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TEACHING BUSINESS LEADERSHIP SKILLS TO PROFESSIONALS IN HEALTHCARE CYBERSECURITY, BIODEFENSE AND BIOTECHNOLOGY THROUGH EXPERIENTIAL LEARNING METHODS

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Abstract: *The COVID-19 pandemic has not only reshaped the global economic landscape but also underscored the critical need for strategic leadership and management skills in organizations spanning diverse sectors. This paper delves into the compelling imperative of nurturing strategic leadership and management competencies among technical experts, with a particular focus on pivotal fields such as biodefense, healthcare cybersecurity, biotechnology, and healthcare operations management. It asserts that the post-COVID-19 era necessitates a profound shift in organizational priorities, urging a renewed commitment to fostering comprehensive leadership capabilities alongside technical proficiency within graduate and degree completion programs. To meet this imperative, the paper advocates for the adoption of innovative and student-centric pedagogical approaches. In today's dynamic landscape, traditional methods fall short in preparing technical managers for the multifaceted challenges they face. Instead, the paper champions the utilization of experiential learning approaches, such as activity-based learning, problem-based learning, design thinking, and Learn-Teach-Do. These approaches go beyond theory, immersing students in collaborative, reflective, and integrative experiences that simulate real-world scenarios, thus equipping them with the leadership acumen needed to excel in technical healthcare roles.*

Keywords: management education; healthcare education; healthcare leadership development; experiential learning; problem-based learning.

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Background

The outbreak of COVID-19 has had far-reaching implications for healthcare organizations, communities, and economies worldwide. While its immediate impact has been devastating, it has accelerated pre-existing trends and created new imperatives for organizations across sectors. One such imperative is cultivating strategic leadership and management skills, particularly among technical experts (Burrell, 2018). Many university programs and faculty are responding with new and engaged approaches to develop better technical experts in strategic management (Hay & Hodgkinson, 2006; Burrell, 2020; Burrell et al., 2020).

Technical experts are typically hired for domain-specific knowledge and skills (Burrell, 2018). While this expertise is undoubtedly essential, it often results in a relatively narrow focus on the technical aspects of a job (Burrell, 2018). The COVID-19 pandemic highlighted the need for a broader skill set that includes strategic thinking, effective communication, and the ability to adapt to rapidly changing circumstances.

The COVID-19 pandemic disrupted operations in various sectors, including those heavily reliant on technical experts. Biodefense and healthcare cybersecurity, for example, saw a surge in cyber threats and espionage attempts as adversaries capitalized on the chaos. Biotechnology, biodefense, and healthcare operations management faced supply chain disruptions, labor shortages, and unprecedented logistical challenges. In this context, the role of technical experts expanded to include crisis management, adaptability, and strategic planning (Burrell, 2018).

In the wake of the COVID-19 pandemic, organizations recognized the limitations of a technical-only approach and began prioritizing the development of strategic leadership and management skills among their technical experts (Burrell, 2018). Several factors drive significant leadership shifts.

The Volatile Organizational Environment: The post-COVID-19 world is marked by volatility, uncertainty, complexity, and ambiguity (VUCA). Organizations must be agile and responsive in such an environment, requiring leaders who can navigate uncertainty and make strategic decisions beyond their technical expertise (Shufutinsky et al., 2021).

The Interconnectedness of Challenges: Challenges in the post-pandemic era are often interconnected and multifaceted. For example, a healthcare cybersecurity breach can affect a company's reputation, financial stability, and legal liabilities. Leaders with a broader skill set are better equipped to understand these interdependencies and make informed decisions (Shufutinsky et al., 2021).

The Importance of Crisis Management: The pandemic underscored the critical importance of crisis management skills. Technical experts who can lead during crises, communicate effectively with stakeholders, and adapt to evolving circumstances are invaluable assets to organizations facing unforeseen challenges (Shufutinsky et al., 2021).

Challenges and Opportunities: While the shift toward developing strategic leadership and management skills among technical experts is imperative, it is not without challenges (Shufutinsky et al., 2021). These challenges include:

Resistance to Change: In some organizations, there may be resistance to expanding the role of technical experts. This resistance may stem from a traditional view that technical experts should focus solely on their technical responsibilities. Overcoming this resistance requires effective change management and communication (Shufutinsky et al., 2021).

Identifying and Cultivating Leadership Potential: Identifying individuals with potential leadership roles among technical experts can be challenging. Traditional performance metrics may not capture the full range of leadership qualities (Shufutinsky et al., 2021). Organizations need to develop robust assessment mechanisms to identify and nurture leadership talent.

Balancing Technical and Leadership Development: Technical skill development with leadership training is delicate (Shufutinsky et al., 2021). Organizations must ensure that technical experts excel in their specialized areas while acquiring the skills necessary for leadership roles. Despite these challenges, the shift towards cultivating strategic leadership and management skills among technical experts presents numerous opportunities.

Improved Decision-Making: Technical experts with strategic leadership skills are better equipped to make informed decisions that align with organizational goals and navigate complex challenges effectively (Shufutinsky et al., 2021).

Enhanced Innovation: Leaders who think strategically are more likely to drive innovation within their fields (Shufutinsky et al., 2021). More leaders are needed to identify new opportunities, anticipate market trends, and foster a culture of creativity and adaptability (Shufutinsky et al., 2021).

Resilience in the Face of Uncertainty: Organizations with technically proficient leaders are more resilient in uncertainty. Leaders must respond quickly to emerging threats and opportunities ensuring long-term sustainability (Shufutinsky et al., 2021).

Problem statement

There are several leadership challenges in the COVID-19 pandemic transformed world. This unforeseen event has led to unique challenges that healthcare cybersecurity, biotechnology, and biodefense leaders should focus on to survive and thrive in the pandemic-transformed world. These challenges include:

The Talent Shortage: The number of talented workers has fallen considerably since the pandemic began, for example, in the. U.S., 3.2 million more workers from the Baby Boomers generation retired in the third quarter of 2020 than in the third quarter of 2019 (Mann, 2022). Many women left jobs in the U.S. between February 2020 and January 2022; more than 1.8 million have yet to rejoin the workforce (Mann, 2022).

Attracting and Retaining Top Talent: There were 10.3 million job openings in the U.S. in October 2022. Moreover, 4 million employees quit in October 2022 (Mann, 2022). With many employees quitting jobs and needing more talent to fill the vacancies, attracting and retaining top talent has also become a significant leadership challenge (Mann, 2022). This is a different challenge for an organizational manager who may have seen most of their academic training in healthcare cybersecurity, information technology, biotechnology, or Biodefense and currently work in those roles.

Leading a Hybrid Team: Remote working became the norm for many during the pandemic. Moreover, even now that most businesses have reopened, many employees are not keen to return to their workplaces (Mann, 2022). They want employers to implement a more flexible hybrid model that combines working from home and working from the office (Mann, 2022). 52% of American employees prefer the hybrid model (Mann, 2022). However, maintaining successful professional relationships with employees not regularly seen face-to-face is a new challenge for many leaders (Mann, 2022).

As a result, more technical managers are looking for programs that develop practical leadership skills. More organizations are looking for programs that teach strategic management and leadership adaptability skills with curriculum and instructional approaches that teach real-world skills. This paper explores the nature and importance of those approaches.

Methodology

A practical case study approach was employed. A real-world practical case study is invaluable research and learning tool by offering a tangible example that bridges the gap between theory and practice. Researchers and learners can analyze this case to understand how disruptive innovation can positively impact the world of practice. A practical case study provides a useable example that others can emulate as an action learning resource (Larraza-Mendiluze et al., 2020; Kolb, 2014).

Why technical managers need leadership training

Technical managers, frequently recruited for their specialized technical knowledge and expertise, play a pivotal role in modern organizations across diverse sectors. However, a persistent challenge in this context is the significant gap between their technical prowess and leadership skills (Burrell, 2018). While technical excellence remains crucial, the capacity to lead and inspire teams, navigate change, and adapt to external environmental volatility is equally vital in today's dynamic business landscape (Burrell, 2018). A growing body of research highlights that technical managers' deficient leadership skills can substantially affect organizational effectiveness and resilience (Burrell, 2018).

One salient issue in technical management is the limited availability of leadership skill development opportunities (Burrell, 2018). Organizations often invest heavily in technical training and skill enhancement but may prioritize leadership development with a different fervor. This gap is particularly pronounced in sectors where technical managers are frequently promoted from within due to their technical expertise. This leads to situations where individuals ascend to leadership roles without adequate preparation (Burrell, 2018). Furthermore, leadership development programs tailored to the unique needs of technical managers are relatively scarce, exacerbating the challenge of bridging the leadership skills gap (Burrell, 2018).

In an era marked by unprecedented external environmental volatility and rapid technological advancements, the need for technical managers to possess robust leadership skills is more pressing than ever (Burrell, 2019; Burrell, 2022). These individuals are crucial conduits between their domains' technical intricacies and their organizations' overarching strategic goals. (Burrell, 2019; Burrell 2022). With a strong foundation in leadership, technical managers can guide their teams through change, communicate effectively

with stakeholders, and foster a culture of adaptability (Burrell, 2019; Burrell, 2022). Hence, recognizing and addressing the leadership skills deficit among technical managers is not merely a matter of professional development but a strategic imperative for organizations seeking to thrive amidst uncertainty and disruption (Burrell, 2019; Burrell, 2022). As organizations face ever-increasing levels of uncertainty and disruption, the demand for effective leadership has never been greater (Shufutinsky et al., 2021). To address this challenge, technical leaders must draw upon diverse leadership theories and adapt their approaches accordingly (Burrell, 2018).

Human Capital Theory

Human Capital Theory posits that individuals possess unique skills, knowledge, and abilities that are valuable organizational assets (Amah, 2022; Ayandibu & Abiwu, 2020; Stefanova, 2022). In today's turbulent landscape, the theory's emphasis on recognizing and nurturing the value of human resources is more relevant than ever. One crucial aspect of Human Capital Theory is identifying and developing organizational talent (Amah, 2022; Ayandibu & Abiwu, 2020; Stefanova, 2022). Leaders must recognize their teams' diverse skills and potential and provide opportunities for growth and development (Amah, 2022; Ayandibu & Abiwu, 2020; Stefanova, 2022). In disruptive times, harnessing and leveraging the full spectrum of human capital can be a significant strategic advantage (Shufutinsky et al., 2021).

In a rapidly changing world, leaders must foster a culture of continuous learning. Human Capital Theory underscores the importance of ongoing training and skill development. Leaders should support their teams in acquiring new competencies and adapting to emerging challenges, ensuring that human capital remains a dynamic and valuable resource (Amah, 2022; Ayandibu & Abiwu, 2020; Stefanova, 2022).

Influential leaders must align human capital with organizational objectives (Burrell, 2018). Effective leadership involves recognizing the skills and knowledge present within the workforce and ensuring that these capabilities are directed toward strategic priorities. This alignment is crucial for the organization's pivot and response to disruptions in volatile environments. The critical skills from a Human capital theory perspective can be developed through curriculum and teaching approaches that develop real-world problem skills and utilize practical applications.

Adaptive Leadership Model

The Adaptive Leadership Model is centered on the notion that leaders must adapt their approaches to suit their specific challenges and contexts (Benson, 2023; Shufutinsky et al., 2021; Heifetz et al., 2009). This model is particularly relevant in today's disruptive and volatile organizational landscape (Burrell et al., 2023). Adaptive leaders excel in diagnosing complex challenges and distinguishing technical problems from adaptive ones (Naim, 2021). In the face of disruption, leaders must effectively identify and address the root causes of issues (Shufutinsky et al., 2021; Burrell et al., 2023). Effective leadership requires a keen understanding of the ever-changing dynamics of internal and external organizational environments (DeRue, 2011; Cojocar, 2008; Obolensky, 2017; Burrell et al., 2023).

The Adaptive Leadership Model emphasizes the importance of embracing discomfort and uncertainty. Leaders must be willing to confront complex realities and make tough decisions (Obolensky, 2017; Burrell et al., 2023). In a volatile environment, this adaptability and resilience are essential for leading through adversity (Burrell et al., 2023). The competencies essential within the framework of the Adaptive Leadership model can be cultivated through educational curricula and instructional methodologies designed to nurture practical problem-solving abilities and encourage real-world application (Burrell, 2020).

Human Relations Theory

Human Relations Theory emphasizes interpersonal relationships and organizational social dynamics (Nicotera, 2019; Overvold, 1987). In an era of disruption and volatility, fostering solid connections is a critical leadership skill (Shufutinsky et al., 2021; Burrell, 2022).

In times of uncertainty, leaders must be empathetic and attuned to the emotional needs of their teams. Human Relations Theory encourages leaders to understand the perspectives and concerns of their employees (Nicotera, 2019; Overvold, 1987). This empathy fosters a supportive and inclusive environment, crucial for maintaining team cohesion during disruptive periods.

Clear and open communication is a hallmark of Human Relations Theory (Nicotera, 2019; Overvold, 1987). Leaders must be adept communicators, conveying information transparently and engaging in active listening. Effective communication is vital when navigating uncertainty, as it helps reduce anxiety and

confusion among team members (Nicotera, 2019; Overvold, 1987). The intrinsic proficiencies encapsulated within the Human Relations Theory framework of leadership can be systematically nurtured and honed via meticulously tailored educational curricula and pedagogical approaches, thereby cultivating pragmatic acumen in problem resolution and facilitating the transposition of acquired knowledge into real-world scenarios.

Applied teaching and learning approaches

The value and importance of teaching and learning approaches emphasizing practical, real-world, and experiential elements over traditional theoretical methods cannot be overstated (McCarthy, 2016). In today's dynamic and rapidly evolving world, the gap between academic knowledge and practical application has never been narrower (Burrell, 2020). Practical learning experiences bridge this divide by equipping individuals with the skills and competencies necessary to excel in their professional endeavors (Burrell, 2020). These approaches prioritize hands-on engagement, problem-solving, and critical thinking, enabling learners to navigate complex challenges with confidence and adaptability (Burrell, 2020; McCarthy, 2016; Kolb, 2014).

Moreover, practical and experiential learning approaches empower individuals to grasp the intricacies of their fields in a meaningful and tangible manner (Hulaikah et al., 2020; Towne et al., 2012). Theoretical knowledge alone often remains abstract and disconnected from real-world contexts (Burrell, 2020). Conversely, experiential learning immerses learners in authentic situations, allowing them to apply theories, test hypotheses, and witness the consequences of their actions firsthand (Hulaikah et al., 2020; Towne et al., 2012). Efficient learning approaches foster a deeper understanding of concepts and principles, enabling individuals to make informed decisions, innovate, and excel in their chosen fields (Burrell, 2020). Ultimately, the value of practical and experiential learning lies in its capacity to bridge theory and practice, equipping learners with the skills, insights, and adaptability needed to thrive in an ever-changing world (Burrell, 2020).

Activity-Based Learning (ABL)

Activity-Based Learning (ABL) is a pedagogical approach that places active engagement and experiential learning at its core (Singal et al., 2018; Towne et al., 2012). It prioritizes hands-on experiences, interactive exercises, and practical applications as vehicles for knowledge acquisition (Singal et al., 2018; Towne et al., 2012). When applied to teaching leadership skills, ABL can be a powerful tool for developing the next generation of effective leaders.

ABL promotes active participation in leadership scenarios. Rather than passively absorbing theories or concepts, learners are encouraged to engage in leadership activities actively. For instance, students may take on roles in team projects that simulate real-world leadership challenges. By actively participating in decision-making, conflict resolution, and team dynamics, they gain a deeper understanding of leadership principles and how they apply them in practice (Singal et al., 2018; Towne et al., 2012). This experiential learning fosters a sense of ownership over their leadership development, making the lessons more enduring and applicable.

ABL emphasizes collaborative learning experiences (Singal et al., 2018; Towne et al., 2012). Leadership often involves working with diverse teams and understanding the dynamics of group interactions. ABL creates opportunities for learners to collaborate with peers, share perspectives, and collectively solve leadership-related problems. Group projects, case studies, or role-playing exercises challenge students to navigate interpersonal relationships and develop teamwork skills essential for effective leadership. Through these collaborative experiences, learners gain insights into the complexities of leadership and the importance of interpersonal skills, empathy, and communication.

ABL encourages reflection and feedback as integral components of the learning process (Singal et al., 2018; Towne et al., 2012). Learners are prompted to critically evaluate their leadership experiences, identify areas for improvement, and seek constructive feedback from peers and instructors. This reflective practice enhances self-awareness and self-regulation, both fundamental aspects of effective leadership. By continuously assessing their actions and learning from successes and failures, individuals can refine their leadership approaches and adapt them to evolving challenges. ABL fosters a growth mindset, nurturing skilled leaders committed to ongoing self-improvement (Singal et al., 2018; Towne et al., 2012).

Activity-based learning has a wide range of pedagogical applications to teaching. Its core premise includes the requirement that learning should be based on doing some hands-on experiments and activities (Singal et al., 2018; Towne et al., 2012). The original idea of activity-based learning is rooted in the common notion that people are active learners rather than passive recipients of information. If an individual is provided the opportunity to explore on their own and provided an optimum learning environment, the learning becomes joyful and long-lasting (Anandalakshmi, 2007; Singal et al., 2018; Towne et al., 2012).

The philosophy of ABL finds its antecedents in the common notion that learning can be done best when initiated by the surrounding environment and motivated by providing optimum opportunities to learn. A fearless, free-to-expression environment always adds to the best learning outcomes. (Anandalakshmi, 2007; Singal et al., 2018; Towne, De Jong, & Spada, 2012).

Case example of ABL

One effective ABL activity is the Leadership Simulation Challenge. In this activity, technical managers are presented with a realistic scenario that mirrors their challenges, such as managing a cross-functional team to implement a critical project in a rapidly changing environment. An example could be an organization experiencing significantly high employee turnover. Here is how the activity can be structured.

Scenario Introduction: Begin by introducing the scenario to the participants. Provide background information about the fictional organization, its industry, and the specific project or challenge they will be tasked with. Emphasize the volatility and complexity of the situation to create a sense of urgency and relevance.

Role Assignments: Assign participants to different roles within the scenario, such as project manager, team lead, technical expert, or communication coordinator. Ensure that the roles reflect the diversity of responsibilities and expertise required in real-life leadership situations.

Problem-Solving and Decision-Making: Present the participants with challenges and decision points they must navigate throughout the simulation. These challenges should encompass various aspects of leadership, including team dynamics, conflict resolution, communication, strategic planning, and adaptability.

Team Collaboration: Encourage participants to collaborate within their teams to analyze the challenges, develop solutions, and make decisions collectively. Collaboration promotes teamwork, communication, and understanding of different leadership roles within a group.

Real-Time Feedback: Facilitate ongoing discussions and feedback sessions during the simulation. Encourage participants to reflect on their leadership choices and the impact of their decisions based on the elements of the Human Capital Theory, the Adaptive Leadership Model, and the Human Relations Theory. Peer feedback and facilitator guidance can provide valuable insights into leadership strengths and areas for improvement.

Debrief and Analysis: Conclude the activity with a debrief session where participants discuss their experiences, lessons learned, and key takeaways. Facilitate a group discussion to identify common leadership principles that emerged during the simulation.

The Leadership Simulation Challenge offers technical managers an experiential learning opportunity to apply leadership concepts practically. It allows them to develop essential skills such as decision-making under pressure, effective communication, conflict resolution, and adaptability—all while navigating a realistic leadership scenario. By actively engaging in this ABL activity, technical managers can gain valuable insights into leadership challenges and develop their leadership acumen in a safe and immersive environment, preparing them for the complexities of leadership roles in today's volatile work environment.

Problem-Based Learning (PBL)

Problem-based learning (PBL) is a pedagogical approach that centers on exploring and resolving authentic, complex problems (Hawamdeh & Adamu, 2021; Pang, 2010; Burrell, 2020). When harnessed for teaching leadership skills, PBL offers a dynamic and immersive learning experience that mirrors the multifaceted challenges leaders encounter in the real world.

PBL immerses learners in intricate leadership scenarios. It presents them with genuine, multifaceted problems that require a comprehensive understanding of leadership theories and the practical application of leadership skills. Students are tasked with dissecting these problems, identifying potential solutions, making informed decisions, and replicating the intricacy of real leadership challenges (Hawamdeh & Adamu, 2021; Pang, 2010; Burrell, 2020). By navigating these authentic scenarios, learners develop problem-solving skills, critical thinking, and the ability to assess situations from various angles, all essential for effective leadership.

PBL cultivates teamwork and collaboration. Leadership is seldom a solitary endeavor; it involves guiding and collaborating with diverse teams. In PBL settings, learners work in groups to analyze and address complex problems. This collaborative environment allows students to harness their collective knowledge and skills and helps them understand the importance of interpersonal relationships, communication, and conflict resolution in leadership roles (Hawamdeh & Adamu, 2021; Pang, 2010; Burrell, 2020). By grappling with group

dynamics within the context of solving real problems, students gain insights into how to lead and inspire teams effectively (Hawamdeh & Adamu, 2021; Pang, 2010; Burrell, 2020).

Finally, PBL promotes lifelong learning and adaptability in leadership. The iterative nature of problem-based learning encourages students to refine their leadership approaches continually. They learn that leadership is not a static skill set but a dynamic one that evolves in response to changing circumstances. Through reflection on their problem-solving experiences and feedback from peers and instructors, learners develop the capacity for self-assessment and self-improvement, crucial traits for adaptive leaders (Hawamdeh & Adamu, 2021; Pang, 2010; Burrell, 2020). PBL equips future leaders with the resilience and flexibility needed to thrive in an ever-evolving leadership landscape.

PBL as a teaching-learning method has been implemented in academic and business settings. There have been several applications of PBL in science, medicine, biotechnology, and education. The conceptual framework of conducting PBL uses a systems approach involving input, process, and output. The system's input of PBL is the preparation stage, which includes the determination of clear learning outcomes in the development of generic skills, the introduction of PBL as a teaching-learning method to students as well as teaching staff, training of the facilitators, and preparation of PBL package to ensure the success of PBL (Mata et al., 2011). The system process of PBL involves three activities: i) encountering the problem, ii) self-directed learning, and iii) back to the problem. The activities of each stage will produce the outcomes of the PBL. The system's output of PBL is the generic skills that individuals gain after completing the three stages of activities in PBL. The generic skills include i) application of knowledge, teamwork, and communication skills, ii) professionalism skills, iii) leadership skills, and iv) critical thinking and problem-solving skills. This systems approach can be applied in conducting PBL, starting with preparation before the PBL sessions, known as input; the three stages and activities of PBL are the process and the generic skills known as output (Mata et al., 2011). The CM uses PBL in the empathic or ideation phase. What is the problem or challenge of the stated question? Creating a unique business? Or is it enhancing a current product or service through a new business model design? The PBL is a very crucial and valuable approach.

Case example of Problem-Based Learning (PBL)

Problem-Based Learning (PBL) can effectively teach technical managers leadership skills through practical and experiential activities. An example of a PBL activity is the Leadership Challenge Project. Here is how it can be structured.

Activity Overview: The Leadership Challenge Project is designed to provide technical managers with a real-world leadership experience. Participants are tasked with identifying and addressing a significant challenge or opportunity within their organization, requiring them to apply leadership skills to drive positive outcomes. An example could be an organization looking to open a new office in a new location and hire an entire staff for the office.

Steps in the Leadership Challenge Project

Challenge Identification: Participants are divided into teams and tasked with identifying a genuine leadership challenge or opportunity within their organization or industry. The exercise challenge could be related to improving team performance, addressing a specific issue, or capitalizing on an emerging trend.

Analysis and Planning: Each team thoroughly analyzes the chosen challenge or opportunity. They research relevant data, gather stakeholder input, and assess the potential impact on the organization. This phase encourages participants to think critically and strategically.

Leadership Strategy Development: Teams develop a leadership strategy to address the identified challenge or opportunity. They must consider leadership styles, communication plans, conflict resolution strategies, and stakeholder engagement techniques. This phase allows participants to apply leadership principles in a practical context.

Implementation: Teams execute their leadership strategies within the organization. Leadership activities may involve leading project teams, facilitating change, or influencing organizational culture. Participants gain hands-on experience in leading and managing initiatives.

Monitoring and Adaptation: Throughout the implementation phase, teams continuously monitor progress and adapt their strategies as needed. The exercise activities mirror the dynamic nature of leadership in real-world scenarios, where adjustments are often required.

Reflection and Presentation: After completing the project, each team reflects on their leadership experiences and presents their findings and outcomes to the larger group. The life-like exercise encourages participants to analyze their leadership effectiveness and learn from successes and challenges.

Peer Feedback and Evaluation: Teams provide constructive feedback to one another, offering insights into their leadership approaches and outcomes based on the elements of Human Capital Theory, the Adaptive Leadership Model, and Human Relations Theory. Facilitators and instructors also assess the leadership development demonstrated during the project.

The Leadership Challenge Project is a Problem-Based Learning activity that immerses technical managers in a real leadership context, allowing them to practice and refine their leadership skills while addressing actual organizational challenges. It fosters experiential learning, critical thinking, teamwork, and adaptability—all crucial attributes for effective leadership in today's dynamic and unpredictable work environments. By engaging in this PBL activity, technical managers can bridge the gap between leadership theory and practice, equipping themselves with the skills needed to lead confidently and competently.

Design Thinking (DT): Design Thinking (DT) is an innovative problem-solving approach that prioritizes empathy, creativity, and iterative processes (Long, 2012; Hennessey & Mueller, 2020). When applied to learning experiences to teach leadership skills, DT offers a unique framework that fosters adaptive and empathetic leaders who navigate complex challenges.

DT encourages leaders to empathize with their teams and stakeholders. It teaches learners to step into the shoes of others and understand their perspectives, needs, and aspirations (Long, 2012; Hennessey & Mueller, 2020). By incorporating this element into leadership education, students develop a deep appreciation for the importance of empathy in leadership. They learn to actively listen, consider diverse viewpoints, and tailor their leadership approaches to the unique needs of their teams. This empathy-driven leadership fosters trust, enhances collaboration, and promotes a sense of belonging within organizations.

DT emphasizes creativity and innovation as critical leadership skills. Leaders are often tasked with finding innovative solutions to complex problems. DT learning experiences encourage students to think outside the box, generate creative ideas, and prototype solutions. These skills are directly transferable to leadership roles, where creativity is instrumental in devising novel strategies and adapting to rapidly changing circumstances. Leaders who undergo DT-based training become more adept at fostering cultures of innovation within their teams and organizations, driving long-term success.

Finally, DT instills an iterative mindset in learners. In leadership, adaptability is paramount, as leaders must continually refine their strategies in response to evolving challenges. DT teaches students to embrace the process of experimentation and iteration, understanding that failure can be a valuable source of learning (Long, 2012; Hennessey & Mueller, 2020). By integrating this aspect into leadership education, individuals become more comfortable with ambiguity and change, essential attributes for influential leaders in today's dynamic and disruptive business environment. DT-based learning experiences equip future leaders with the resilience and agility to thrive in leadership roles.

There is an excellent amount of literature on the subject of design thinking, what design thinking is about, and what it may involve (Long, 2012; Hennessey & Mueller, 2020; Kuo et al., 2021; Cook & Bush, 2018; Jamal et al., 2021). From these many works, there appears to be a standard reference to design thinking as a cognitive, strategic, and practical process by which design concepts are developed by designers and design teams (Viser, 2006; Cross, 2001). Core features include resolving ill-defined or wicked problems, adopting solution-based strategies, using abductive/productive reasoning, and employing non-verbal, graphic/spatial modeling media (Cross, 1990). The design thinking approach (as defined above) is most relevant as it promotes and encourages creativity (Long, 2012; Hennessey & Mueller, 2020; Kuo et al., 2021; Cook & Bush, 2018; Jamal et al., 2021).

Often, multiple options of design models are offered to facilitate critical thinking and problem-solving (Kuo et al., 2021; Cook & Bush, 2018; Jamal et al., 2021). Applying design thinking to achieve alternative model options under a standard set of criteria presents an opportunity to gain differing designs and respective types (Kuo et al., 2021; Cook & Bush, 2018; Jamal et al., 2021). It takes some ability to think through the notional ideas or concepts, which can be very intuitive (Cross, 2011). What may appear to be the problem at first glance may not be the problem but a symptom or part of a significant issue or a completely different challenge (Kuo et al., 2021; Cook & Bush, 2018; Jamal et al., 2021). Design thinking activities redirect the design effort and result in a different solution that is more applicable and aligned with the actual challenge. An exciting aspect of this design thinking is how one's mind processes design thinking. One way is to visually represent the ideas and solutions – a drawing or graphic storyboard. Cross states, that designing is difficult to conduct by purely internal mental processes; the designer needs to interact with an external representation (Cross, 2011, p. 12). This interaction manifests in a sketch or drawing that reflects the thoughts and ideas

generated. The act of graphic representation allows the designer to move to and from (or between) the problem and solution environments. By doing this, it links the two environments. Using design thinking activities has direct implications as drawing and physically exhibiting ideas is very powerful and communicative for a student to grasp ideas, concepts, and solutions. One of the essential features is illustrating a concept or topic to communicate quick ideation and generate immediate feedback.

Design Thinking (DT) offers a creative and experiential approach to teaching technical managers leadership skills. An example of a DT activity for leadership development is the Leadership Innovation Workshop. Here is how it can be structured.

Activity Overview: The Leadership Innovation Workshop challenges technical managers to apply DT principles to develop innovative leadership solutions for complex, real-world organizational challenges. An example could be that your organization has partnered with Gallaudet University, the preeminent university for people who are deaf or hard of hearing in the United States in Washington, DC. In this partnership, your organization will use Gallaudet to hire new healthcare cybersecurity talent who are deaf and hard of hearing. Your goal is to use DT to consider the organizational resources and cultural changes needed to effectively hire, on-board, and create a welcoming environment for these new employees.

Steps in the Leadership Innovation Workshop

Challenge Framing: Participants are presented with a leadership challenge relevant to their roles or industries. This challenge should be complex and open-ended, such as improving team collaboration, fostering innovation, or navigating organizational change.

Empathize: Participants engage in the empathize phase of DT by conducting interviews and surveys with team members, colleagues, or stakeholders to gain insights into the challenge. They seek to understand the perspectives, needs, and pain points of those affected by the leadership issue.

Define: After gathering insights, participants define the specific leadership problem they aim to address. They create a problem statement that encapsulates the challenge and identifies the desired outcome.

Ideate: Participants generate a wide range of creative ideas and potential solutions to the defined leadership challenge using brainstorming techniques. This ideation phase encourages participants to think innovatively and explore unconventional approaches to leadership.

Prototype: Teams select one or more promising ideas and develop prototypes of their proposed leadership solutions. These prototypes can take various forms, such as role-play scenarios, process diagrams, or mock leadership interventions.

Testing and Feedback: Teams test their leadership prototypes in a controlled setting, such as a simulated leadership scenario or through role-playing based on the elements of the Human Capital Theory, the Adaptive Leadership Model, and the Human Relations Theory. They gather feedback from peers or instructors to assess the feasibility and effectiveness of their solutions.

Iteration: Based on feedback and insights from testing, teams refine and iterate their leadership solutions. This iterative process mirrors the dynamic nature of leadership, where adaptability and continuous improvement are essential.

Presentation: Each team presents their innovative leadership solution to the larger group, explaining the problem they addressed, their approach, and the anticipated impact. Debriefing activities encourage participants to communicate their ideas effectively, a crucial leadership skill.

Reflection and Learning: Participants engage in reflective discussions after all presentations, sharing their experiences and lessons learned throughout the workshop. They identify fundamental leadership principles and insights gained through the DT process.

The Leadership Innovation Workshop leverages DT principles to provide technical managers with hands-on experience in addressing complex leadership challenges innovatively. By combining empathy, creative ideation, prototyping, and iterative testing, participants gain practical leadership skills directly transferable to their roles. This experiential approach allows technical managers to think critically, adapt to change, and develop innovative leadership strategies, preparing them to navigate the dynamic and unpredictable nature of today's work environments with confidence and agility.

The Learn-Teach-Do MODEL

The Learn-Teach-Do (LTD) MODEL represents an innovative and comprehensive approach to fostering leadership skills through a dynamic and experiential learning framework. This model comprises three interconnected phases: learning, teaching, and doing, each contributing to the holistic development of leadership acumen. Individuals study leadership theories, concepts, and best practices in the learning phase. This foundational knowledge forms the basis for their leadership journey. The teaching phase then encourages

participants to share their newfound insights with peers, solidifying their understanding and reinforcing their role as learners and educators (Larraza-Mendiluze et al., 2020). Finally, the doing phase challenges individuals to apply leadership principles in real-world scenarios, honing their practical leadership skills and fostering adaptability in dynamic challenges (Larraza-Mendiluze et al., 2020). The LTD MODEL recognizes that leadership is not solely an academic pursuit but a multifaceted endeavor that requires continuous learning, knowledge sharing, and real-world application.

Learning experiences can be meticulously crafted through the LTD MODEL to cater to developing leadership skills. Participants engage in a rich and interconnected cycle of learning, teaching, and doing, which mirrors the complexities of leadership in practice. This model emphasizes the importance of leadership as a journey of self-improvement and continuous growth, where individuals acquire knowledge and empower themselves and their peers through teaching and mentorship (Larraza-Mendiluze et al., 2020). By employing the LTD MODEL, educators, and organizations can create tailored learning experiences that foster leadership development and equip individuals with the competencies needed to thrive in ever-evolving and unpredictable work environments based on the elements of Human Capital Theory, the Adaptive Leadership Model, and Human Relations Theory.

LTD Model Case Study

The LTD Model comprises three levels of learning: primary, secondary, and tertiary. The three levels are interrelated and foster expansion from one level to the next (Larraza-Mendiluze et al., 2020; Kolb, 2014). The Primary Level promotes learning, while the Secondary Level expands learning by teaching (or sharing) the information and knowledge gained (Larraza-Mendiluze et al., 2020; Kolb, 2014). The third is the Tertiary Level, which advances learning and teaching by doing (Larraza-Mendiluze et al., 2020; Kolb, 2014). LTD is not necessarily a new approach but is enhancing. The LTD Model incorporates the hands-on approach from ABL, a systems approach input process and output from PBL, and visual representation from D.TDT The other approaches noted earlier (i.e., Inquiry-Based Approach, Collaborative Approach, etc.) also had certain features feathered into the LTD Model. The result is as follows:

Primary Level – Learn

The primary level involves essential learning using four steps. First, the student reads the subject matter from a prescribed textbook (or sourced material such as journal articles, online websites, etc.). Next, the student produces a written one-page brief of the material that was read. Third, they listen to the instructor's lecture, supplementing information. Furthermore, fourth, the student answers a list of open book exam questions that require the answers to be extracted from the book. These four steps expose the student to the same material four times, each in a different manner. This enables the student to capture essential information initially, refine their understanding, and catch any missed details.

Secondary Level – Learn-Teach (Share)

The Secondary level allows the student to present course-related research from journals, articles, and podcasts. A simple synopsis of the written piece is submitted to the instructor, and the topic is opened for class discussion. This technique has several advantages. First, the student is exposed to light research in selecting a topic to brief. Second, the student must take a volume of information that is written chiefly and condense it into a succinct narrative. Third is the open discussion that, when led by the student with prompting by the instructor, engages other students in expressing a specific problem or opinion verbally in 5 or 10 minutes.

Moreover, given the number of students in the class, much information is shared. For example, if the class is 15 students, then 15 articles will be presented in one session. Doing this ten times in a 15-week semester equals 150 articles on different yet related topics. These learning activities will undoubtedly expose the class to varied topics in a way that they would not have necessarily pursued on their own. It also provides the instructor with a generous source of information they did not need to research and present per se. Additionally; this information may contribute to an instructor's academic research and future lectures – a win-win for all concerned.

Tertiary Level – Learn-Teach-Do

The third level, the Tertiary Level, results from the first two levels, advancing the student from learning and teaching (sharing) to doing or applying what information and knowledge has been gained. The essence of this third level enables the student to use previous research, discover, learn, and analyze information to

generate a paper, a project, or a case study. If a paper is required for doing, it should be short and manageable with a specific focus. The length should be approximately three to four thousand words. This short narrative gives the student an achievable goal without being overwhelmed. The number of short papers or projects should also be limited to 2-3 per semester. The exception is a semester-long project (i.e., a business plan, strategic plan process model, etc.). Breaking down several papers or projects into multiple assignments allows the student to practice staying focused on one topic at a time. Subsequently, when future expansive papers (or projects) are assigned, designing compartmentalized sections may be more familiar.

Conclusions

In conclusion, innovative applied teaching and learning models present a robust and practical approach to crafting learning experiences tailored to teach leadership skills to technical managers in information technology, healthcare cybersecurity, biotechnology, and Biodefense. In a post-COVID-19 landscape characterized by unparalleled unpredictability and rapid transformation, the imperative for technical experts to complement their specialized knowledge with solid leadership capabilities is undeniable. Innovative applied teaching and learning models encapsulate the essence of leadership development by fostering a holistic learning journey that combines theoretical knowledge acquisition, practical application, and peer-driven teaching (Larraza-Mendiluze et al., 2020; Kolb, 2014).

In the wake of the COVID-19 pandemic, the organizational environment has become a crucible of constant change and uncertainty (Shufutinsky et al., 2021). Technical managers in critical fields must transcend their traditional roles as domain-specific experts and emerge as agile, adaptable leaders who can steer their teams and organizations through uncharted waters (Burrell, 2019). Innovative applied teaching and learning models offer a dynamic platform for building the leadership skills essential for addressing complex challenges, fostering innovation, and ensuring organizational resilience (Burrell, 2020). By recognizing that leadership is not a static concept but an evolving journey of continuous learning, teaching, and practical implementation, innovative applied teaching and learning models offer learning activities that equip technical managers to excel in the modern workplace where the fusion of technical expertise and leadership acumen is paramount for sustained success (Burrell, 2019; Burrell, 2020).

In an era where leadership is no longer a peripheral skill but a central necessity for technical managers, innovative applied teaching and learning models guide professors attempting to develop better leaders through their teaching approaches (Burrell, 2020). It underscores the pivotal role of ongoing self-improvement, mentorship, and knowledge-sharing in leadership development. By embracing this approach, technical managers can harness their technical expertise as a foundation to build their leadership prowess (Burrell, 2019). In doing so, they not only fortify their career trajectories but also contribute to the resilience and adaptability of their organizations in the face of unforeseen disruptions. As we continue to navigate the unpredictable terrain of the post-COVID-19 world, innovative applied teaching and learning models offer a steadfast framework for nurturing the leaders our evolving times demand (Burrell, 2020).

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