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CREATIVE PROBLEM SOLVING IN DIGITAL HEALTH ENTREPRENEURSHIP: A THEORETICAL FOUNDATION

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Abstract. The development of digital health technologies has led to the emergence of a distinct group of entrepreneurs working at the intersection of healthcare and technology. Digital health entrepreneurship is inherently creative, as it involves developing solutions that transform healthcare systems, support patient empowerment, and improve the delivery of health services. Digital health entrepreneurs operate in dynamic healthcare systems characterised by regulatory requirements, technological constraints, and ongoing uncertainty, which continuously shape both problems and acceptable solutions. Drawing on literature from entrepreneurship, creative problem solving, and digital health innovation, this conceptual paper frames creative problem solving as an ongoing process shaped by healthcare system dynamics and sustained through self-directed learning. By integrating entrepreneurial competencies, divergent–convergent problem-solving processes, and learning autonomy, the article clarifies how creative problem solving is maintained in digital health contexts and offers a foundation for future empirical research.

Keywords: creative problem solving, creativity in entrepreneurship, digital health entrepreneurship, self-directed learning, entrepreneurial competencies.

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1. Introduction

Digital health technologies in healthcare emerged just over five decades ago (Weimar et al., 2025), and in the current Health 5.0 context, in order to build resilient, strong, and effective healthcare systems, there is a need to create, develop and integrate various emerging technologies (Mbunge et al., 2021).

After these technologies were created and as their applications expand, a new generation of entrepreneurs – digital health entrepreneurs – is emerging. Digital health entrepreneurship refers to the practice of utilizing digital technologies to develop and implement innovative health solutions that enhance patient care or improve the broader health and social care system (Weimar et al., 2025).

Digital health entrepreneurship involves pursuing innovative opportunities in digital health by creating value-driven solutions through design, development, and deployment of technological innovations under uncertain conditions (Wulfovich & Meyers, 2019). The primary goals include improving patient outcomes, increasing the quality of healthcare, enhancing the health professional experience, and reducing costs (Wulfovich & Meyers, 2019; Charles et al., 2021).

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Innovation does not emerge in isolation – it is often the result of a structured creative process that involves identifying problems, generating diverse ideas, and selecting viable solutions. In this context, creative problem-solving becomes a central mechanism for translating new ideas into practical applications. There is no doubt that digital health entrepreneurs, in their pursuit of optimal and unique solutions, must rely on creative problem-solving principles (Wigert et al., 2024): when searching for solutions, they should diverge to explore different possibilities before selecting the best approach; and when choosing and implementing solutions, they should converge to ensure that creative ideas are practical, efficient, and feasible.

Importantly, creative problem solving in digital health entrepreneurship takes place amid ongoing uncertainty and constraint, influenced by regulatory standards, clinical evidence requirements, technological interoperability issues, and the differing expectations of multiple stakeholders. These factors continually alter both how problems are defined and which solutions are acceptable, turning creative problem solving into a recurring process rather than a single event. Consequently, digital health entrepreneurs increasingly depend on self-directed learning to maintain and enhance their creative problem-solving capabilities. By proactively recognizing what they do not yet know, seeking out pertinent information, and embedding new learning into their day-to-day activities, entrepreneurs can adjust their problem-solving approaches on the fly.

Studies show that entrepreneurship education programs integrating self-directed learning strategies can enhance students' problem-solving skills, critical thinking, and capacity for innovation (Charokar & Dullo, 2022). Morris and König's (2021) indicates that self-directed learning competence prepares individuals for entrepreneurship and resilience in the face of dynamic changes. However, there remains a lack of research that conceptualises the mechanisms of creative problem-solving in digital health entrepreneurship through self-directed learning in environments characterised by persistent uncertainty and constraints. Therefore, the **aim of article** is to conceptualise creative problem-solving in digital health entrepreneurship, shaped by healthcare system dynamics and sustained through self-directed learning.

2. A set of competences for a digital health entrepreneur to creatively solve problems

Digital health interventions must be compatible with the country's context and health system (World Health Organization, 2019) and go through a specific development and implementation mechanism (Marvel et al., 2018).

According to the recommendations of the World Health Organization (2019), a digital health solution can only be realistically implemented if the following factors are ensured:

- The solution is targeted at a specific health domain and ensures information compatible with recommended health practices or validated health content.
- The solution enables the achievement of health sector goals.
- The solution is compatible with other health technologies operating within the health system (interoperability) and therefore seamlessly interacts and assimilates with the country's healthcare system by exchanging and integrating health data.

Meanwhile, Marvel et al. (2018) present a Digital Health Intervention Innovation Roadmap that reveals the mechanism of developing and advancing digital health innovation up to its market introduction.

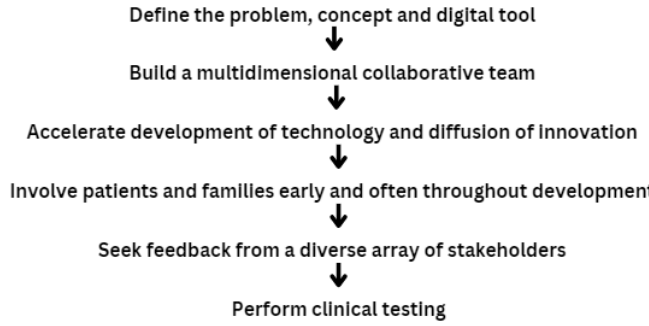


Figure 1. Digital health innovation mechanism (source: Marvel et al., 2018)

Ensuring the factors shaped by the health system and implementing the process of developing and advancing health technology solutions determine the specificity of the activities of digital health entrepreneurs. The product development and validation take longer, investing in such innovations is riskier, but the return and the social impact are much greater. Also, it has been observed that innovation faces various tasks such as spotting a problem, being able to understand the technicalities, analyzing the market, building and managing a multidimensional team, securing funding, being able to test the product with different groups of people, and collecting and evaluating their experiences and conducting clinical trials (El-Chaarani et al., 2023; Tariq, 2023). All of these tasks undoubtedly require specific competence.

Looking at the digital health innovation mechanism, it can be stated that digital health entrepreneurs apply a creative problem-solving approach. In the first stage, defining the problem, concept, and identifying the digital tool – the principle of divergence is crucial for digital health entrepreneurs (see Figure 1). Skills such as brainstorming, free thinking, and considering unconventional or out-of-the-box solutions enable them to explore a wide range of potential digital health solutions.

Meanwhile, in all subsequent stages of the digital health innovation mechanism, the principle of convergence dominates. At this point, a broad spectrum of planning and implementation decisions is made to realize the developed digital health solution, relying heavily on critical thinking. In classical entrepreneurship theory, the structure of an entrepreneur's competences has been elaborately developed. The competences presented by the European Commission (2018) and the authors of various studies (Bańka et al., 2023; Wang & Johnston, 2022; Gliddon & Rothwell, 2018; Ahmed & Harrison, 2021; Bachmann et al., 2024) allow to understand what broad capabilities an entrepreneur needs to have to create innovations with high added value, which, according to a study conducted by Guo and Li (2018), stimulates the demand for quality and affordable healthcare services. These competences are divided into

various fields that include creativity, communication, technological thinking and knowledge about people and the demand they create, which is constantly changing.

El-Chaarani et al. (2023) emphasize that the ever-growing medical entrepreneurship is attracting more investors who are strongly interested in investing in digital health products and services that use the latest technologies, such as virtual reality, artificial intelligence, data management and other cutting-edge technologies. Strong investor interest and the need to improve the healthcare system are fueling the growth of digital medicine entrepreneurs. This process of search, creation, risk and other factors, which is the inevitable work cycle of digital medicine entrepreneurs, is depicted as a circular and never-ending process (Tariq, 2023; El-Chaarani et al., 2023; Zajicek & Meyers, 2018). Moreover, innovation development within the healthcare system is distinct, as these innovations often integrate diverse perspectives such as pharmaceuticals, biotechnology, medical devices, and information technology. To ensure that healthcare innovations meet the needs of modern healthcare systems – such as rapid diagnostics, precise treatment selection, data interoperability, accurate interpretation of diagnostic results, and more – the creation and development of artificial intelligence (AI) driven innovations are essential. Nassani et al. (2023) emphasize that AI supports innovation performance in the healthcare industry.

Open innovations are also integral to digital health innovations due to their complex nature, which necessitates integrating external knowledge from patients, healthcare professionals, and caregivers with internal resources at the early stages of the innovation process (Wass & Vimarlund, 2016). Healthcare innovations are increasingly aligned with sustainable development goals, with new models prioritizing technology, service delivery optimization, and system efficiency. These advancements enhance care quality, organizational productivity, and the long-term stability of healthcare systems (Akenroye & Kuenne, 2015).

This context of healthcare system demands requires digital health entrepreneurs to possess a specific set of competencies, which help them creatively solve problems, to successfully operate in this field.

Arguably, the most significant contribution to the development of entrepreneurship theory is the EntreComp framework (European Commission, 2018). There are three key areas with five competences, each of which describe what it means to be entrepreneurial (Table 1).

Table 1. EntreComp framework: key areas and competencies (source: European Commission, 2018)

Area of ideas and opportunities:	Area of resources:	Area of action:
Spotting opportunities Creativity Vision Valuing ideas Ethical and sustainable thinking	Motivation and perseverance Self-awareness and self-efficacy Financial and economic literacy Mobilizing others Mobilizing resources	Learning through experience Working with others Planning and management Taking the initiative Coping with ambiguity, uncertainty and risk

The EntreComp framework outlines general competency areas but does not address the unique competency needs of digital health entrepreneurs to meet the demands of a dynamic and complex healthcare system's stakeholders.

3. Self-directed learning methods for the competency development of digital health entrepreneurs

In today's world, there are countless ways to acquire the skills needed to become a digital health entrepreneur. These can be formal learning in special educational institutions according to the curriculum, specialized courses, seminars, mentoring or practical learning, when competences are acquired during work. It is important to realize that the ever-changing digital health sector requires new competences or the improvement of existing ones.

To acquire the necessary competences, the traditional learning strategy is not effective in keeping up with the ever-changing demands of learning for entrepreneurs (Olokundun et al., 2018; Scarmozzino et al., 2017). Self-directed learning is offered as an alternative (Charokar & Dullo, 2022). It is a process in which the learner determines their own learning needs, formulates goals, and selects learning resources (du Toit-Brits, 2018). Thus, it is the learner who determines the concept of learning, its implementation and evaluation (Brookfield, 2009). It is noteworthy that the self-directed learning process is ensured by the learner themselves through the dimensions of self-management, self-monitoring, and motivation (Sam & Shalini, 2021).

Self-directed learning encompasses a variety of methods that enable individuals to take initiative in their own education and skill development. These methods include networking, which involves attending events and workshops to build connections and learn from experienced professionals; self-reflection, where individuals assess daily interactions and feedback to identify areas for growth; and mentorship, where guidance from a mentor and observing their expertise can provide valuable insights (Institute of Entrepreneurship Development, 2022). Additionally, it highlights participation in online courses to acquire new skills and reading books or articles to expand knowledge as essential self-directed learning strategies (K. R. Mangalam University, 2024). Together, these methods offer diverse pathways for personal and professional development.

Self-directed learning plays a proactive and influential role facilitating entrepreneurial performance through such output as self-efficacy of enhancing performance, self-evaluation and reflection, and critical thinking (Tseng, 2013). Digital health entrepreneurs with higher self-efficacy level would have an enhanced ability to develop comprehensive skills and abilities for healthcare system problems. The ability to self-evaluate and reflect makes it possible to identify missing competences, weaknesses, and thus accelerate the creation and development of a digital health solution. Reflection is a way of reasoning through complicated, uncertain and complex situations, rather than usual or predictable ones for which a correct answer can be known (Huxtable-Thomas & Brahm, 2023). Meanwhile, critical thinking provides an opportunity to objectively assess the needs of the healthcare system, analyze uncertain situations, evaluate risks that arise, choose appropriate solution alternatives and foresee consequences.

4. A mechanism of creative problem solving in digital health entrepreneurship

Creative problem solving in digital health entrepreneurship cannot be fully captured by a linear or stage-based model, because entrepreneurial challenges in healthcare are not definitively solved but are continually reshaped. Shifts in regulatory frameworks, clinical standards, and technological possibilities repeatedly transform both how problems are defined and what

counts as an acceptable solution. Each round of problem solving thus produces new limitations and understandings that influence subsequent creative efforts. Consequently, creative problem solving takes the form of a cyclical process of continuous adjustment, where the results of one cycle serve as the initial conditions for the next.

Contextual triggers and ongoing problem redefinition. In digital health entrepreneurship, creative problem solving is driven by continual disruptions emerging from the healthcare environment. Regulatory changes, clinical evidence expectations, interoperability limitations, and evolving stakeholder needs constantly reshape the landscape in which entrepreneurs operate. Consequently, problems cannot be treated as fixed or fully specified; instead, entrepreneurs must continually reinterpret what the core problem is and what counts as a viable and acceptable solution within the system.

Divergent–convergent creative problem solving. After reframing the problem, entrepreneurs proceed with creative problem solving through repeated cycles of divergence and convergence. Divergence allows them to explore numerous interpretations, solution routes, and unconventional ways of addressing healthcare issues. Convergence then narrows this exploration by bringing emerging ideas into alignment with regulatory, ethical, clinical, and technological constraints. Instead of stifling creativity, these constraints actively shape the creative process, steering it toward solutions that are simultaneously original and feasible.

Situated mobilisation of entrepreneurial resources. As creative problem solving progresses, entrepreneurial competencies are drawn upon in context-specific and selective ways. Cognitive, technological, social, and managerial resources contribute to various stages of divergence and convergence, yet they do not predetermine how the process unfolds. Instead, these competencies operate as enabling resources within creative action, being activated and recombined in line with the problem's shifting requirements rather than deployed as stable, predefined skill sets.

Self-directed learning and recursive recalibration. Each cycle of creative problem solving uncovers fresh gaps in information, new ambiguities, and additional constraints. These, in turn, activate self-directed learning, through which entrepreneurs autonomously search for knowledge, examine their own experiences, and weave emerging insights into their ongoing activities. Importantly, self-directed learning is not separate from the creative process; it reorients later cycles by altering how problems are defined, how idea generation unfolds, and how solutions are judged. Thus, learning keeps creative problem solving functioning as a recursive, adaptive sequence rather than a single, isolated burst of creativity.

5. Conclusions

Creative problem solving in digital health entrepreneurship operates as a cyclical mechanism because healthcare system conditions continuously change and repeatedly reshape both problems and acceptable solutions. Changes in healthcare system conditions repeatedly trigger problem redefinition, followed by divergent idea generation and convergent solution selection. Entrepreneurial competencies are mobilised in a context-specific manner to support these phases, while self-directed learning enables continuous adjustment by addressing emerging knowledge gaps and integrating new insights into subsequent problem-solving cycles.

This conceptualisation implies that creative problem solving in digital health entrepreneurship is best supported when learning, adaptation, and problem redefinition are treated as ongoing rather than one-time activities.

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