials for each lesson via links to the Learning Resources (LRs).
- Each competency consisted of lessons within the section: The lessons were a mix of video recordings and lectures.
- Formative questions allowed learners to gauge their level of understanding. However, there was no prescriptive feedback based on how learners answered the questions.

Course of Study B (CosB). The content was organized such that learners could navigate to different competencies and lectures throughout the learning process. Learners accessed the course materials within the learning management system and could navigate freely throughout the course. Formative questions provided prescriptive feedback and allowed learners to return to course materials when needed. CosB courses incorporated cognitive science learning principles into the design process.

- Knowledge retrieval - regular learning checks.
- Varied practice - learning checks were varied in type and style.
- Chunking - learning modules were distributed in short blocks.
- Relevance - well-produced videos were integrated into the learning experience.
- Visual anchors - the content was paired with visual anchors throughout the course.
- Variable priority - the content was practiced at a varied pace.

7.2 Dependent Variables

The dependent variables centered on evidence of learning and performance outcomes and included *summative assessment scores*, *course completion rates*, and *course pace*.

Summative Assessment Scores. Measured as students' percent correct scores on their first summative assessment attempt. Summative assessments contained approximately 70 dichotomously scored items, and overall percentage scores for all courses ranged from 0 to 100, with a mean of 77.48 (SD = 8.78).

Course Completion. Scored as a dichotomous variable (course completed or not completed), with a mean course completion rate of .86 (SD = 0.38).

Course Pace. Measured as days to the course completion, the mean was 79.19 days (SD = 52.35). At WGU, this represents the time between enrollment and passing the required summative assessment. Thus, it is often interpreted as indicating the effort needed to complete the course.

8. Analysis and Results

Data were aggregated across the five courses to compare students' performance outcomes in CosA versus CosB instructional formats. Hypotheses were tested via a series of independent samples t-tests. Mean and standard deviation values for all dependent variables by course of study are located in Table 2. Students in CosB courses achieved higher summative assessment scores, on average, than students in CosA courses (t (89,548) = -37.04; $p<0.01$). CosB students also had a significantly higher course completion rate than CosA students (t (89,548) = -28.36; $p<0.01$). Finally, CosB students completed the course faster than CosA students (t (89,548) = 54.79; $p<0.01$). The effect sizes for these estimates were computed using Cohen's d (Cohen, 1992) and were 0.25, 0.19, and 0.38, respectively. Although these are considered small effects, the hypotheses are directionally supported by the findings. It can be inferred that students in an OCBHE program who experience a more flexible, cognitive science-based instructional format more successfully complete the course and at a faster pace while performing better on the summative assessment than students who undergo a more traditional instructional method.

9. Discussion

The focus on ensuring that degrees correlate with careers is a promising development in online competency-based higher education. Nearly every academic discipline and job require some KSAs' transference from college to career. Learning science suggests that programs that practice a blend of learning approaches may improve training transfer when integrated into the learning experience compared to those learned in the traditional format. While it would be too strong to say that science is uniting a new learning theory, there is convergence in the essential attributes of a successful learning model when technology and instructional methods meet.

Today's economy places value on broad knowledge and skills, flexibility, cross-training, multi-tasking, teaming, problem-solving, and project-based work. Learning in an environment that optimizes and aligns explicit and implicit curricula is critical to achieving a new paradigm's desired outcome. Janelle doesn't just need a degree; she needs the ability to apply the knowledge and skills she's built earning that degree. The principles discussed here support learning that is flexible, variable, and integrated, creating learning experiences that bear a close similarity to the contexts in which the learning results will be applied. As a result, students are more engaged in the learning process, more interested in the content, and better prepared to enter the workforce with the generalizable skills employers expect.

Our research demonstrated that the instructional method in an OCBHE program is an important factor in the learning process of a student's education. Methods that are more innovative, flexible, and based on enhanced technology contribute to higher and quicker learning rates than more traditional methods. Since the framework and nature of OCBHE, and thus the nature of the current data sample, emphasizes competency in workplace skills and transference of learned competencies to the application

Table 2. Comparison of learning and performance outcomes for CosA versus CosB

Course of study	Summative assessment scores	Course completion rates	Course pace (in days)
CosA	M = 76.38, SD = 8.69	M = 0.83, SD = 0.42	M = 90.17, SD = 52.87
CosB	M = 78.54, SD = 8.78	M = 0.86, SD = 0.38	M = 79.19, SD = 52.35

of those skills, the findings suggest that technology-based methods of instruction are particularly conducive to training students to develop KSAs necessary for job success.

10. Limitations

It is worth restating the apparent quasi-experimental nature of our research. Our study included treatments and experimental units that did not use random assignment to create the comparisons from which treatment-caused change was inferred. Instead, our comparisons depended on the nonequivalent groups that differed in many ways other than the presence of a treatment whose effects were being tested. Especially in a field setting as complex as higher education and as high volume as WGU, we recognize the inherent threats to valid causal inference that non-random assignment brings to the process. Yet, we must deal with those threats in some meaningful way. After all, designing experimental research in an applied educational setting is seldom done well as day-to-day operations allow little to design experiments. As a result, a historical control group provided the only means to draw somewhat meaningful conclusions without the afforded capability of manipulating the independent variable in an operational setting.

Nevertheless, students in CosB courses achieved higher summative assessment scores, demonstrated significantly higher course completion rates, and completed their studies faster than CosA students. Additionally, while effect sizes were small, it is worth noting that even small effects can be impressive. One strategy for demonstrating meaningful results involves showing that even the most minimal manipulation of the independent variable still accounts for some variance in the dependent variable (Prentice & Miller, 1992). What makes some effects seem important is not their magnitude but rather the studies' methodologies that produced them. Lacking any statistical process control or research design methodology (there were no manipulations of the IV), our findings supported the learning science principles described throughout this paper.

Stated somewhat differently, researchers adopt a tremendous variety of quasi-experimental approaches, including computer simulations, longitudinal studies, psychometric assessments, content analyses, meta-analyses, citation assessments, and biographical data. The research units can be as small as single discoveries and as large as whole generations. The sample sizes can vary from single-case studies to inquiries with thousands of records. Since our research did not employ a strong causal design, I suspect that a future research study could be designed to maximize its power and statistical strength with sufficient ingenuity.

11. Conclusion and Next Steps

There is little doubt that OCBHE is here to stay; students benefit from more inclusive, collective, and interactive experiences compared to traditional learning methods. Which begs the question, what's next? As discussed, much of the focus of conventional learning methods has been on traditional practices, which are necessary, but insufficient for learning transfer. As a result, OCBHE must position itself to advance student achievement through – among other things – identifying and assessing high-performing students and their workforce readiness through a variety of learning mechanisms. Rationalization within the market will occur among institutions as they learn the effectiveness of OCBHE programs and their ability to graduate high-performing students.

That said, our human actions can limit the amount of precision in a training program's effectiveness, despite our best intentions. Some have argued that student achievement is the byproduct of multiple distinguishable causes and refer to effective instructional practices as an entity or personal attribute that holds steady over time and space. However, as Harris and Sass (2008) point out, the "differences between the age, academic level, and needs of students mean that teaching requires different skills and knowledge in a different context. These multiple contexts underscore that effective teaching is not fixed but reflect the particular organizational environment and student needs" (p. 22). Attempts to differentiate students in a nuanced fashion based solely on the broad learning approaches discussed in this paper are surely misguided, as students enter their degree program with varying degrees of KSAs and differing backgrounds.

Therefore, it is undoubtedly critical to appreciate that learning is not uniform or unidimensional from an instructional standpoint. Instead, as educators have frequently attested, individuals can - and do - differ, even for the same instructor, same content, or within the same school (Alexander & Murphy, 1999). Given the distinctive nature of OCBHE, institutions should adopt a robust notion of student attributes and holistic and comprehensive views of every student using the most up to date and available data sources. In addition to scientifically validated academic planning tools, supplementary components such as readiness for self-directed learning, confidence and level of experience with course content, interactions with faculty, and the like should be utilized to as great an extent as the faculty deems necessary and practical. Stated somewhat differently, science should not over-emphasize asynchronous learning as a tool but also include other factors when designing better learning delivery systems. Online delivery is a starting point, not a definitive answer.

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