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Entrepreneurial Competencies and Development Methods in Digital Health: A Case Study of Lithuanian Startups

Master's Final Degree Project

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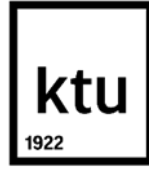
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Summary

The thesis highlights the importance of digital healthcare entrepreneurs who innovate in the field of digital medicine. The paper mentions that there are many challenges to innovating in the field of digital health, and therefore digital health entrepreneurs face many challenges.

In order to successfully solve emerging challenges and to create and develop innovations in digital healthcare, entrepreneurs in this field must have various competencies. The possible methods of acquiring and improving the necessary competences are also indicated.

The thesis identifies a research gap in the literature on the competencies of digital healthcare entrepreneurs and their acquisition and development methods. Although the importance of the competencies needed by entrepreneurs is clearly understood, there is a lack of research that would help specifically identify the competencies needed by entrepreneurs creating digital health care innovations and possible methods to improve them.

In order to eliminate this gap, a study was conducted with startups operating in Lithuania that create innovations in the field of digital healthcare. The aim of the research is to reveal what competences entrepreneurs face and what methods they use to acquire and improve these competences.

The research question is aimed at identifying the competencies needed by digital health entrepreneurs and the applied methods to acquire and improve them. In order to answer the research question, a literature review, qualitative data collection, data analysis and visualization were performed. At the end of the paper, recommendations are presented, which aim to help digital healthcare entrepreneurs to assess the necessary competencies and possible methods of acquiring and improving them. The conclusions highlight thirteen main competences, which entrepreneurs of digital healthcare startups operating in Lithuania face, and the possible methods of acquiring and improving the named competences.

It is important to note that the findings and recommendations of the study may not be applicable to all digital healthcare entrepreneurs. The creation of each digital healthcare innovation and the entrepreneur who creates it is unique and therefore requires specific competencies.

Santrauka

Baigiamajame darbe pabrėžiama skaitmeninės sveikatos priežiūros antreprenerių, kurie kuria inovacijas skaitmeninės medicinos srityje, svarba. Darbe minima, kad inovacijų kūrimas skaitmeninėje sveikatos priežiūros srityje kelia daug iššūkių, todėl skaitmeninės sveikatos antrepreneriai susiduria su daugybe iššūkių.

Siekiant sėkmingai spręsti kylančius iššūkius bei kurti ir vystyti skaitmeninės sveikatos priežiūros inovacijas, šios srities antrepreneriai turi pasižymėti įvairiomis kompetencijomis. Taip pat nurodomi reikalingų galimi kompetencijų įgijimo bei tobulinimo metodai.

Baigiamajame darbe identifikuojama mokslinio tyrimo spraga literatūroje apie skaitmeninės sveikatos priežiūros antreprenerių kompetencijas ir jų įgijimo bei tobulinimo metodus. Nors antrepreneriams reikalingų kompetencijų svarba aiškiai suprantama, tačiau trūksta tyrimų, kurie padėtų konkrečiai įvardinti kompetencijas, kurios reikalingos skaitmeninės sveikatos priežiūros inovacijas kuriantiems antrepreneriams, ir galimus jų tobulinimo metodus.

Norint pašalinti šią spragą, buvo atliktas tyrimas su Lietuvoje veikiančiais startuoliais, kurie kuria inovacijas skaitmeninės sveikatos priežiūros srityje. Tyrimo pagalba siekiama atskleisti, su kokių kompetencijų poreikiu susiduria antrepreneriai ir kokius metodus taiko šioms kompetencijoms įgyti bei tobulinti.

Tyrimo klausimas yra skirtas nustatyti skaitmeninės sveikatos antrepreneriams reikalingas kompetencijas ir taikomus metodus jas įgyti bei tobulinti. Siekiant atsakyti į tyrimo klausimą, buvo atlikta literatūros apžvalga, kokybinių duomenų rinkimas, duomenų analizė ir vizualizavimas. Darbo pabaigoje pateikiamos rekomendacijos, kuriomis siekiama padėti skaitmeninės sveikatos priežiūros antrepreneriams įvertinti reikalingas kompetencijas ir galimus jų įgijimo bei tobulinimo metodus. Išvados išryškina trylika pagrindinių kompetencijų, su kurių poreikiu susiduria Lietuvoje veikiančių skaitmeninės sveikatos priežiūros startuolių antrepreneriai, ir įvardintų kompetencijų galimus įgijimo bei tobulinimo metodus.

Svarbu paminėti, kad tyrimo išvados ir rekomendacijos negali būti taikomos visiems skaitmeninės sveikatos priežiūros antrepreneriams. Kiekvienos skaitmeninės sveikatos priežiūros inovacijos kūrimas ir ją kuriantis antrepreneris yra unikalus, todėl tai reikalauja specifinių kompetencijų.

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List of abbreviations

Abbreviations:

Assoc. prof. – associate professor;

Prof. dr – professor doctorate

IoT – the internet of things

SDL – self-directed learning

IT – information technology

Introduction

Medicine is crucial today for people in order to keep them healthy and treating illnesses. It helps us to extend life span and live a better life. According to the European Commission, more than half of the world's population does not have access to the healthcare services. A better and more sustainable future for all people will depend on healthcare innovation and equitable access to medical developments as the world's population expands. The growth of medical innovation and research depends on digital health entrepreneurs. Entrepreneurs play a big role in advancing the creation of fresh healthcare approaches and bridging the gap between scientific advancements and useful applications. Their absolute dedication to finding medical needs and coming up with innovative solutions has a significant influence on the development of healthcare.

Examples of the importance of entrepreneurs in the creation of digital health innovations can be found in the scientific literature. In a study conducted by Apostolopoulos, Makris, and Stavroyiannis (2022), they wrote about the integration of innovation. The integration of these innovations, which largely depends on health entrepreneurs, helps to digitize and improve the systems and services of the medical sector and introduce solutions based on the latest technologies. The difficulties of integrating such innovations were studied by Cozzolino & Geiger (2024). The study highlights that digital health innovation startups face a challenge in the established health sector ecosystem. This problem stems from the fact that creating value involves many interrelated parties that require specific alignment to maintain and improve interworking. For this reason, the implementation of digital health innovations becomes a complex and unpredictable matter, which is conditioned by the hard and challenging work of entrepreneurs creating digital health innovations.

Knowing the importance of digital health entrepreneurs in the medical sector, it is important to delve into the competencies of digital health entrepreneurs who successfully develop innovations in this field. By understanding what competences are required by the digital health innovation development process, we could provide recommendations to entrepreneurs in this field on which necessary competences to focus on and offer methods for developing these competences.

A wide range of competencies that are important for innovation can be found in the literature, but there is a notable lack of research that specifically focuses on entrepreneurs who innovate in the field of digital health. The challenges and obstacles faced by digital health entrepreneurs in a study was written by Tariq (2023), who discussed the challenges of innovating in the rapidly changing field of digital medicine. A similar study was conducted by El-Chaarani, Raimi & El-Abiad (2023), who identified the challenges faced by medical entrepreneurs. Based on the research conducted by these researchers, it is clear that there are many challenges and difficulties faced by entrepreneurs developing digital health innovations. In order to successfully deal with emerging challenges and difficulties, entrepreneurs need competencies that enable them to make the right decisions. Having the opportunity to name the competences needed by digital health entrepreneurs, it is important to provide a set of methods based on which the entrepreneur could develop the necessary competences by applying the self-directed learning method.

Knowing that there are no detailed studies on the necessary competencies and their development methods for entrepreneurs creating digital health innovations, especially in the case of Lithuanian startups, a study is conducted that aims to provide recommendations on the competencies necessary for digital health entrepreneurs and possible methods of their development.

The **aim** of the research is to provide recommendations for developing competencies in digital health entrepreneurship for innovativeness.

The research **objectives** are:

1. To highlight the problemic issue of competence development of digital health entrepreneurs.
2. To provide a theoretically based set of competencies and methods of their development for digital health entrepreneurs.
3. To ground a research methodology aimed to identify digital health entrepreneurs competencies and applied methods to develop them in the case of Lithuanian startups
4. Provide recommendations on the competencies needed by digital health entrepreneurs and the methods used to develop them for innovativeness.

1. The Problemic Issues of Competence Development of Digital Health Entrepreneurs

The health sector is constantly faced with complex situations that make it difficult to provide services to patients. Issues such as the increasing prevalence of chronic diseases, rising health care costs that cause financial strain, obvious disparities in access and quality of services, shortage of professionals, and burnout from the workload are of great concern.

In order to curb these pressing problems the health industry is undergoing substantial changes due to the rapid implantation of digital health technology and the emergence of Health 5.0 as a forward-thinking approach to medicine. As we approach the dawn of this new era, it is essential to examine the current state of the health business and grasp the crucial role that health entrepreneurs, involved in the development of digital health technology and Health 5.0 concepts, play.

1.1. The Context of health 5.0

Due to constantly growing population (United Nations, 2023) medical services will become more and more important in the future. The progression of healthcare from Health 1.0 to Health 5.0 (Kaur et al., 2020) emphasizes the critical need for affordable and cutting-edge medical treatments. Health 2.0 highlighted the transition from Health 1.0, which concentrated mainly on reactive disease treatment, to preventative care and health promotion. With the advent of adapted medicine in Health 3.0 and the integration of technology and data-driven healthcare in Health 4.0, the era of the digital age was announced. Now that the world is moving into Health 5.0, the value of medicine is even clearer (Mbunge et al., 2021).

Health 5.0 marks a revolutionary departure from traditional medical practices, presenting a visionary outlook for the future of healthcare. Its central concept is the establishment of a new era rooted in patient-centric care, where state-of-the-art technology converges with a comprehensive and proactive approach to medicine. At the heart of Health 5.0 are principles that emphasize a shift in healthcare's focus from merely treating illnesses to empowering individuals to take charge of their health and overall well-being. Patient engagement and personalization are integral to the Health 5.0 framework, enabling patients to play an active role in their healthcare journey. They are guided by data-driven insights and supported by an interconnected network of healthcare providers. Additionally, Health 5.0 promotes integrative and preventive medicine, placing emphasis on addressing the individual as a whole, encompassing both the mind and the body. By harnessing the potential of genetics, lifestyle choices, and environmental factors, this approach aims to prevent illnesses and enhance overall wellness. As we delve deeper into the principles of Health 5.0, we uncover a healthcare model that prioritizes wellness, early detection, and sustainable health. This transformation promises a healthcare system that is not reactive but proactive, ultimately fostering a society that is healthier and happier.

1.2. Digital Health Solutions for Precision Medicine

According to various researches, there are significant emerging digital technologies that are adapted in Health 5.0 era of medicine. Mbunge, Muchemwaa, Jiyane and Batani (2021) emphasized in research that in order to built resilient, strong, and effective healthcare systems, one needs to integrate various emerging technologies. Table 1 further explains how each technology can be implemented in the healthcare sector.

Table 1. Implementation of digital health technologies.

Technology	Implementation
Nanotechnology	Nanotechnology advances treatments, quick diagnostics, and illness prevention in Healthcare 5.0. Nanotechnology is used in the form of nanomaterials, nanodevices, and nanobiosensors to improve individualized health monitoring via the Internet of Nano Things (Anjum et al., 2021).
The Internet of Things (IoT)	The IoT offers remote monitoring and smart healthcare by linking medical devices and sharing health data with healthcare providers. They enable patient-tailored treatment, proactive monitoring, early disease identification, and smart rehabilitation, changing traditional healthcare into a more comprehensive and efficient system. (Swayamsiddha & Mohanty, 2020)
AI	Sensor-based AI technologies, such as smart wearables, can monitor, gather information, and diagnose diseases. These systems include automated disease prediction, detection, and smart drug creation. Cognitive AI systems with emotion analysis capabilities are envisaged in Healthcare 5.0 to improve mental health monitoring and individualized therapy. AI and developing technologies have the potential to improve medical imaging, medication discovery, research, clinical trials, and robotic surgery (Mohanta, Das & Patnaik, 2019; Cominelli, Mazzei & Rossi 2018).
Cloud computing	In the healthcare sector, cloud computing is the practice of delivering computer resources and patient health data via the Internet and remote servers. This technology provides a cost-effective solution for data storage and efficient data management, enabling more innovative and adaptable resource access (Javaid et al., 2020).
Big data	The widespread use of intelligent sensors and digital tools in Healthcare 5.0 generates a significant amount of big data that has the potential to revolutionize tailored care and disease prevention (Mbunge et al., 2021).
Robotics	During the COVID-19 outbreak, for example, medical supplies and medications were delivered to hospitals by robots and drones. Additionally, patients received medical consultations and virtual rehabilitation services. Furthermore, healthcare workers have been assisted by autonomous robot systems in carrying out repetitious activities (Zeng, Chen & Lew, 2020)
5G technology	Digital automation in Healthcare 5.0 is dependent on high-speed wireless technologies. 5G technology, with its high data rates and vast network coverage, is critical. It offers remote clinical services and care delivery with low latency, providing a seamless user experience (Siriwardhana et al., 2021).
Blockchain	Blockchain technology is increasingly being integrated into healthcare systems to ensure the secure and efficient exchange of health information. According to Ben Fekih & Lahami (2020), the use of blockchain in healthcare improves digital access rules, data aggregation and liquidity, patient identity and privacy, and the immutability of health data transmission across multiple entities.

Knowing how these technologies could be utilized, there are expectations to make healthcare more personalized and centered on the needs of the individual.

Remote monitoring and treatment of patients is a method that is performed without patients coming to a treatment facility. This method uses various smart devices. With the help of smart devices, the work of the patient's heart system, blood oxygen saturation, temperature measurement, breathing or sleep efficiency, appetite, cough or general well-being can be monitored (Gordon et al., 2020; Mbunge et al., 2021).

The outbreak of the Covid-19 pandemic was a very good moment to test the need for remote patient monitoring. Gilbert et al. (2020) presented data on the situation of patient counseling in the United

Kingdom. Before the pandemic, on average, only 7% of consultations took place remotely. During the pandemic, a goal was set for 80% of patient consultations to be done virtually. In the first 6 weeks, it managed to reach as much as 87%. The most important thing is that even 90 out of 100 patients and 78 out of 100 doctors evaluate this counseling method positively.

Detailing remote patient care, which is extremely closely related to medicine and doctors, the healthcare industry is exposed to various digital alternatives that enable people to take care of their health and track various health indicators. Some common types of digital health tools include:

1. mHealth – The delivery of medical services and public health initiatives through mobile devices, primarily through text messaging or applications, is referred to as mHealth. These apps are typically intended to promote wellness by assisting users in managing their diet, lifestyle, or health conditions such as diabetes and heart disease. While many of these applications contribute to preventive healthcare, an increasing proportion is designed to help people with chronic health conditions (Rowland et al., 2020).
2. Digital twins in healthcare are virtual replicas of patients, organs, or medical devices created by combining data from electronic health records, medical imaging or wearable devices. These digital representations enable real-time monitoring, personalized treatment plans, and predictive analytics to predict health issues. Digital twins improve decision-making, medical research, and training, ultimately improving patient outcomes and healthcare efficiency (Attaran & Celik, 2023).
3. Telehealth includes the use of video or phone calls and online platforms to facilitate virtual consultations, remote monitoring, and the exchange of medical information. The main goal is to provide patients with a convenient means to access medical care from their homes (Basu et al., 2021).
4. Health analytics provides the ability to analyze vast amounts of diverse health data. This data can be electronic health records, data collected from patients, test results or medical images. The main goal of this technology is to systematize significant information that can be used to make significant decisions and improve the efficiency of patient treatment (Razzak, Imran & Xu, 2020).

The adoption of virtual health services has introduced a new model in patient care, offering significant conveniences and benefits. In the context of managing chronic diseases or remote patients monitoring, virtual health technologies have demonstrated high patient satisfaction. It is due to their accessibility and the elimination of travel requirements. This not only reduces the risk of infection transmission, but also allows efficient remote monitoring and data collection, making healthcare more patient-centric. This indicates that virtual health services can provide quality education and support, transcending physical barriers. These examples collectively highlight the transformative impact and demand for virtual health services in improving patient access, convenience, and satisfaction in various medical specialties.

The integration of digital technologies in healthcare which is reshaping the landscape of patient care is driven by innovative business models. The healthcare industry has become an intriguing market for both entrepreneurs and established organizations. Due to big interest, a rise of new entrants and disruptive innovations, the market has resulted in an unprecedented amount of competition.

Research conducted by Boni & Foley (2020) highlights the challenges early-stage organizations may face in the digital health sector. Successful operation in this market requires a deep understanding and management, not only in the integration of new technologies, but also in the regulatory environment and financial aspects of healthcare systems.

The healthcare system is strictly regulated to ensure things such as patient safety, the privacy of their data, and the effectiveness of treatment.

When it comes to financial aspects, it is important to understand how services are paid for. In the health care sector, the payers for services are often not the patients themselves, but also insurance companies or public health funds, which play a large role in deciding which treatment and how much will be reimbursed (Cai et al., 2020).

In addition, as stated by Madhusudhana (2021) in the conducted study, information and advertising strategy plays a very important role as we live in the age of digital marketing. Accurate, fair, and objective marketing materials that meet both legal and high ethical standards are undoubtedly one of the most important aspects in presenting healthcare options to patients. In the ever-growing and innovating healthcare industry, this approach is vital because business strategies can have a profound impact on people's health outcomes.

Lessons from the Covid-19 pandemic crisis, discussed in a study by Karimi, Mohammadi & Sakhteh (2022), reveal the role of social enterprises and entrepreneurship in addressing healthcare challenges. For example, social enterprises and entrepreneurs are often much more flexible, agile and innovative than traditional healthcare institutions. Such characteristics of companies allow them to react more quickly to the challenges that have arisen and make the necessary decisions. Young companies have developed new technologies and services during the Covid-19 pandemic, such as telehealth platforms, digital health applications or remote patient monitoring. For these reasons, it is visible how important it is to support start-ups, as these new companies often present promising and innovative methods that allow us to manage crises.

The impact of startups in the healthcare sector is perfectly reflected in the statistics presented on the PitchBook platform by Lean Hodgson (2023). The peak was indicated to have been reached in 2021, when as much as 5.2 billion euros were invested in 906 start-ups in the health sector. Although investment in health startups has declined slightly in recent years, innovation that can solve huge medical problems continues to accelerate.

After evaluating the situations mentioned above, it can be said that the impact of business on the healthcare sector is very important, deep, and multifaceted. This requires technical knowledge, patient orientation, and strategic business skills.

1.3. The Relevance of Digital Healthcare Entrepreneur to Precision Medicine

To understand the connection that is made between business and the digital healthcare sector, it is important to appreciate the role of the entrepreneur.

In society, an entrepreneur is considered a person who is able to see the gaps or opportunities in the market and create new solutions to fill these gaps. Entrepreneurs are found in every sector, from

technological innovation to education reform, playing an important role in driving economic development and innovation, and the healthcare sector is no exception.

In order to understand the role of the healthcare entrepreneur, some valuable insights can be found in the article by Apostolopoulos, Makris, and Stavroyiannis (2022). The article assesses the challenges and prospects of Greek health entrepreneurs in developing innovative solutions for the healthcare sector. According to the authors of the article, solving problems such as improving the quality of services, managing costs, and integrating advanced technologies and devices in the clinical environment depends on the entrepreneurial spirit of the health entrepreneur.

Although health entrepreneurs want to create innovative projects and see the positive results of such initiatives, they also face an obstacle. These obstacles affect the implementation of ideas.

Apostolopoulos, Makris, and Stavroyiannis (2022) highlight the importance of health entrepreneurs in driving innovation in the healthcare sector. Entrepreneurs can demonstrate their critical role in introducing new technologies or services and in overcoming systemic challenges that arise to improve healthcare delivery. There is no doubt that the work of entrepreneurs is helping to shape a more patient-centered healthcare system that is more efficient and effective.

Khayatan, Bahrevar and Hosseini (2022) published an equally relevant article on the role of health entrepreneurs. The conducted research highlights the growing need for entrepreneurial thinking and innovation in the health sector, which is especially needed in academic institutions. Recognizing that the challenges and opportunities in healthcare increasingly require innovative solutions and business foresight, it is clear that fostering an entrepreneurial mindset among healthcare professionals and students is much needed. As a result, it is believed that entrepreneurship education should be integrated into the educational program when preparing future health professionals. Integrating entrepreneurship education would enable future healthcare professionals to be more adaptable, creative and proactive in addressing medical needs.

This approach is in line with the broader trend of health entrepreneurship, where future professionals are trained not only in medicine or other health science fields, but in the ability to innovate, lead and manage the highly dynamic field of healthcare. As a result, there is a shift towards a more dynamic and interdisciplinary approach to health education that recognizes the essential role of healthcare entrepreneurs in shaping a more effective, efficient and responsive healthcare system.

Health entrepreneurs play a big role in advancing the creation of fresh healthcare approaches and bridging the gap between scientific advancements and useful applications. Their absolute dedication to finding medical needs and developing innovative solutions has a significant influence on the development of healthcare.

The importance of an entrepreneur working in the healthcare sector and seeking to create breakthrough innovations can be assessed through aspects such as:

1. Identification of unfilled gaps – Salma, Lee & Afshin (2019) wrote about the importance of understanding various needs and preferences of patients and healthcare workers when implementing innovations. This understanding is critical for entrepreneurs who develop and then integrate health technology solutions.

2. Solving financing and resource supply problems – entrepreneurs often have a wealth of experience that helps secure the financing needed to innovate. For example, a study conducted in Denmark highlights the importance of procurement strategies for innovation in healthcare organizations. This importance is justified by the fact that it can significantly increase the value created for patients and society (Pedroso et al., 2022).
3. Navigation in regulated environments – the implementation of new things in the healthcare sector has to meet an endless of requirements. Entrepreneurs who implement these innovations must ensure that their products meet the requirements of healthcare, which are strictly regulated. This necessity is substantiated by a study by Elgabry (2023), which highlights the complexity of regulatory compliance in the development of health technology solutions. According to the author, there is a lack of support for innovative ideas coming from academia in the field of healthcare regulation.
4. Creating partnerships – collaboration between entrepreneurs and healthcare providers is critical to improving the performance of healthcare facilities. For example, a study by Liu et al. (2023) highlights that private-public partnerships can improve the infrastructure and quality of services in the healthcare sector.

Because of these arguments, it is clear that the growth of digital health innovation and research depends on digital health entrepreneurs. Knowing the importance of digital health entrepreneurs in the medicine sector, it is very important to understand what specific competencies a digital health entrepreneur must have for furthering scientific discovery and innovation in the ever-changing healthcare industry.

In order to identify these competencies and possible methods of their development, a study must be conducted, which will help determine the competencies needed by digital health entrepreneurs, presenting the methods of developing these competencies.

2. The Formation of a Set of Competencies and Methods to Acquire Them for Digital Health Entrepreneurs

Academia has conducted numerous studies on the importance of the entrepreneur in creating successful and value-added businesses. An entrepreneur is considered an essential person on whom the success of the company depends. Entrepreneurial competences are vital to deal with emerging issues, market demands and ever-emerging risks. The literature related to this topic presents various concepts, according to which, entrepreneurs can evaluate their existing competences, improve them or acquire new ones.

2.1. Theoretical Aspects of Entrepreneurship

Entrepreneurship is the part of business that allows to successfully build a business. Entrepreneurs who actively engage in this activity are responsible for the implementation of each vision (Diandra & Azmy, 2020).
Understanding of what an entrepreneur is comes from the French word "entrependre" which means "to undertake". Economist Jean-Baptiste Say was the first to use this word in its current meaning in 1800.

The concept of an entrepreneur has often changed over time. These changes could be caused by various things, such as:

- Cultural and social changes – these days, the often-heard focus on sustainability and green business shapes the concept of an entrepreneur.
- Technological advancements – the internet, artificial intelligence and other technological innovations have encouraged entrepreneurs to innovate and adapt to ever-increasing competition and risk, leading to a change in the concept of an entrepreneur.
- Economic shifts – events, such as economic crises, the growth of the digital economy or the transition from an industrial economy to a knowledge and service-oriented economy, lead to changes in entrepreneurs.
- Educational shifts – entrepreneurship is becoming increasingly accessible in educational institutions. Educational institutions are implementing methodologies that increasingly focus on improving interdisciplinary skills.
- Demographic changes – the circle of people who create businesses is constantly expanding. The increase in women taking this initiative is particularly noticeable, something that seemed impossible 200 years ago (Takayanagi, 2019).
- Policy and regulatory changes – political decisions and regulatory frameworks can affect factors such as international trade or intellectual property laws. Such factors force entrepreneurs to adapt to the demands and thus model the concept of what an entrepreneur should be.
- Globalization – the opportunity to do business in international markets allows reaching different peoples and their cultures. Such factors create new challenges for entrepreneurs who need to understand what is possible and what is not possible in one country or another.

In the current literature, it is easy to find many definitions that describe the concept of an entrepreneur in various ways. In order to understand how the definition "entrepreneur" can be understood differently, table 2 presents some examples found in the literature:

Table 2. Definitions of entrepreneur.

Author(s)	Definitions of entrepreneur
Vaz-Curado & Mueller, (2019)	An entrepreneur is someone who gives life to products and services that other people haven't thought of. An entrepreneur is someone who creates new goods, services and production methods and thus pushes the economy forward.
Dimov & Pistrui, (2024)	Entrepreneurs seek to have some impact on the market. The market determines whether an entrepreneur succeeds in achieving his goals. Meanwhile, the changes that can happen depend on the market, which depends on the entrepreneurs.
Dwyer, Lerman & Gras, (2023)	The article discusses two types of entrepreneurs, i.e. social and commercial. Social entrepreneurs are people whose main goal is to solve social problems and contribute to the welfare of society. Commercial entrepreneurs are the opposite and their goal is to create businesses for financial gain.
Bhatta et al., (2024)	Entrepreneurs are agents who create meaningful change and unique advantages for the company.

Seeing how many different definitions there can be of what an entrepreneur is, it becomes apparent that all entrepreneurs differ in their approach and aspirations. The reason for this can be the personal aspects of each entrepreneur, why he starts business and what he wants to achieve. For example, one entrepreneur's goal may be to create an innovation and make a profit from it, while another dreams about a calm and fulfilling life without stress.

For such reasons, there are distinguished four types of entrepreneurs, in the research carried out by Postigo, Cuesta & Garcia-Cueto (2023). These types of entrepreneurs are presented in Figure 1.
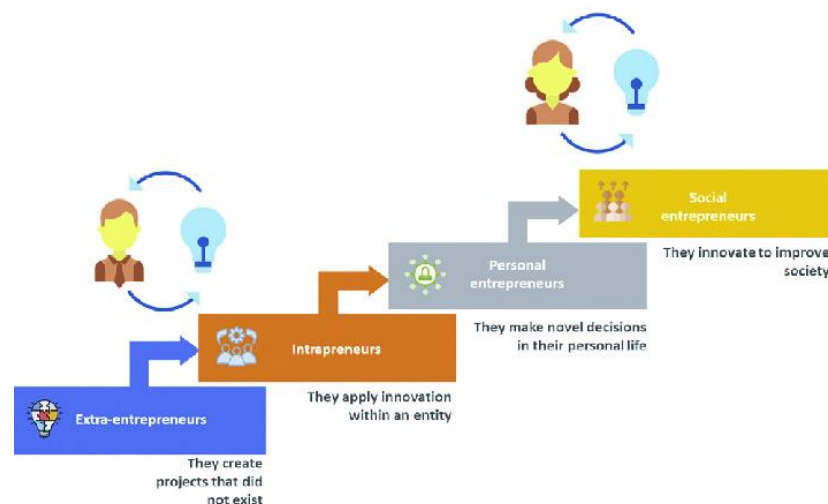
Figure 1. Types of entrepreneurs (Postigo, Cuesta & Garcia-Cueto, 2023).

Based on the Figure 1, there are several types of entrepreneurs:

- Extra-entrepreneurs – the individual whose objective is to create new external projects related to the establishment of businesses.

- Intrapreneurs – the individual who brings new ideas to an organization and makes ongoing projects better.
- Personal entrepreneurs – the individual who handles challenging circumstances involving pressures, unemployment, or adjustments at work.
- Social entrepreneurs – the individual who acts in a social capacity.

In order to have a more accurate and clear understanding of the types of entrepreneurs, the definitions in other literature sources are presented, what other types of entrepreneurs can be and what they are characterized by:

- Social entrepreneur – the primary mission of a social entrepreneur is to improve the world. This type of entrepreneur puts their personal values first, not profit. Profit is evaluated only as a positive result of the innovations being created (Crawford, Kelder & Know, 2023).
- Lifestyle entrepreneur – this type of entrepreneur focuses on a comfortable and fulfilling lifestyle. Their goal is not to make impressive profits or grow the business they are creating (Bredvold & Skålén, 2016).
- Innovative entrepreneurs – this type of entrepreneur is the driving force behind creating new specializations and focusing on higher value-creating activities. They usually introduce new ideas and create a market where none existed before (Grillitsch, 2019).
- Serial entrepreneurs – this type of entrepreneur builds one business after another. A serial entrepreneur often moves on to a new venture when the previous one becomes stable or is sold (Dujowich, 2009).

Creating educational programs in educational institutions, it is important to take into account different types of entrepreneurs and provide only the material necessary for that group. Another example relates to each entrepreneur personally, since an entrepreneur, who clearly understands his type, can develop a strategy much more precisely. It helps entrepreneurs identify strengths and weaknesses and assess challenges that may be faced.

The different types of entrepreneurs made it clear that people live in different environments and have different backgrounds. All this raises the problem of entrepreneurial skills, which inevitably affects the entire business process.

Understanding the problem of lack of entrepreneurial skills and the theory of entrepreneurship is necessary for several reasons which are given below:

1. Business practices – making reasonable and strategically correct decisions depends on it. Strategic thinking directly correlates with the quantity and quality of available practical knowledge.
2. Understanding business development – understanding how a business is developed allows to make the right decisions that promote business development, so understanding entrepreneurship theories is undeniably important.
3. Formation of political demands – political factors often have a great influence in business. In order to create pro-business policies, one needs to understand the factors that can help or hurt business growth from a political perspective.

4. Personal improvement – a future or existing entrepreneur is constantly thinking about success, so the entrepreneurial skills available provide insights on how to start or further develop a business.
5. Promoting innovation – innovation is considered one of the indicators with the greatest competitive advantage. Theories of entrepreneurship for the creation of innovations allow a proper understanding of what innovations are needed and how they can and should be created.
6. Understanding cultural differences – in order to build a successful cross-cultural business, it is necessary to understand and know the fundamental differences between certain cultures.

After evaluating these reasons, it can be seen that entrepreneurship can be understood and evaluated from very different angles. In order for the understanding and assessments to be correct, it is very important to understand what the entrepreneurship ecosystem consists of.

A study by Ali et al. (2021) presents a model that represents the entrepreneurial ecosystem. The components of this ecosystem are presented in Figure 1.

Figure 2. Entrepreneurship ecosystem (Ali et al., 2021).

Based on the Figure 2, there are several types of entrepreneurship ecosystem domains and sub-elements:

- Policy consists of government and leadership. The government is responsible for passing laws and regulations that affect the business being created. Leadership is understood as leaders in politics who push the entrepreneurial environment forward.
- Markets consist of early customers and the market. Since the products and services created by entrepreneurship are closely related to high risk, the insights and evaluation of the primary customers allow a more confident step into the wider market. Meanwhile, entering a larger market opens up more opportunities for business growth.
- Human capital consists of labor and educational institutions. Labor points out that skilled workers are very important in the business sector. Educational institutions are important because they prepare people who have the necessary specific fields to create and develop various projects. In addition, educational institutions contribute significantly to the scientific research that is carried out, which provides an opportunity for the development of science.

- Supports consists of infrastructure, the supporting profession and non-governmental institutions. Reaching the consumer is very important in business, so the infrastructure that transport or telecommunications companies build is very important. The support that an entrepreneur can get from specific specialists, such as lawyers or accountants, allows him to focus on other complex business processes. Non-governmental organizations can also provide assistance to businesses in non-profit organizations.
- Culture consists of success stories and societal norms. Because people often tend to conform to established societal norms, cultural attitudes toward entrepreneurship can have a significant impact on a person considering starting a business. Meanwhile, various success stories can often inspire and encourage innovation.
- Finance it consists of financial capital. Financing is undoubtedly one of the most important factors in business, which is needed both when starting a business and in order to develop it. Funding can come from equity or from investors, banks and other alternative funding sources such as crowdfunding.

An entrepreneur with a deep understanding of what the entrepreneurial ecosystem is, of what parts it consists of, and the ability to notice and critically evaluate possible risks and opportunities, is on the right path to discovering and creating what is called innovation.

Innovations created by entrepreneurial entrepreneurs are very well described by Austrian political economist Joseph Alois Schumpeter's claim that inventions are the only major challenge in history (Juliana et al., 2021). It essentially provides a perspective on entrepreneurs who create new inventions and discover new technologies.

Schumpeter's approach, on which innovation studies are based, is substantiated by a study conducted by Piñeiro-Chousa et al. (2020). The research takes the positive view that innovation is seen as a dynamic force. These forces encourage entrepreneurs to create, develop, and use value-added activities because they can create new social and economic opportunities.

In order to understand how innovations that can create new social and economic opportunities are observed, discovered and created, it is important to master the basic steps that are inevitable from the birth of an idea to the launch of a product or service in the general market. These steps are shown in Figure 3, which is based on the illustration and information provided in Gunnars and Kemberen's (2019) study.
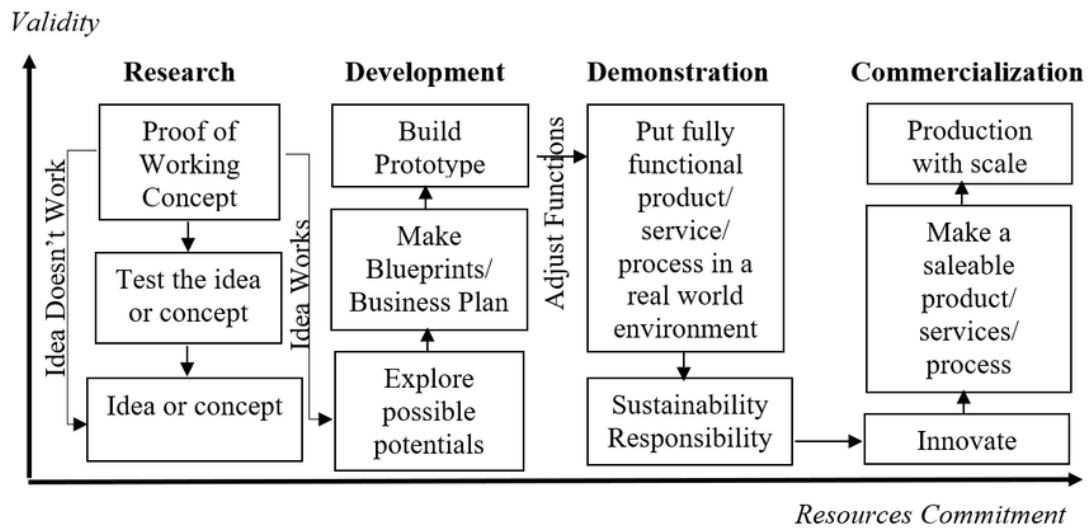
Figure 3. Innovation model (Gunarso & Kembaren, 2019).

Figure 3 shows the stages of the innovation development model, each of which is detailed according to the most important steps. The steps shown in the figure are further detailed below:

The **research** stage is critical to creating a foundation for future success. The main goal is to assess whether the existing idea is worth further investments of work, time, finances and other resources. As shown in Figure 1, innovation starts with an idea. An existing idea is developed into an initial concept that shows how the idea works. If the performance of the idea meets the expectations, further work is started and the second stage of innovation development is reached. During the evaluation of the concept of the idea, it is very important to evaluate the novelty and practicality of the idea.

If the initial concept created does not live up to expectations, it is returned to the initial step, where additional time is spent on idea generation and development.

The **development** stage is devoted to the development of the idea. The main goal of this stage is to reveal a concrete image of the idea, therefore, a prototype of the idea is created.

A business strategy is developed in parallel with the prototype. The significance of strategy for business is explained by Abdulwase et al. (2020) study. Its purpose is not only to create a competitive advantage, but also to create sustainable growth, to deal with ongoing changes, to ensure the introduction of innovations or to promote strategic thinking in the company.

A positive assessment of the prototype's potential and the strategy in place allow further steps to be taken that open the door to the creation and introduction of the final product or service to the market.

In the **demonstration** stage, the prototype of an innovative solution is transformed into a final product, technology or service that is presented to potential buyers. The main goal is to show potential buyers the efficiency and practicality of an innovation that can solve a problem they have.

As this phase is not the last, it is very important to gather as much feedback as possible from the market. The insights of potential buyers are very significant and provide an opportunity to purposefully improve the innovation being developed and eliminate shortcomings before launching the product, technology or service on the market.

The **commercialization** stage is when the created innovation is fully ready for use. Actions are taken that allow starting to sell the product. Depending on the demand, the supply of the product or service to the market must be ensured.

At this stage, actions that will be carried out in a long-term perspective must be evaluated. As the world is constantly evolving and one technology is replaced by another, it is very important to take regular corrective actions that will allow innovation to remain competitive. The importance of corrective actions in business is also substantiated by a study conducted by Gil-Gomez et al. (2019), which says that improving business strategy is important in order to adapt to market changes.

After evaluating all the stages that are inevitable when creating and introducing innovations to the market, it is clear that an entrepreneur must have various specific competencies.

It is very important to understand what competence is, because according to Kenaan-Jebna et al. (2022), this word has various meanings. Competence can be the ability to meet the needs of one's body and mind, the ability to acquire necessary knowledge, or the ability to perform a task effectively. For example, Hernandez-de-Menendez et al. (2020) indicate that competencies are abilities that include decision-making, problem-solving, learning, or interdisciplinary thinking skills.

Understanding how diverse competencies can be, a list of competencies is provided that different authors indicate as necessary for an entrepreneur who creates innovative solutions.

Table 3. Entrepreneur's competencies.

Author(s)	Competence(s)	Importance
Bańka et al. (2023)	– Creativity – Analytical thinking	The importance of creativity is manifested in the development of innovative solutions, meeting the needs of consumers and providing a competitive advantage. A constantly changing environment forces to adapt. Analytical thinking is required in order to see and understand possible changes in the environment.
Johnston & Wang (2022)	– Understanding market dynamics – Understanding of funding opportunities	Innovative solutions to problems require large financial investments. In order to attract investors, it is very important for entrepreneurs to understand customer needs and market opportunities in order to prove the potential of the idea. There are many ways to get financing in the market, so it is necessary for an entrepreneur to understand the financing options and critically evaluate which one best suits the needs and goals of the business.
Gliddon & Rothwell (2018)	– Team leadership	Innovation is about people, so team leaders need to be able to lead groups of people and encourage creativity in them so that people can innovate freely.
Ahmed & Harrison (2021)	– Technical knowledge – Strategic foresight – Market savvy	Knowledge of technical knowledge allows understanding the latest technologies and their possible uses. The latest technologies are an inevitable part of creating innovative products or services.

		Strategic foresight provides an opportunity to plan steps into the future, which allows for the assessment of potential challenges or opportunities.
		Knowledge of the market provides an opportunity to successfully meet the needs of consumers and the competitive environment.
Bachmann et al. (2024)	– Digital competencies	Knowing that we live in a digital age, the authors claim that digital competencies are necessary to be successful in digital entrepreneurship. A study by Steens, Bots and Derks (2024) states that digital competencies include big data, analytics, visualization, blockchain and other competencies.

Additionally, due to the constantly fast-changing society and it's needs, the European Commission (2018) provides recommendations on what competences are necessary to be able to exploit opportunities, develop ideas, work in a team, create a dynamic career and create a better future. The recommendations are presented as a European entrepreneurship competence framework (Figure 4.) that offers a comprehensive set of knowledge, skills and attitudes. In order to make proper use of this system, EntreComp can be applied in various sectors for the development and understanding of entrepreneurial competences and is the main working tool for cooperation between educators, employers, politicians or professional organizations.
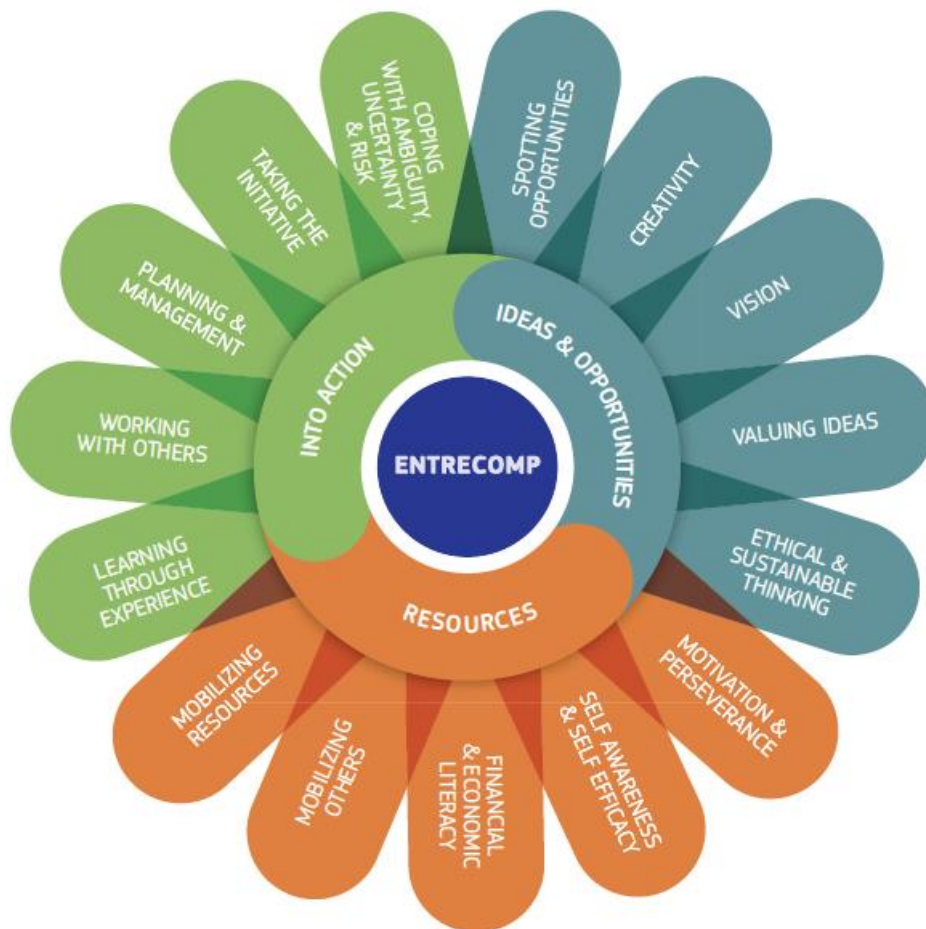
Figure 4. EntreComp framework (European Commission, 2018).

Based on the Figure 4, there are three key areas with five competencies each that describe what it means to be entrepreneurial:

- Into action:
    - Learning through experience
    - Working with others
    - Planning and management
    - Taking the initiative
    - Coping with ambiguity, uncertainty and risk

- Ideas and opportunities:
    - Spotting opportunities
    - Creativity
    - Vision
    - Valuing ideas
    - Ethical and sustainable thinking

- Resources:
    - Motivation and perseverance
    - Self awareness and self efficacy
    - Financial and economic literacy
    - Mobilizing others
    - Mobilizing resources

The competencies presented by the European Commission and the authors of various studies allow us 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 & Li (2018), stimulates the demand for quality and affordable healthcare services. It can be seen that these competencies are divided into various fields that include creativity, communication, technological thinking and knowledge about people and the demand they create, which is constantly changing.

In order to better understand the importance of the various competencies presented above in the process of innovation creation, it is necessary to understand how the need for different competencies can manifest itself in the different stages of innovation creation, which are presented in Figure 3.

In the first stage, which is dedicated to testing an idea or concept, important competencies are creativity, analytical thinking, learning, technical knowledge, idea evaluation, ethical and sustainable thinking. Possession of these qualities allows an entrepreneur to create new and innovative ideas, check their implementation possibilities or ethical standards. The listed competences also allow the entrepreneur to assess that the idea is not only new, but also promising in the market.

In the second stage, when the development of the idea progresses to the development stage, competencies such as understanding the entrepreneurial ecosystem, understanding market dynamics, strategic foresight, technical knowledge, collaboration, planning and initiative are distinguished. Possession of these competences allows the development of the initial tested conception of an idea

into a tangible prototype. Prototype development is carried out together with the assessment of market needs and trends in order to create long-term products, services or technologies that meet customer needs.

In the third phase, essential competencies understand of funding opportunities, ability to lead a team, market knowledge, risk management and digital competencies. In order to present the created product, service or technology, knowledge of the market is necessary because it depends on how exactly the target audience will be selected. The correct choice of the target audience provides an opportunity to interest stakeholders, attract capital for further development of the product or find potential users. Living in a digital world, it is important to be able to reach consumers in the most convenient ways, and this requires digital competences that not only increase the reach of stakeholders, but also help to reveal the strong features of a product, service or technology as accurately as possible.

In the fourth stage, which focuses on the mass production and sale of the product, it is important to ensure the satisfaction of the production scale. In addition, the entrepreneur must understand the principles of innovation, since the competitive environment requires differentiating the product from the competition. It is also important to ensure the market access and economic viability of a product, service or technology, which provides an opportunity to grow sales and ensure success. Given these needs, competencies such as innovation, the ability to ensure production scale, financial literacy and market knowledge are required at this stage.

2.2. The Specifics of Digital Health Entrepreneurship, Required Competences and Methods of Their Development

The first signs of digital health appeared in the middle of the last century, when the first digital devices appeared with the possibility to track certain parameters of people's health. Later, computers, the internet, and smartphones appeared which changed both the approach to digital health and the opportunities created.

These days, the understanding of the possibilities of digital health is still evolving, so in the literature it is possible to find many different explanations of what it is and what opportunities and risks it creates. For example, Mathews et al. (2019) mention in a study that the concept of "digital health" has expanded to include an ever-expanding set of technologies that include artificial intelligence, analytics, or wearable devices. Zwack et al. (2023) in a study stated that digital health is a general term that is used to describe various digital technologies that are used in medicine.

According to Yahoo finance statistics, the value of the digital health market was estimated at 217 billion USD in 2022 and is expected to reach 1.592 billion USD by 2032. Such high growth in value shows that digital health has a huge demand and attracts not only consumers but also entrepreneurs and investors, thus creating a basis for the development of digital health entrepreneurship.

Raimi, Oreagba & Lukman (2023) also highlighted in their study that the healthcare industry has opened up new investment opportunities. Private investors and commercial banks positively value and are willing to invest in health entrepreneurs, who develop solutions that help solve public health problems. According to the authors, health entrepreneurship is a promising niche that operates like alternative medicine, but emphasizes only the most effective methods of care and treatment. At the

same time, health entrepreneurship is compared to commercial entrepreneurship, which is based on a business mindset. It is emphasized that such a mindset encourages doctors and healthcare professionals to consider the needs in healthcare and create new business opportunities accordingly.

Digital healthcare can be described as the use of technology as a tool to improve public health. The most important person in this chain, who creates these technologies and continuously improves healthcare options, is the medical entrepreneur who creates these digital health solutions. Below is a list of digital medicine tools widely used to improve public health, developed by medical entrepreneurs:

- Artificial Intelligence
- Mobile health apps
- Telemedicine
- Wearable devices
- Digital therapeutics
- Robotic surgical system
- Electronic health records
- Digital twins
- Health analytics

Knowing what digital medicine tools are being developed to solve complex public health problems, is critical to understanding the mechanism by which these tools are developed. Understanding how digital medicine tools are created allows assessing what competencies a digital healthcare entrepreneur who develops innovative products, services or technologies in the medical field must have. The model of innovation creation presented in Figure 3 made it possible to understand the main stages that are inevitable in the process of innovation creation and introduction to the market, and to refine the competences of entrepreneurs required for these stages. In order to reveal in more detail the mechanism of innovation creation in the field of digital health, and to identify what competencies are needed specifically for digital health entrepreneurs, in a study conducted by Marvel, Wang & Martin (2018), they present a mechanism of 6 stages that are inevitable in creating an innovative solution in the medical sector. This mechanism is presented in Figure 5:
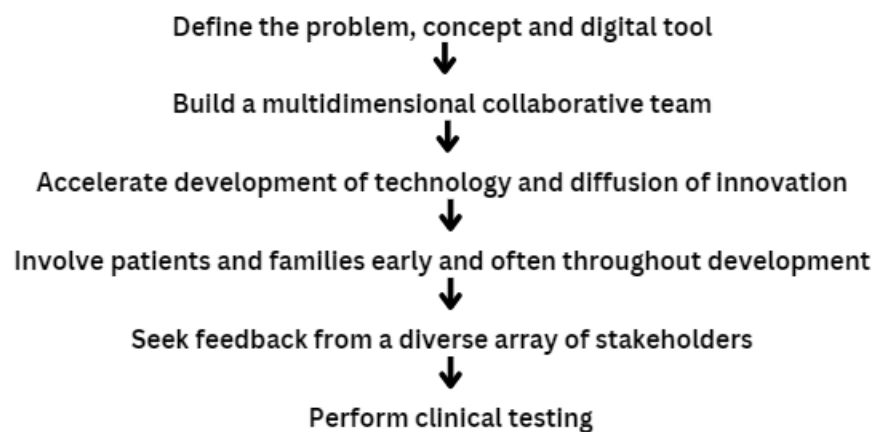

Figure 5. Digital health innovation mechanism (derived from Marvel, Wang & Martin, 2018)

The first stage is characterized by the observation and identification of a clinical problem that can be solved using digital health innovation. In order to create a unique product, it is necessary to conduct a literature analysis that will help to clarify the understanding of the problem, the methods that are applied to solve this problem, and the challenges that have been faced in solving this problem. At the same time, it is necessary to conduct market research and familiarize with already developed solutions, evaluating their strengths and weaknesses. Such problems, their possible solution methods, strengths and weaknesses make it possible to critically evaluate the uniqueness and novelty of the innovation being created.

The second phase emphasizes that digital health innovation requires interdisciplinary teamwork. Interdisciplinary team work is characterized by a complex structure, since the team consists of specialists of different profiles, such as doctors, managers, engineers, computer scientists, business experts and even patients. As mentioned earlier, managing an interdisciplinary team requires good team management skills, as it is very difficult to arrange processes in such a way that each team member can bring the greatest value to the overall team work.

The third phase is characterized by effective and efficient solution development in the rapidly developing field of digital health. At this stage, it is important to secure funding, which allows the project to develop smoothly. Otherwise, the innovation process may get stuck at a certain stage due to the lack of necessary finances, which would mean a loss of competitive advantage in the ever-evolving and fast-changing field of digital health.

The fourth stage emphasizes that in order to achieve end-user acceptance, the product, service or technology must be attractive and easy to use. In order to understand whether the attractiveness and usability of the product meet the expectations of the users, the innovation development process can include users who test the intermediate product and provide feedback about the experience.

The fifth stage emphasizes that not only patient feedback is important. Other stakeholders, such as healthcare providers, IT experts, or hospital administrators, may also have accurate insights that are important in the digital health tool development process. Each group with a different field of education brings its own unique perspective that contributes to the smooth functioning of the innovation.

The sixth stage emphasizes that all the previously listed stages are important for the last step, which depends on the validation of the created innovation. Although clinical trials of digital health innovations are not mandatory, conducting them allows confirming that the innovation has high-quality evidence. It is important to make sure whether the created innovation accurately and qualitatively performs various measurements, information transfer and, in general, whether the innovation is suitable for use.

Considering all the 6 stages of the digital health innovation mechanism, it is 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. All these tasks undoubtedly require specific competences.

Tariq (2023) revealed more emerging challenges and obstacles faced by digital health entrepreneurs who are innovating in the rapidly changing field of digital medicine:

- The success of a product or service in the market depends on whether consumers perceive the value.
- Consumer needs are too poorly researched to know which product, service or technology will succeed.
- There is a lot of competition, so success is achieved by those companies that are able to quickly find customers and thus convince investors that a product, service or technology is potentially successful.
- Technologies often change, improve, and create new ones, which makes it difficult to retain a customer.
- Doctors are not sufficiently trained to use digital health innovations, which leads to disruptions in work and patient distrust of innovations.
- It is difficult to ensure confidentiality and privacy of patient data.
- Patent protection for the developed technology is not as important as in the pharmaceutical industry, so the cycle of active operation of the product is shorter. Insufficient time duration prevents the dissemination of a product, service or technology among customers.

Potential challenges facing by digital health entrepreneurs are also presented by El-Chaarani, Raimi & El-Abiad (2023). It is stated that the challenges have been studied in Middle Eastern countries. However, given that digital health products, services or technologies tend to be developed for a multinational customer base, these challenges can be seen as relevant to all digital health entrepreneurs. An illustration that presents the challenges and difficulties faced by medical entrepreneurs in digital innovation in healthcare is presented in Figure 6.

Figure 6. Challenges of medical entrepreneurs (El-Chaarani, Raimi & El-Abiad, 2023).

Based on the Figure 6, there are several characteristics of an entrepreneur that are inevitable when innovating in digital healthcare:

- Lack of entrepreneurial knowledge – digital health entrepreneurship is characterized by its own problems and challenges. The lack of knowledge in this area can cause difficulties in making decisions at all stages of innovation entrepreneurship.
- Multi-disciplines team – innovating in digital health requires a variety of expertise, which requires a multidisciplinary team. Leading such a team and developing it can be a big challenge for an entrepreneur.
- Big data management – the illustration presents the challenge of big data management, as it requires analytical thinking and knowledge of information technology, which provides the opportunity to properly manage and process the received data.
- Security and privacy – cyberattacks are increasingly seen online, so digital health entrepreneurs need to ensure the security and privacy of patient data.
- Communication – verbal and non-verbal communication is one of the ways in which an entrepreneur reaches both investors and customers. Good communication can be the key to success.
- Financing – digital health innovations are risky and can take a very long time to develop and adapt to the market, so securing funding can be a big challenge.
- Clinical test and regulatory – the medical sector is strictly regulated by state organizations, so the knowledge, understanding and application of these regulations to the innovation being created is a challenge for an entrepreneur.

- Quality of medical outputs – the goal of every innovation is to solve a problem or offer a more practical and acceptable solution. The ever-changing market and existing competition create an environment where it becomes difficult for entrepreneurs to create something that fulfills all the conditions and provides better results.

One way or another, digital health entrepreneurs do not give up, create, take risks and seek innovations that meet market needs. El-Chaarani, Raimi & El-Abiad (2023) emphasize that the ever-growing medical entrepreneurship is attracting more and 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, which is presented in Figure 7. The figure shows the seven characteristics of a medical entrepreneur that are essential in developing and improving digital healthcare products or services.
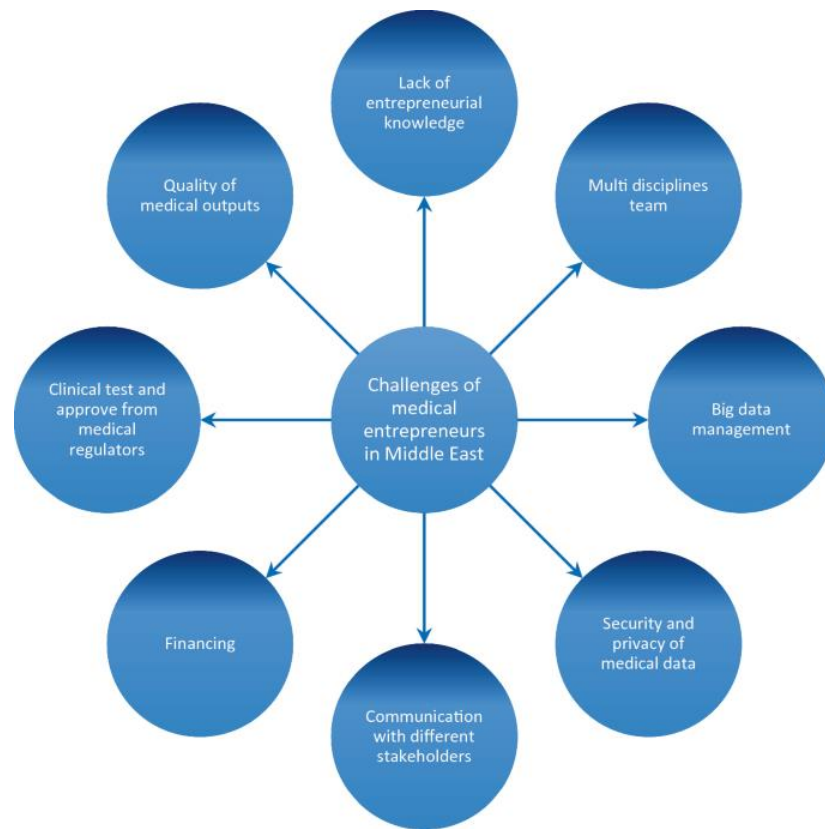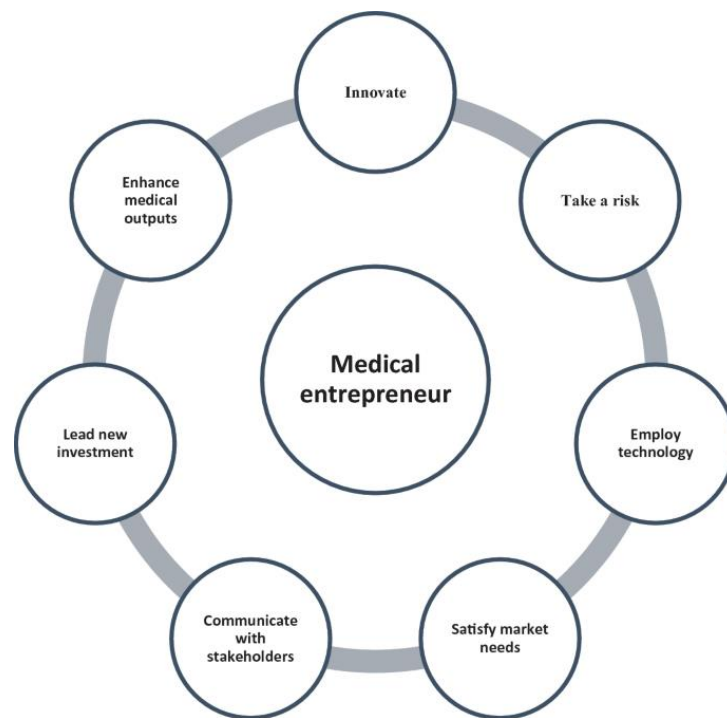

Figure 7. Medical entrepreneur characteristics (El-Chaarani, Raimi & El-Abiad, 2023)

Based on the Figure 7, there are several characteristics of an entrepreneur that are inevitable when innovating in digital health:

- Innovate – it is a characteristic that is needed during the origin of the idea and the entire process of its development. This feature requires creativity.
- Take a risk – high competition, uncertainty of consumer wishes and rapid changes in the market force constant risk-taking, and high risk creates stress and tension that entrepreneurs have to face.
- Employ technology – a characteristic that requires knowledge of technologies and the ability to apply them to the innovation being created.

- Satisfy market needs – a characteristic that requires market knowledge and an understanding of what product, service or technology is and will be needed in the future.
- Communicate with stakeholders – interested parties can speed up the innovation implementation process, so proper communication that can convince investors or other interested parties is very important.
- Lead new investment – additional investments allow both to start developing the project and for it to grow at a later stage, so a sufficient amount of investment allows to ensure the necessary amount of money to create the innovation. In order to attract the required amount of investment, it is necessary to have a good knowledge of the financing options, which are numerous in today's world.
- Enhance medical outputs – a characteristic that requires critical evaluation of products, services or technologies on the market and the ability to spot unfilled niches that could yield better medical outcomes.

Zajicek and Meyers (2018) wrote in the chapter on digital health entrepreneurs that many of the innovations created are usually invented by the users themselves, who face a certain health problem in their lives and are looking for ways to solve it. Not finding a solution in the market that can help, people start looking for ways to help themselves, and this is how many innovations are born.

People who are committed to innovating in the field of digital health, should follow the regulations that are created and overseen by government organizations. Failure to follow rules and regulations may not help but harm the people using a particular product.

After evaluating the data collected from various literary sources, what is a traditional commercial business entrepreneur and what is a digital health entrepreneur, it is possible to raise the question of what competencies a digital health entrepreneur can successfully operate in such a complex and constantly changing sector. Based on the literature sources analyzed in the theoretical part, the list of competencies that are important for a digital health entrepreneur is presented in Table 4 below:

Table 4. A set of competencies for a digital health entrepreneur.

Competence	Importance
Creativity	It drives innovation and unique solutions to problems. It promotes unique thinking that gives entrepreneurs a competitive advantage.
Analytic thinking	Analytical thinking helps to critically evaluate information, understand emerging risks, see opportunities and make decisions based on correct information.
Market savvy	It helps to understand and critically assess market demand, customer behavior or the influence of competitors.
Financial literacy	Sufficient funding allows the development of the idea. There are many ways in the market for a project to get funding from external parties, but it is very important to choose a safe and suitable option.
Team leadership	The team creating innovation in the field of digital care is made up of various specialists. An entrepreneur who is a team leader must set an example for the team. It requires communication, organization, and other human qualities.
Technical knowledge	The field of digital health is surrounded by the latest technology and all kinds of regulations on what is allowed and what is prohibited. Technical knowledge allows understanding the possibilities of technology and how they can be used.

Knowing what competencies are necessary for a digital health entrepreneur to successfully create and develop innovations in healthcare industry, it is very important to understand how those competencies can be acquired.

It is well known that each individual has a set of various competencies that he has acquired throughout his life. As Gnahs (2011) states, changes in the development of competences occur over time and are conditioned by various factors such as environment, reaction to situations or even genetics.

Everyone can create the environment that they want and that would help them achieve their goals. A digital health entrepreneur or someone planning to enter the industry can create an environment that will help them acquire the necessary knowledge and competencies that success in health innovation can depend on.

In today's world, there are countless ways to acquire the skills needed to become a digital health entrepreneur. This 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 competencies or the improvement of existing ones.

In order to acquire the needed skills, the literature suggests that the traditional learning strategy is not effective in keeping up with the ever-changing demand for learning. Self-directed learning is offered as an alternative (Charokar & Dullo, 2022).

Self-directed learning is understood as creative opportunities in the learning process. Based on different literature sources, Table 5 presents several definitions of how different research studies define this self-directed learning method.

Table 5. Definitions of self-directed learning.

Author(s)	Definitions of self-directed learning (SDL)
Brookfield (2009)	The SDL method is learning in which the learner himself determines the concept of learning, its implementation and evaluation.
du Toit-Brits (2018)	A learning process in which the learner himself determines learning needs, formulates goals and selects learning resources. Other persons may be involved in this learning process.
Loeng (2020)	Learning practices in adult education as manifested in literature, professional conversations and debates.

In understanding what self-directed learning is, it is very important to understand the methodology of this learning method. A study by Cronin-Golomb and Bauer (2023) presents a learning scheme that is designed for motivated and purposeful learning. The schematic is shown in Figure 8.
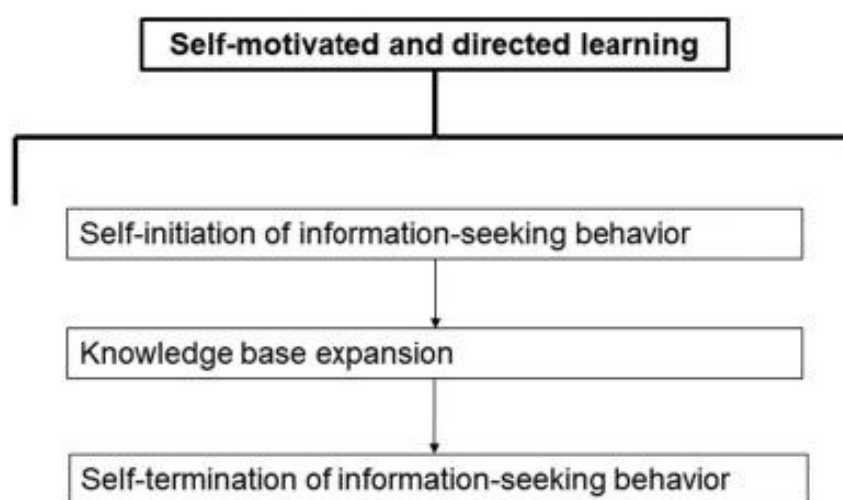
Figure 8. Schematic of self-motivated and directed learning (Cronin-Golomb and Bauer, 2023).

According to the authors of the picture, informal, motivated and purposeful learning is very important for the successful acquisition of new competencies. Voluntarily motivated and autonomous learning is characterized by the initiative to acquire new knowledge and competencies, which is promoted by the learner's own motivation. Three stages are distinguished in self-motivated and self-directed learning:

1. Self-initiation of information-seeking behavior. Human motivation to acquire new knowledge and competences after noticing gaps.

2. Knowledge base expansion. Persistent involvement of a learner in the deepening of knowledge, skill formation and learning process.

3. Self-termination of information-seeking behavior. Realizing that knowledge gaps are properly filled and a new competence or knowledge package is formed.

The motivation to acquire the necessary competencies that allow one to operate confidently and successfully in the dynamic field of healthcare can be conditioned by various things. For example, the desire to improve the experience of patients, facilitate the work of medical workers, realize their

ideas and create products, technologies or services with high added value. The competitive environment is also an important source of motivation, as entrepreneurs need to constantly improve their competencies in order to stay competitive in the field of digital healthcare.

Understanding what keeps digital health entrepreneurs motivated to act, it is important to ensure a smooth and efficient way for the entrepreneur to acquire new knowledge, skills or competencies in order to be a successful entrepreneur. To facilitate this phase of self-directed learning, the table below (Table 6.) outlines a set of methods for acquiring the competencies needed to become a digital health entrepreneur. These methods are presented on the basis of various literature sources that indicate learning methods that can be applied to self-directed learning.

K.R Mangalam University (2024) provides self-directed learning methods such as:

- Participation in online courses – improving knowledge with the help of online courses can help to improve or acquire new competencies.
- Reading – reading books or articles can provide useful insights and expand knowledge base.
- Mentorship - communication with mentors can provide useful advice, insights and help to make informed decisions, which in the long term form the competence to do it individually.
- Networking – participation in networking events and forums can widen the circle of acquaintances that often provide useful advice, insights or information.
- Self-reflection – recording and analyzing actions and their consequences allows learning from your mistakes and forming a positive attitude despite challenges.

Institute of Entrepreneurship Development (2022) provides self-directed learning methods such as:

- Networking – participating in various events and workshops where it is possible to make connections and gain insights from more experienced people.
- Self-reflection – reflecting on everyday conversations and actions, which allows identifying areas for improvement. Collecting and evaluating feedback from colleagues and other relevant people.
- Mentorship – finding a mentor who can provide valuable advice. Monitoring of mentor's competences.

In a study by McFadzean (2000) on techniques to improve creative thinking, it is recommended that the most popular technique for developing creative thinking is brainstorming sessions, where a group of people generate ideas and write them down.

In an article written by Cote (2021), how to improve analytical thinking skills, such methods as considering opposing points of view, playing logical games, participating in online courses and engaging with data are recommended.

2.3. Theoretical result of a set of competencies and their development methods

Taking into account the recommendations of learning methods provided by various literature sources, Table 6 assigns a certain learning method to the competence required for a digital health entrepreneur. Each method was evaluated according to the possibility of providing the necessary knowledge or

information that is necessary for the acquisition of competence. "X" indicates that the method is applicable for developing the competence.

Table 6. A set of competencies and their development methods for digital health entrepreneurs

Competencies / Self directed learning methods	Creativity	Analytic thinking	Market savvy	Strategic financial management	Team leadership	Technical knowledge
Brainstorming	X					
Opposing points consideration		X				
Logical games		X				
Online learning	X	X	X	X	X	X
Reading	X	X	X	X	X	X
Networking		X	X	X	X	X
Mentorship		X	X	X	X	X
Self-reflection	X	X	X	X	X	

Below is detailed information about the relevance of the selected competencies and possible methods of their acquisition:

Creativity – Bańka et al. (2023) identified that creativity is an important criterion that manifests itself in the development of innovative solutions. The development of these innovative solutions contributes to the satisfaction of consumer needs and the opportunity to gain a competitive advantage over competitors. El-Chaarani, Raimi & El-Abiad (2023) also wrote about creating innovative solutions. They stated in their research that the ability to innovate is a quality that is required during the idea generation and development process, and it requires creativity. Creativity, as an important characteristic of an entrepreneur, is also included in the competency system "EntreComp" (2018) created by the European Commission. Given that digital healthcare is a high-value-added and constantly innovating industry, it can certainly be said that this industry requires a high level of creative process, so creativity competence is an inevitable part of every digital healthcare entrepreneur's job.

Methods to acquire creativity competency:

- Brainstorming – participating in brainstorming sessions creates an opportunity to generate ideas and exchange them with other people. This generation of ideas fosters creativity, which unfolds through the diversity of thought of each person involved.
- Online learning – participation in online courses that cover topics necessary to promote creativity competence, such as creative thinking, innovation, creative writing, etc. A person

who develops creativity competence can apply the newly received information in his life and improve in this area.

- Reading – reading different literature can broaden your horizons, provide new insights into certain topics, and provide an opportunity to explore the ideas of writers. All this encourages the acquisition of new information and broader thinking, which creates the basis for being able to creatively solve emerging situations.
- Self-reflection – a person who uses the method of self-reflection can evaluate thinking behavior and actions and based on this, ask himself questions, the search for answers of which stimulates creativity.

Analytic thinking – given that the digital healthcare industry is constantly faced with challenges such as risk, funding opportunities, collaboration with a multidisciplinary team, ensuring patient privacy or satisfying consumer needs (El-Chaarani, Raimi & El-Abiad, 2023; Tariq, 2023), it can be concluded that the digital healthcare industry is a constantly evolving and changing process. Bańka et al. (2023) wrote about the need for analytical thinking in a constantly changing environment. The conducted research states that in order to see and understand the changes taking place in the environment, an entrepreneur needs analytical thinking. This skill enables an entrepreneur to make informed decisions and achieve sustainable growth.

Methods to acquire analytic thinking competency:

- Opposing point consideration – analytical thinking competence can be improved in order to find an opposite opinion or a solution to a problematic situation. For example, such situations can be modeled on the principle of debate, when a person has to defend the opposite point of view than his own.
- Logical games – strategic games that require assessing the situation several steps ahead, strategic thinking and problem solving encourage analytical thinking.
- Online learning – participation in online courses that provide information about critical thinking, logic or reasoning. The obtained information can be applied in simulated or real situations, with the help of which the competence of analytical thinking is improved.
- Reading – in order to improve analytical thinking, the reader should choose challenging literary sources that encourage the reader to think. The reader should try to analyze and evaluate the arguments presented by the writer.
- Networking – surrounding yourself with professional people helps gaining analytical thinking competence, as a person gets to know different perspectives, ideas and problem solving methods.
- Mentorship – finding a mentor who has strong analytical thinking skills and having regular communication or working sessions can help to acquire or improve your existing analytical thinking skills.
- Self-reflection – tracking the decisions made, evaluating them according to their consequences, drawing conclusions and reasoning about how the problematic situation could have been better solved contributes to the improvement of analytical thinking competence.

Market savvy – evolving technology and consumer needs are driving change in the digital healthcare industry. It is very important for entrepreneurs to understand these changes and be able to adapt to

them. Ahmed & Harrison spoke about this in a study conducted in 2021, which states that knowledge of the market allows making appropriate decisions and thus meeting the needs of consumers and withstanding the pressure of competition. In a study conducted by El-Chaarani, Raimi & El-Abiad (2023), they state that meeting market needs requires market knowledge and the ability to evaluate technologies, services or products based on what will be attractive and useful to consumers in the future. The competence of market knowledge was also emphasized by the European Commission (2018), indicating that the spotting opportunities are an important criterion in business. This criterion depends on the future vision of the product, technology or service that the innovative entrepreneur sees in the future, and according to Tariq (2023), the success of a product or service in the health market depends on whether consumers see positive benefits, so the ability to anticipate consumer needs is endless a significant thing in business.

Methods to acquire market savvy competency:

- Online learning – participation in courses that provide information on current prevailing trends, market analysis or potential customer behavior.
- Reading – reading various literature provides new knowledge and deepens a person's understanding of a certain topic. For example, books that provide information on market strategies, customer psychology, or competitiveness can provide strong background information that is the basis for establishing yourself in the market. Literature sources that provide the latest situation in the market can help to understand what factors are happening in the market today.
- Networking – expanding network of people can be a significant method of gaining the necessary market knowledge. The network of market knowledge professionals provides an opportunity to get acquainted with the current market situation, provides valuable insights into the latest trends, and shares other valuable information and experience.
- Mentorship – a mentor who has a lot of knowledge and a lot of experience about the processes taking place in the market can provide valuable information and knowledge that helps to form the right and correct thinking that is needed to survive in a dynamic market.
- Self-reflection – tracking, evaluating and analyzing the consequences of actions taken in the market can provide valuable insights, knowledge and experience for future decisions.

Strategic financial management – developing innovative digital healthcare solutions requires significant investment, so it is critical for digital healthcare entrepreneurs to be able to secure the necessary funding. According to a study by Johnston & Wang (2022), an entrepreneur must be able to understand and critically evaluate the financing options available in the market. The challenges of financing and the need to be able to manage finances have also been proven by El-Chaarani, Raimi & El-Abiad (2023), a study that states that the process of developing innovations in digital health care is characterized by high risks and uncertain duration, so entrepreneurs may have difficulties in ensuring financing of the innovative solution being developed. The European Commission (2018) also included the importance of financial literacy in the EntreComp set of competencies.

Methods to acquire strategic financial management competency:

- Online learning – participation in distance courses in which professional lecturers share information about financial strategies, financial management, funding opportunities, investments and their attraction can provide valuable information and knowledge that will help to make the right financial decisions.
- Reading – reading a variety of literature that provides information, knowledge and experience about aspects of financial management, distribution or attraction can help to find answers to questions that arise or teach the right foundational steps to take.
- Networking – a network of people who know how to properly manage finances in a business can provide valuable information that helps avoid mistakes. This network can also help entrepreneur get to know people who are potential investors in the project of the innovative solution being developed.
- Mentorship – having a mentor who is characterized by strong competencies in financial management helps to get quick answers to the questions that arise, to form the right thinking and thus acquire the necessary competencies that help to ensure successful financial management in business.
- Self-reflection – tracking, evaluating and analyzing the financial decisions made can help to gain the necessary knowledge and insights that help to make correct and reasonable financial decisions in the future.

Team leadership – usually, the team working on the development of digital health solutions is composed of specialists from various fields. Different people's skills and cultural backgrounds can be a challenge in organizing the work of such a diverse team. El-Chaarani, Raimi & El-Abiad (2023) wrote about the leadership of a multidisciplinary team in a study conducted, who stated that digital health innovation requires a team with different competencies, so working with a multidisciplinary team can become a challenge for the team leader. The European Commission (2018) also thought about the importance of working in a team with other people and included the competence of working with others in the set of competences. Gliddon & Rothwell (2018) also wrote about the ability to lead groups of people in their research, who claim that the creation of innovative solutions is closely related to people, so team leaders must be able to take on a leadership role that encourages creativity and freedom to create in the team.

Methods to acquire team leadership competency:

- Online learning – distance courses, which provide information and practical training on leadership, team building or management, allow acquiring the competencies necessary for successful work in a team.
- Reading – reading various literatures that present the characteristics of a successful team leader and their application can provide valuable insights that are applicable in practice.
- Networking – a network of people who work in teams can provide insight and experience about the successes and failures of team leaders. Such information helps to make the right decisions in the development of leadership competence.
- Mentorship – a mentor who has strong leadership qualities can answer the questions that arise, point in the right direction and form the right thinking of the team leader.

- Self-reflection – analyzing your team and leadership experience and the decisions team leader makes helps to understand strengths and weaknesses. Knowing the positives and negatives and reacting appropriately to them allows to make more correct decisions in the future.

Technical knowledge – developing digital healthcare solutions requires specific technical expertise. The digital healthcare industry itself dictates that an entrepreneur must understand what is happening in the digital world and be able to apply and integrate modern technologies. The need for digital competences was written by Bachmann et al. (2024) who argue that working in a digital business requires the ability to work with digital technologies if an entrepreneur is to remain successful in this complex medical industry. The competency of knowing digital technologies is also emphasized by Steens, Bots and Derks (2024), who state that such digital technologies as big data, their analysis, the ability to visualize things, blockchain require a deep understanding if the goal is to be able to apply these technologies. Another area that requires digital healthcare entrepreneurs to have technical knowledge of the medical sector is the stringent medical regulatory framework. The regulatory framework in digital healthcare was written by El-Chaarani, Raimi & El-Abiad (2023), who argue that the medical sector is heavily regulated by government organizations, so entrepreneurs may face challenges in innovating in this area. For these reasons, competence in technical knowledge is considered one of the main factors that often determines the successful development of a business in a technology-driven market.

Methods to acquire technical knowledge competency:

- Online learning – courses, during which the knowledge of the latest technologies, their possibilities and methods of use are deepened, provide knowledge and information that can be successfully used in the development of innovative digital health care solutions.
- Reading – reading a variety of literature can provide valuable and actionable information about the latest technologies that can be applied in digital healthcare.
- Networking – expanding the network of people who are constantly deepening their knowledge about the application of the latest technologies can help to find the most suitable solutions in emerging situations in the creation of innovations in digital healthcare.
- Mentorship – a mentor who is able to work with the latest technologies and understands the possibilities of their use can point in the right direction in finding solutions that help solve emerging problems.

The competencies presented in Table 6 and the possible ways to acquire them are of great help for digital healthcare entrepreneurs who need to acquire the competencies necessary to succeed in healthcare industry. The set of competencies and the methods of their acquisition are intended to ensure a smooth and effective learning process for an entrepreneur, which was indicated in the second stage of the self-management learning process presented in Figure 7. According to the presented list of competencies, the entrepreneur must independently assess which competencies he has, which competencies need to be improved and which need to be acquired anew. According to the individual self-assessment of each digital healthcare entrepreneur, a plan must be prepared, according to which the entrepreneur will expand his knowledge, accumulate experience and acquire new competencies.

The individual competence improvement plan drawn up by each entrepreneur allows to move to the third stage of the self-management learning process, which was presented in Figure 7. After assessing that the necessary competence is formed or properly improved, the entrepreneur can stop the educational process, according to which the aim was to acquire a certain competence necessary for a digital health entrepreneur.

3. Research Methodology

The ever-changing healthcare industry brings many new things to the medical world. New technologies, changing consumer needs, and a strong competitive environment encourage digital healthcare entrepreneurs to constantly expand their horizons, update their knowledge, improve their existing ones, and acquire new competencies. The required competencies allow digital healthcare entrepreneurs to succeed in the complex healthcare field and deliver innovative solutions that bring significant benefits to public health.

This chapter provides a detailed outline of the research process, including the methodology used, the aim and objectives. It also presents the tools and procedures that are used to collect and analyze data for the research being conducted. The data collected and analyzed should provide detailed knowledge and targeted insights into the research conducted.

Lithuanian digital health startups and the entrepreneurs developing them were selected for the research. Based on statistical data presented on the "statista" page, it is predicted that the digital health market in Lithuania will reach 132 million euros in revenue in 2024. Looking at the data of the statistical forecast four years ahead, it is predicted that the volume of the digital health market in Lithuania will be almost 183 million euros in 2028 (Statista, 2024). Considering these market forecasts, it can be concluded that digital health services in Lithuania will receive more and more attention and the development of innovations. For this reason, digital health entrepreneurs operating in Lithuania are chosen as research participants, whose need are clearly visible these days and are likely to grow in the future.

The **aim** of the study is to disclose the competences of Lithuanian digital healthcare start-up entrepreneurs and their acquisition and development methods, which are applicable to self-directed learning.

The empirical research **objectives and tasks** are:

1. What are the competencies of a successful digital health entrepreneur in Lithuania?
2. What self-directed learning methods do successful digital health care entrepreneurs in Lithuania use to acquire new or improve existing competencies?
3. Which self-directed learning methods are the most appropriate for competence development in the case of Lithuanian digital healthcare startups?

Research strategy. In order to find out what competencies digital healthcare entrepreneurs have and what methods of their acquisition are used by successful Lithuanian digital healthcare entrepreneurs, a qualitative research methodology was chosen. When applying the qualitative research method, the aim is to delve into the process and understand how the analyzed situation works within the research group. For this reason, a qualitative research approach asks less precise research question and it focuses on accurate questions that reveal the existing situation in the target group (Gaber, 2020).

Data collection method. The research uses a **semi-structured** interview model. Knowing that a structured interview has a defined and limited set of questions, the chosen semi-structured interview model provides flexibility as it allows to ask the interviewee new questions in response to answers.

This gives an opportunity to explore any important ideas that may come up during the interview. In order to maintain a balance between the main questions, it is necessary to be well prepared for the interview topics, which makes it reasonable to create a guide to the main questions, which helps not to get lost throughout the interview (Ruslin et al., 2022).

It is important to ensure that the conversation between the respondent and the interviewer takes place in a private and confidential environment. During the interview, the conversation is recorded using dedicated audio recording equipment. Recording a conversation facilitates data collection, as the recording can be directly translated into transcripts that are structured well for data analysis.

A semi-structured interview was conducted with the selected research participants, during which the respondents were asked key questions (Table 8) in order to collect the information needed for the study about competencies and methods of their development.

Table 7. Guidelines for semi-structured interview questions

Question group	Rationale of the question	Question
Innovation ideas for digital healthcare	The provided information allows sharing a broader picture of digital health care innovations being developed and deepening the competences required for a specific solution	How and where does the idea to create a digital healthcare innovation come from?
Challenges in digital healthcare innovation	The question helps to reveal what difficulties an entrepreneur faces when developing a digital health care innovation and what competences are needed to solve these problems.	What are the challenges facing digital healthcare innovation and how they are resolved?
Formation and management of a multifunctional team	The question helps to reveal what specialists are needed for a team that creates innovations in the field of digital health care and what challenges arise in managing such a team.	What kinds of specialists are needed in a digital healthcare innovation team and what are the challenges of managing a cross-functional team?
Required competencies for digital health care innovation	Question helps to reveal which competencies the research participant identifies as necessary to have in order to successfully create and develop digital health care innovations	What competency needs do you face when innovating in digital healthcare?
Competence acquisition methods	The question helps reveal what competence acquisition and improvement methods entrepreneurs use to develop competences	What methods do you use to acquire or improve a particular competency you have?

Sampling. The best and most informative way to gather information about the competences of digital health entrepreneurs working in Lithuania and their improvement methods is to have a direct conversation with people working in this field. Respondents to participate in the study were sought in the digital health care startup community operating in Lithuania and on the LinkedIn platform.

Successful digital healthcare entrepreneurs in Lithuania were selected based on the criteria presented in the study conducted by Gorgievski, Ascalon & Stephan (2011). The conducted research presented the criteria about the utility of created solution. This **criterion** assesses that the product, service or technology created by entrepreneurs would not only look good, but performs an important and useful function in society. Additionally, the founder of health tech accelerator established in Lithuania was invited to participate in the research. The purpose of this participant invitation was to create a more detailed picture of the trends in participant's competencies observed during the accelerator.

The invited participants were sent a prepared invitation with all the necessary information about the research being conducted (the invitation is presented in the appendices).

Five participants participated in the study. Four of them are owners or co-owners of digital healthcare startups. One participant is the founder of a medical technology accelerator operating in Lithuania, which promotes innovation in the field of medicine. Table 7 provides detailed information on medical technology accelerators and digital medical startups.

Table 8. Characteristics of the digital health solution.

Digital health solution	Interview number
Health tech accelerator, which aims to bring together entrepreneurs and other interested parties every year to create a health technology ecosystem in Lithuania.	Interview 1
Advanced artificial intelligence technology that provides insights into the health of a diabetic patient.	Interview 2
An innovative mobile application whose algorithm allows finding the most suitable therapist in a few minutes.	Interview 3
An innovative sports and wellness platform that helps people discover personal trainers and wellness services.	Interview 4
Improving the quality of life of the patient, his relatives, and the caregiver, slowing the progression of the disease, helping to solve the main challenges faced by patients with dementia in an innovative way.	Interview 5

Data analysis. Using the MAXQDA program, a study was conducted based on collected data from selected successful digital healthcare entrepreneurs in Lithuania. The MAXQDA tool was chosen for its ability to transcribe and analyze information collected from research participants during semi-structured interviews. The following features were used during analysis with the MAXQDA tool to provide visual information about the results of the data collected during the interviews:

- Code Matrix Browser – it displays the relationship between codes and documents by illustrating which codes are linked to which documents. It offers a summary of the distribution of specific codes across document segments, showing how many segments within each document are associated with each code.
- Code Map – in the Code Map, selected codes are displayed as on a map. The proximity function was used to create the code map. Proximity of codes in the same document counts the number of times two codes were assigned at a definable distance in the same document. The maximum spacing for this feature was set to 15 lines.

Research ethics. When conducting empirical research, it is important to ensure that it is conducted ethically. Research is considered ethical when it is conducted with a responsible evaluation of all respondents' answers. This means that the answers of the respondents must be studied thoroughly and objectively. Confidentiality is ensured for research participants.

Organization of research. In order to ensure that there were no problems during the interviews, the interviews were conducted in Lithuanian language. The answers collected from the respondents were later translated into English language. During the translation, it was ensured that the content of the respondent's answers did not change, so that the real experiences of the respondents could be preserved.

Research limitations. Regarding the conducted qualitative research with Lithuanian digital health care entrepreneurs, it is important to mention the existing limitations. Since five participants participated in the study, the study sample is too small to provide generalized conclusions about the competencies needed by digital healthcare entrepreneurs and methods of their development. It is also important to consider subjectivity, as the researcher interprets the collected data subjectively, as in any qualitative study.

4. Results of Entrepreneurial Competencies and Development Methods in Digital Health Lithuanian Startups

The results of an empirical study conducted with digital health care entrepreneurs working in Lithuania are presented in this part of the master's thesis. In order to find out what competencies and methods of their improvement are important for digital health care entrepreneurs in Lithuania, the data collected during the interviews will be analyzed and evaluated. After the analysis, the necessary competences and their improvement methods identified by Lithuanian digital health entrepreneurs will be presented, based on the entrepreneur's experience, knowledge and theoretical overview.

4.1. Data Analysis and Interpretation

Based on the information presented in the theoretical part, a set of digital health care competencies and methods for their improvement was compiled. Based on this set, an analysis was conducted with digital healthcare startups in Lithuania with the MAXQDA tool. In the MAXQDA tool, competences and methods of their improvement, which are faced by digital health care startups working in Lithuania, were coded.

Information collected during semi-structured interviews is divided into two categories (Figure X), consisting of types of competences and methods of their development.
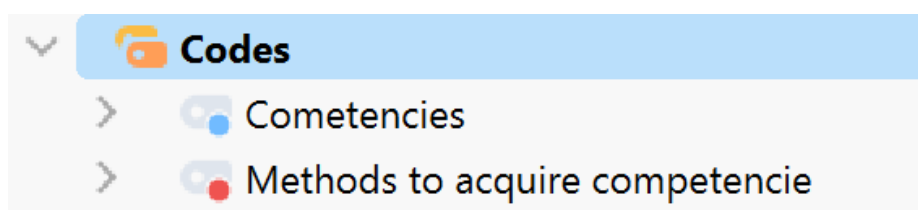
Figure 9. Categories of codes.

The categories of codes presented will be detailed in separate sub codes. The sub codes are based on the competencies identified by digital health entrepreneurs and their improvement methods. The subsections 4.1.1 and 4.1.2 below analyze and graphically present the results of the study, which will reflect the competencies required by a digital healthcare entrepreneur and possible methods of their improvement in Lithuania.

4.1.1. Types of Competencies

After analyzing the information gathered during the interview, it can be concluded that the main competencies that different Lithuanian digital healthcare entrepreneurs identify as necessary are creativity, strategic thinking, information technology knowledge, sales knowledge, medical knowledge, financial literacy, market knowledge, leadership, team skills , technical knowledge, marketing, knowledge of legal regulations, ability to experiment and communication (Figure 10).

Figure 10. Required competencies in digital health of Lithuanian startups, according to interviews.

A sub code category consists of each competency mentioned during the interview. The number of coded segments in the "SUM" column and the size of the circle symbol (the larger the circle, the more often the competence was named) in the presented graph show the frequency of naming each competence during all interviews (Figure 11). After analyzing the competences named by all the respondents who participated in the study, it is possible to rank them from the most needed to the least needed. This ranking method helps to analyze data more effectively and to understand which competencies are the most important and necessary for Lithuanian digital health care entrepreneurs.

Figure 11. Browser of competencies of Lithuanian digital health entrepreneurs.

After analyzing the comments of each respondent who participated in the interview, it was found that the most frequently mentioned competence is communication. This competence was identified as necessary for a digital health care entrepreneur by all respondents who participated in the study.

The success of digital healthcare startups depends heavily on communication (Table 9). As can be seen from the comments provided by the respondents, communication can be very different. This includes communicating within the team, pitching the idea to potential investors, pitching the idea to a wide audience, and communicating with customers. All of these processes, which depend on communication, are extremely important for the successful operation of digital healthcare startups in Lithuania and are inevitable when carrying out innovation activities in the field of digital medicine.

Table 9. Categorization of communication competence.

Interview number	Category	Subcategory	Coded quotes
Interview 1	Competencies	Communication	"The team leader <...> is able to present and convey his vision to others."
			"<...> the team stays in one room and discusses <...>"
Interview 2			"<…> need to create a community <...> and there will always be a role <...>"
			"<…> it was necessary to conduct pitches in front of investors <...> a very high caliber event <...>"
			"<…> knows how to approach <...>"
			"I am a person who likes to talk <...> this is a quality that I use very well <...>"
Interview 3			"Usually now I'm pitching an idea <...> afraid to speak in front of people <...>"
			"<…> communication is the main make or break factor in a company."
			"<…>we try to share information <...> so that others always know what is happening <…>"
Interview 4			"Need to talk to your customers <...>"
			"<…> that matter must be considered and broad questions must be asked <...>"
			"<…> a position that requires a lot of communication <...>"
			"<…> you are responsible to the shareholders <...> this is a job that requires a lot of communication. "
			"<…> thing I could mention <...> general communication <...>"
Interview 5			"<…> I learned a lot about people, about communication <...>"
			"<…> verbal intelligence <...> a person can speak or not <...>"
			"<…> must be brought to the public <...> is oral communication <...>"

The analysis of the information provided by the respondents who took part in the study showed that another competence on which the work results of digital healthcare startups depend is marketing knowledge (Table 10). Research participants define the importance of marketing in creating a personal brand, in order to present the created product to a wide range of consumers and in creating advertisements, which are also intended to spread the word about the created innovation. Considering

these factors, marketing is also an inevitable part of the work of digital healthcare entrepreneurs, which has a very important meaning.

Table 10. Categorization of marketing competence.

Interview number	Category	Subcategory	Coded quotes
Interview 1	Competencies	Marketing	"We have marketing specialists in the accelerator. "
			"<…>we talk about personal branding <…>"
Interview 2			"<…> the simplest way would be to allow advertising <…>"
			"If you need advice, for example marketing <…>"
Interview 3			"I started doing marketing because there was no one in the team to do it <…>"
			"<…> how it will help your marketing, how it will help you stand out from other competitors <…>"
			"<...> if you know how marketing will use your implementation <...> you will know what other functions to take into account <...>"
			"<…> covers our social networks and articles <…>"
			"We cannot think of what can be done in that place <...> what kind of marketing advertisement."
			"We had to look at where we advertise and how we advertise <…>"
			"Marketing has been an obstacle for a long time <...> it would be good to have someone who understands marketing <…>"
Interview 4			"<...> a team member is a <...> marketing specialist. "
			"<…> work with marketing <...> these roles are very important <...>"
Interview 5			"<...> people were hired <...> who have experience <...> in the advertising niche. "
			"<…> the created product must be brought to the public <...> this is the most difficult work. "
			"<…> this is infrastructure development <...> this is part of marketing. "

Another competence, the importance of which was expressed by all the participants in the study, is leadership (Table 11). The importance of leadership can be seen in various situations, such as encouraging the team to move forward, not losing motivation and being able to move positively from one failure to another, so that team members are not infected with negative emotions. It is important to understand that in order to be a good leader, it is needed to develop leadership competencies.

Table 11. Categorization of leadership competence.

Interview number	Category	Subcategory	Coded quotes
Interview 1	Competencies	Leadership	"<…> leadership competencies are lacking and we are trying to develop them <…>"

Interview 2			"It is very important for a team that at least one person has vision and leadership <…>"
Interview 3			"<…> to understand about leadership <...> it is very important not to overwhelm your colleagues <...>"
Interview 4			"<…> if you want to be a leader <...> you need to improve your leadership competence. "
Interview 5			"<…> people get infected <...> if you are a leader <...> you lead <...>"
			"<…> for a successful company <...> the leader is also very important <...>"

Another competence, which was named by the majority of the surveyed respondents, is knowledge of legal regulations (Table 12). Knowledge of legal regulations can help in areas such as knowing what actions need to be taken now to avoid legal malpractices in the future. For example, in order to obtain a certain certificate, it is necessary to responsibly prepare and collect the material required for certification. Knowing the legal regulations can help protect yourself, the patient, and the treatment facility. The conclusion of contracts, the collection of data and their publication are also conditioned by legal regulations that must be followed. It is important to understand that the health care sector can be conditioned by a wide variety of legal acts, so it requires a lawyer with specific competences who knows the conditions applied in medicine.

Table 12. Categorization of knowledge of legal regulations competence.

Interview number	Category	Subcategory	Coded quotes
Interview 1	Competencies	Knowledge of legal regulations	"It happens that if you don't have certain data from the beginning, you can't get some certificates <…>"
			"<…> legal regulations are <...> to protect the patient or the treatment facility <...> participants interpret those regulations in one way or another and respond to them <...>"
			"Participants learn about opportunities early <...> we have legal mentors <...> those topics are touched on in one way or another <...>"
Interview 2			"There are requirements for obtaining a certificate <...> tells you what you can be, what you can do, what you cannot do <…>"
			"<…> legal matters <...> there is a lot of paperwork, but there are guidelines and the whole thing is shaped according to them."
			"We have partners who can help us from the legal side <…>"
			"There are legal limits on what you can and cannot say <…>"
			"<…> a technical matter, but those limits will be supported by the legal framework <…>"

Interview number	Category	Subcategory	Coded quotes
Interview 3			„<...> there are legal issues that may delay implementation. "
			"<…> it took time to conclude contracts with psychologists <...> what should be included in that contract <...> to protect oneself <…>"
			"We wanted to collect feedback from other pages and didn't know if that was allowed. "
Interview 5			"There are a lot of laws, regulations and legal matters. If I had to hire a lawyer, I doubt that he would be useful, since there are different areas of law. "
			"<…> reduce the chance of getting intellectual property because you made mistakes <...> self-published, self-written <...> it shouldn't be <...>"

Research participants strongly emphasized that the successful work of digital healthcare startups depends on a well-organized and purposeful team (Table 13). A good team atmosphere, equality, the opportunity to open up and be heard are identified as necessary conditions for a good team. The ability to build, maintain and lead a team is essential skills to achieve high goals. The importance of a good team is reflected in the fact that a good team is superior to a unique idea.

Table 13. Categorization of team skills competence.

Interview number	Category	Subcategory	Coded quotes
Interview 1	Competencies	Team skills	"Here is only the potential of the team <...> if there is a good team, they will do it. If there's a good idea but a bad team, they won't do it anyway."
			"In the early stages you need to evaluate the team. How different they are, how much they can work together, how much they seek compromise and how much they discuss. "
			"All depends not on the uniqueness of the idea, but on the team. "
Interview 2			"Everyone is doing everything they can <...> but there will come a time when we will really say that we need someone to distribute the work <…>"
			"I like that you can manage a team and immediately see the result <...> if no one knows how to lead, it will be bad, everyone will do their own work and will not see a common vision <…>"
			"We strive to make everyone happy and heard. At this early stage, it's really important to be a very good team."
			"<…> advice <...> choose people very well <...> you have to think very carefully if this is the person I want to work with 5 years from now <...>"
			"<…> if you cannot communicate with him normally <...> there will be no use from him <...>"

Interview 4			"<…> team development, management. "
			"<…> the best team <...> one who leads the ideas, one who is the technical person and one who controls."
			"One of the mistakes <...> I was not able <...> to control the team. "
Interview 5			"<…> I won't do anything alone <...>"

Competency in financial literacy was also frequently identified as necessary for digital healthcare entrepreneurs (Table 14). The need for this competence is manifested in different situations. For example, the smart use of available capital, not spending it on things that do not add value to the startup. The ability to make the right financial decisions is also based on the need to present the innovation being developed to potential investors, since attracting investments is a complex process that requires clear evidence of the potential of the idea. The need for financial literacy competence is demonstrated by mentors invited during various accelerators, who provide participants with specific financial-related knowledge.

Table 14. Categorization of strategic financial management competence.

Interview number	Category	Subcategory	Coded quotes
Interview 2	Competencies	Strategic financial management	"<…> we won a prize of 15 thousand <...> that money is frozen for now <...> now we have applied for European Union support <…>"
			"<…> there are usually some clarifications <...> where your income comes from <…>"
			"<…> it is very easy to walk away with that money <...> everything is just lying around and will be used later <…>"
			"<…> we were able to assess ourselves, what is most important to us at the moment <...> we are discussing, looking at alternatives, which is cheaper <...>"
			"<…> if you see that the ship is sinking <...> you can save the company <...> by selling it to competitors <…>"
Interview 3			"<…> the biggest shortcoming is someone who understands finance, both accounting and dealing with investors."
Interview 4			"<…> there are people of various competences <...> with taxes and other things <...>"
Interview 5			"<…> other things like selling, I'm just not interested <...> monetary things have to be. If you want to give joy, you must have money."
			"Another thing about this topic, because it's not so nice <...> they say that everyone gets investments here <...> nothing like that <...> you have to make a profit <...> I already know all the investors <... > and they have very narrow niches <...>"
			"Gives some topic and explores it, let's say investments and everything about investments <...>"

The respondents who took part in the study named the situations for which a digital health entrepreneur must be able to think strategically and strategize business processes (Table 15). For example, business representatives are invited to the accelerator, which is dedicated to the development of medical technology innovation. The purpose of the business representatives is to convey to the participants the available knowledge, how the business should be created and what it is necessary to know, what factors to prepare for. The importance of a strategic plan in creating a business model based on digital innovation is also strongly emphasized. A strategic plan includes the stages of business development, which reflect the planning and execution of specific steps. Such strategic thinking in business development helps to have a goal and carry out the necessary operations that help to reach the planned mountain top.

Table 15. Categorization of strategic thinking competence.

Interview number	Category	Subcategory	Coded quotes
Interview 1	Competencies	Strategic thinking	"They share their know-how. How businesses were created, which is important <…> mainly from a business model perspective <…>"
Interview 2			"Coming up with a plan, then simply putting together the steps towards that goal. This is actually the most difficult work. "
Interview 4			"For every startup, one of the most important things is to first have scale, then build a customer base <...> and have a fairly strong product <...>"
			"<…> the biggest job <...> what helps to achieve our strategy, what is needed and so on. "
			"<…> do I know what we have to do this month? Yes, because we have our plans, we plan what we will do according to the time resources <...>"
			"<…> you need to have a goal and stick to that goal <…>"
Interview 5			"A very important thing <...> is strategic planning <...>"

Innovation in digital healthcare would be difficult without medical expertise (Table 16). The accelerator promoting the creation of innovations in medical technologies is characterized by high activity of medical personnel. It is said that it is difficult for a person who knows technology to develop an innovation in a field in which he has no knowledge. For this reason, teams participating in the accelerator are composed of members who always include doctors or nurses in their ranks. The teams of startups developing digital healthcare innovations in Lithuania also have people with medical knowledge or plan to invite them when the right moment comes, when the startup is able to exploit their potential.

Table 16. Categorization of medical knowledge competence.

Interview number	Category	Subcategory	Coded quotes
Interview 1	Competencies	Medical knowledge	"<…> we have doctors <…>"
			"<…> if you are a tech person <...> but you don't understand medicine <...> it will be difficult <...>"

Interview number	Category	Subcategory	Coded quotes
Interview 2			"<…> the team member is a doctor of pharmacy <...> has a doctorate degree <...>"
Interview 4			"<…> if the topic of wellness <...> comes from the field of health <...> public health competence or something like that <...>"
			"<…> in our case <...> a health specialist who understands some additional things <...>"
Interview 5			"There was the topic of geriatrics and aging <...> I was proud of myself that I hit the mark <...> what I'm talking to the professor <...> she says yes, right <...>"

The study participants also identified the importance of competencies such as creativity, information technology knowledge, sales knowledge, leadership and the ability to experiment (Table 17). These competencies have been mentioned less often, but their importance is also undeniable.

Table 17. Categorization of other important competencies.

Interview number	Category	Subcategory	Coded quotes
Interview 1	Competencies	Ability to experiment	"<…> tends to experiment <...>"
			"The culture of experimentation is still really in its very early stages <…> we learn from the first session <...> to check whether it works or not <...>"
Interview 2		IT knowledge	"<…> took and learned <...> because programming is needed <...>"
		Sales knowledge	"<…> sales are very difficult <...> the same can be with us <...> therefore very good technical sales know-how <...>"
		Market knowledge	"<…> a bigger market, because with a rare disease, it's a very small market <...>"
			"We can gather a list of people who would be our potential customers <...>"
			„There is a very strong connection with competitors and with the market. If there is a market, there are competitors."
			"<…> it shows that the market is there. Maybe uneducated yet, maybe it hasn't found a solution yet <...>"
			"<…> it's not terrible <...> the American market <...> we also want to enter there someday <...>"

Interview 3		IT knowledge	"<…> basically <...> programming knowledge is enough <…>"
			"A colleague is a programmer, so he helps me build all the systems."
		Sales knowledge	"<…> you will know what factors to consider <...> for example, if needed for sales <…>"
		Market knowledge	"<…> our target customer is precisely women <...> we have determined and noticed that the majority of customers we have."
			"<…> we have competitors and not one <...> in Lithuania we have competitors who do a similar thing <...>"
		Ability to experiment	"I keep testing and experimenting. Eventually you find that something works better, something worse."
Interview 4		IT knowledge	"<…> we just need <...> more programmers <...>"
			"For now I am looking for help from programmers to help me <...>"
		Ability to experiment	"This is a test. This is a practice test. You're never 100 percent sure you'll guess right, so you have to test."
			"<…> there were improvements that no one used. This is testing. You can make the most beautiful thing in the world, but if no one uses it <...>"
			"<…> if you try to test what is suitable for the market, you won't know everything <...> one works, ok, let's try this one. This one doesn't work, ok, let's try something else <...>"
Interview 5		Creativity	"<…> all application of thoughts <...> should come from your creativity <...>"
			"<…>creativity is very important <…>"
		Sales knowledge	"The most difficult job is to bring it to the public <...> here a lot is included <...> sales <...>"
			"It's part of sales. It's a mess here, but there's so much work to be done <...>"
		Market knowledge	"<…> make us stronger <...> go to some kind of market, sneak around <...>"
			"<…> gives a topic and deepens it <...> how to do market analysis <...>"
			"<…> systems are needed that <...> would track, analyze competitors <...>"

Research participants provided insights that the ability to experiment is important when creating digital healthcare innovations. For example, in the health technology accelerator, participants are taught from the first sessions to create prototypes, involve the customer and thus test the solutions of the innovation being developed. Developers of digital healthcare startups also emphasize that they constantly experiment with users when developing solutions and presenting them to the user. The results of the experiments often become an indicator of the effectiveness and applicability potential of the presented idea.

Another competency identified by the research participants is knowledge of information technology. According to the study participants, the ability to program with a computer is an inevitable part of the process of creating a digital innovation. For this reason, digital healthcare innovation startups need people who can code. The problem is often encountered that the creation of a new function requires a new programming language, whose specialists are difficult to find. Because of this, programmers constantly have to learn new programming languages.

Sales knowledge was also identified as a necessary competence. Innovations in digital healthcare are often accompanied by complex and niche technologies. This leads to a complicated sales process, since a sales person must understand not only how to sell a service to a person, but also be able to convey technologically complex innovation opportunities. The available sales knowledge plays an important role in the other processes of the startup, since the right decisions can be made, which in later stages will have links with the previously built functions. For example, evaluating the collection interface of an email database with the possibility of using them in the sales process can allow this step to be performed in the earlier stages of the startup's development. For such reasons, the ability to develop a sales process is considered one of the most difficult things that involve introducing an innovation to a wide audience.

Sales knowledge can be strongly associated with market knowledge competence. Research participants emphasized the importance of being able to understand who the target customer of the innovation being developed is. They emphasized the importance of understanding competitors, which allows not only to assess possible threats, but also to assess the market potential based on the number of competitors when introducing a similar type of digital health care innovation. As a result, the study participants identified the ability to understand the market, the target customer and analyze competitors as an important part of the startup's work.

One study participant emphasized the importance of creativity in digital healthcare innovation. Most of the time, ideas for innovation come from a problem, but creativity is very important in the process of creating an innovation, because the possibilities of applying an innovation come from human creativity.

4.1.2. Methods to Develop Competencies

After analyzing the competencies identified by the research participants, it is important to delve deeper into how entrepreneurs develop the necessary competencies. During the research, it was found that Lithuanian digital health care entrepreneurs use such competence improvement methods as self-reflection, reading, practice, participation in events, feedback evaluation, networking, art training and online courses (Figure 12).
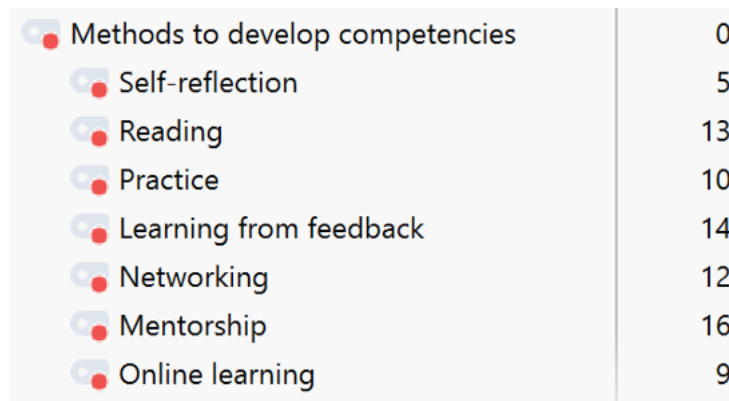
Methods to develop competencies	0
Self-reflection	5
Reading	13
Practice	10
Learning from feedback	14
Networking	12
Mentorship	16
Online learning	9

Figure 12. Methods to develop required competencies in digital health of Lithuanian startups, according to interviews.

The sub code category is composed of each competence development method that was mentioned during the semi-structured interviews. Based on the frequency of mention of competence improvement methods (Figure 13), it is possible to observe which methods Lithuanian digital health care entrepreneurs use most often.
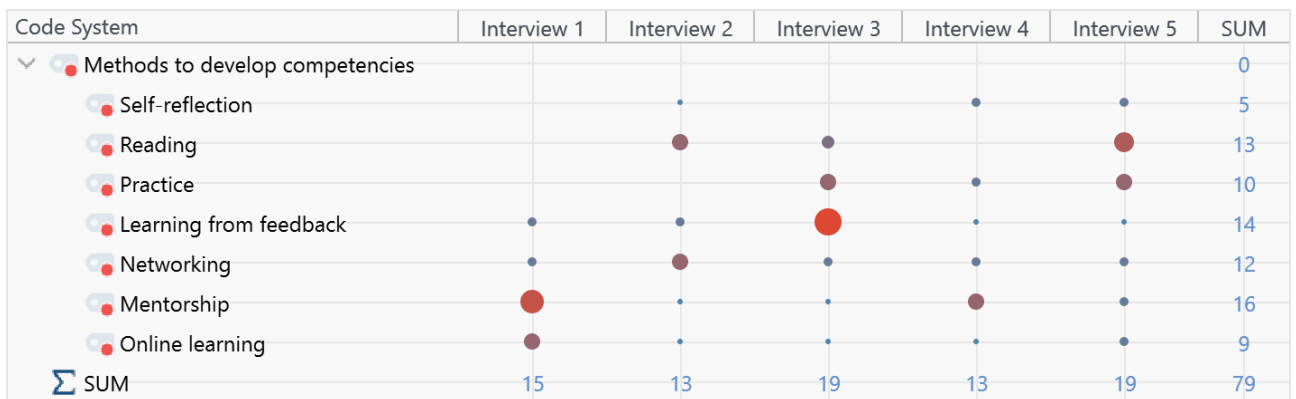

Code System	Interview 1	Interview 2	Interview 3	Interview 4	Interview 5	SUM
Methods to develop competencies						0
Self-reflection		•		•	•	5
Reading		●	●		●	13
Practice			●	•	●	10
Learning from feedback	•	•	●	•	•	14
Networking	•	●	•	•	•	12
Mentorship	●	•	•	●	•	16
Online learning	•	•	•	•	•	9
∑ SUM	15	13	19	13	19	79

Figure 13. Browser of methods to develop required competencies for digital health entrepreneurs of Lithuanian sturtups.

Four methods, which are mentoring, learning from feedback, networking and online courses, were mentioned by all research participants.

Mentoring as a method of improving competences was noticed the most (Table 18). The abundance and diversity of mentors participating in the medical technology innovation accelerator in Lithuania reveals the needs of mentors in the areas entrepreneurs who create innovations in the field of digital healthcare face. Research participants emphasize that a mentor is one of the main and most effective methods for improving competence, the benefits of which are invaluable for the entrepreneur and the startup.

Table18. Categorization of mentorship method.

Interview number	Category	Subcategory	Coded quotes
Interview 1	Methods to develop competencies	Mentorship	"<…> in our accelerator they learn that <...> we have lawyers, very serious mentors <...>"
			"We have lawyers, technology people, entrepreneurs, doctors, startup founders, marketing specialists, project managers, product design experts <...>"
			"<…> they share how they created businesses, what is important, how they manage those businesses now <...> that entrepreneur mentor is probably the broadest position <...>"
			"Everything happens online, the mentor comes to their rooms, they consult with the mentor there <...>"
			"They get feedback from mentors and if they make it to the finals, they get feedback from expert investors."
Interview 2			"<…> everything is fine when you have a serious mentor <...> after going through that path, they just tell you what not to do, where not to go wrong <…>"
Interview 3			"<…> I had a mentor who helped me from the very beginning in creating a startup <...>"
Interview 4			"<…> we had too many mentors at that hackathon. Each mentor had an hour to talk to him and stuff like that. You clarify the idea with the mentors, they give you some kind of feedback <…>"
			"<…> there are all kinds of business mentors. And of course it depends on the topic. If the topic is wellness, then someone from the field of health will definitely come <...> there are people of various competences, depending on the event <...>"
			"<…> there were a lot of mentors there and we got a lot of information from them. Mentors are invaluable <…>"
Interview 5			"<…> I really wanted that criticism <...> mentors give the biggest criticism."
			"I also lacked a mentor whom I could trust and communicate with <...> I have many friends who can be mentors in one way or another, because every person I meet knows something better than me anyway."

Research participants emphasized that learning from feedback is an important tool in developing competencies (Table 19). The experience of the Medical Technology Accelerator has shown that the feedback given by experts allows to evaluate the potential of an idea from a 360-degree perspective. The founders of startups also claim positive benefits from the people around them. Many of them conduct surveys to test how people accept their improvements and evaluate whether the improvement has a positive result. Constant communication with customers allows us to take into account the problems they face and thus make the right decisions, which help to strengthen the connection between the innovation being created and the users.

Table 19. Categorization of learning from feedback method.

Interview number	Category	Subcategory	Coded quotes
Interview 1	Methods to develop competencies	Learning from feedback	"<…> must be open to feedback <...>"
			"And then that feedback is from a 360-degree perspective. Since they all work in a team, evaluate startups, they all give their opinion, why yes, why not <...>"
Interview 2			"<…> we made a meeting for the local diabetic community. We received a lot of feedback, a lot of questions <...> very good feedback, good demand in the market <...>"
			"<…> I had to collect information and from those sources where I had to collect all the information, it turned out that many people would be very satisfied <...>"
Interview 3			"The main criteria by which we evaluate is a unique customer feedback <…>"
			"We have a survey running in our app all the time, where we ask people for their opinion, we make meetings with our customers <…>"
			"In any case, we try to get some kind of feedback from our customers. We learned that trying to guess for yourself is usually the same as going to the casino."
			"For example, I have an idea for functionality, it is sometimes good to get opinions not only from within the team, but also from outsiders <…>"
Interview 4			"When you get to know the coaches, you ask questions about what they need and what they don't like <...>"
Interview 5			"<…> for everything to come together. Different points of view, different angles, advice, criticism. I really wanted that critique <...>"

Networking as a method to improve existing competences was also very often mentioned by the research participants (Table 20). The medical technology accelerator situation revealed the importance of partnerships and the opportunity to hear a variety of cutting-edge lectures from people who are involved in various fields and willing to give their time to the accelerator participants. Research participants emphasized that networking allows for quick and high-quality solutions to emerging problems that acquaintances or colleagues from other startups know the solutions to. Networking often becomes a connecting bridge that connects the path between the entrepreneur and a specialist in a certain field, whose help the entrepreneur needs.

Table 20. Categorization of networking method.

Interview number	Category	Subcategory	Coded quotes
Interview 1	Methods to develop competencies	Networking	"We seem to be trying equally hard and thinking about our partners all the time <...>"
			"<…> joining a lecture with some foreign lecturer <...> we have a session with a Cambridge lecturer <...> then we will have a nice hospital lecture <...>"

Interview 2			"<…> we have acquaintances in all fields <...> one call and you already know the answer <…>"
			"<…> like to learn something new <...> and communication with other people, networking is necessary <…>"
Interview 3			"<…> I go through acquaintances and call. Just in the places where I get stuck, I try to get knowledge from somewhere who knows."
			"<…> gain through networking. I know quite a few lawyers, so I called and asked."
Interview 4			"<…> I ask people how you are doing. I ask another startup, how do you do it <...>"
			"<…> I received lessons, I learned <...> from other startups <...>"
Interview 5			"<…> I applied through acquaintances and they brought me to such a professor <...>"
			"<…> I have many friends who can be mentors in one way or another <...>"

The fourth method of competence development mentioned by all study participants is distance learning (Table 21). The research participants listed the online learning methods they use, which are courses, lectures, trainings, podcasts and even educational materials on the YouTube platform. During online learning, according to the research participants, it is possible to improve various competencies, such as communication, programming, medical knowledge, marketing knowledge and other technical and legal knowledge, which are aimed at startups.

Table 21. Categorization of online learning method.

Interview number	Category	Subcategory	Coded quotes
Interview 1	Methods to develop competencies	Online learning	"The first thing is that we have certain lectures where we teach how to do that <...>"
			"Our accelerator is based on the principle that one hour of lectures <...> everything takes place online <...>"
			"<…> skills are imparted online, through consultations, courses, lectures <...>"
Interview 2			"<…> we won an online training prize <...> very technical stuff <...> video lectures that are paid <...> very great resource <...>"
Interview 3			"<…> I needed someone to look at how to advertise <...> I basically learned through a "YouTube" video <...>"
Interview 4			"<…> yes, we use courses to learn how to code <...>"
Interview 5			"<…> it wasn't that one day I got up and could do <...> I completed a lot of courses <...>"
			"I basically learn it from <...> courses, podcasts <...>"

The reading method has also been identified as an effective method for improving competences (Table 22). Emphasizing this, the research participants highlighted a great interest in literature and a

love of reading. According to them, skills such as understanding people, communication, developing strategies or understanding finances can be learned by reading a variety of literature.

Table 22. Categorization of reading method.

Interview number	Category	Subcategory	Coded quotes
Interview 2	Method to develop competencies	Reading	"I really enjoyed reading all those legal documents <...> a lot of paperwork, but there are guidelines and you shape the whole thing according to them."
			"I am interested in reading technical information <…>"
			"<…> I have read quite a lot <...> about finances. Those topics were really interesting to me <...>"
Interview 3			"The technical part of selling would not be difficult to learn as it is readable <...>"
			"<…> you find strategies, you read how they work <…>"
			"<…> came from books <...> good books that helped to understand about leadership <…>"
Interview 5			"<…> books are like a second me. I read a lot <...> I read everything, that's what I need. But basically now it's about business <...>"
			"<…> it was strange to me why I hit everything <...> because I read a lot <...>"
			"<…> in this place, I bow my head to all the books that helped me come to terms with myself <...> I talk a lot about books because I learned a lot about people, about communication <...>"
			"<…> the more books you read, the more connection points you create in your brain <...>"

The remaining two methods mentioned by the research participants are self-reflection and practice (Table 24).

Research participants name self-reflection as a method that allows improving competences based on previous experiences, events or mistakes, which cannot cause one to stumble, but one needs to analyze and make decisions that will give a positive result in the future.

Practice as a learning method is defined as a guaranteed method to practice communication or programming skills.

Table 23. Categorization of other competence development methods.

Interview number	Category	Subcategory	Coded quotes
Interview 2	Methods to develop competencies	Self-reflection	"You must not stumble on every mistake <...> you must not stumble as a team and yourself, you must learn <...>"

Interview 3		Practice	"<…> there is a lack of someone who has gone through that process, because then it is much easier to make the right decisions <...>"
			"I think this is the most difficult and only learned through practice."
			"<…> now I usually present the idea <...> I have had experience with oratories <...>"
Interview 4		Self-reflection	"I look at my work practice, what we do, what works for us <...>"
			"<…> you make a mistake, you find out why, you wonder why you did that and if it was bad <…>"
		Practice	"<…> a lot of programming expertise comes on the job <...>"
			"<…> I develop communication by communicating <...> you go to talk, you try to find points of synergy <...>"
Interview 5		Self-reflection	"<...> when you don't know much, you just make mistakes and learn from them <...>"
			"<…> I'm asking how you could have done it differently, why did you do it <...>"
		Practice	"<…> others might think I'm relaxed, but I'm not, because I don't have that much practice <...> it would be easier, but I just don't have enough practice <...>"
			"<…> I prepare the text <...> and start practicing <...> I do it anyway, both while driving and on the bike <...> until I can't look anymore <...>"

In summing up all five interviews, research participants identified thirteen different competencies that are needed for entrepreneurs creating digital health care innovations. Based on the named competencies, the research participants presented the main methods of developing competencies.

4.1.3. The Connection between Competences and Their Development Methods

Analyzing the information collected during the semi-structured interview, thirteen competencies were identified that the research participants identified as necessary for a digital health care entrepreneur. Out of the thirteen competencies presented, three competencies were named by all participants of the study, therefore it is concluded that these competencies have the greatest importance in the creation of digital healthcare innovations. These competencies are communication, marketing knowledge and leadership.

The research participants presented seven competence development methods that they use in practice to develop competences.

Taking into account the main competences named by the research participants and the methods of their improvement, below are graphs that reflect the relationship between the competences and the methods of their development. The graphs visually reflect which competence development methods in practice are closest to the competence named by the research participants. The closer the distance between the competency and the development method, the more likely the digital healthcare entrepreneur will choose that particular competency development method.

Figure 14 presents the communication competence and the connections with the methods of improving this competence. It can be seen from the graph that Lithuanian digital health care entrepreneurs in practice improve their communication competence the most through three methods, which are reading, practice and networking.

The relationship between communication competence and reading method is reflected in the following quotes from research participants:

"<…> in this place, I bow my head to all the books that helped me come to terms with myself <...> I talk a lot about books because I learned a lot about people, about communication <...>"

"<…> came from books <...> good books that helped to understand how to maintain a good relationship <…>"

Communication competence and the connection between practice is reflected by:

"<…> others might think I'm relaxed, but I'm not, because I don't have that much practice <...> it would be easier, but I just don't have enough practice <...>"

"<…> I prepare the text <...> and start practicing <...> I do it anyway, both while driving and on the bike <...> until I can't look anymore <...>"

"<…> I develop communication by communicating <...> you go to talk, you try to find points of synergy <...>"

The method of improving communication competence and networking can be based on the fact that networking happens between people. Any connection between people, sharing of information or advice is based on communication:

"<…> we have acquaintances in all fields <...> one call and you already know the answer <…>"

"<…> like to learn something new <...> and communication with other people, networking is necessary <…>"

"<…> I ask people how you are doing. I ask another startup, how do you do it <...>"

The remaining competence improvement methods, which are online learning, feedback evaluation, mentoring and self-reflection, also have a connection with communication competence, but based on the information provided by the research participants, they are used less often.
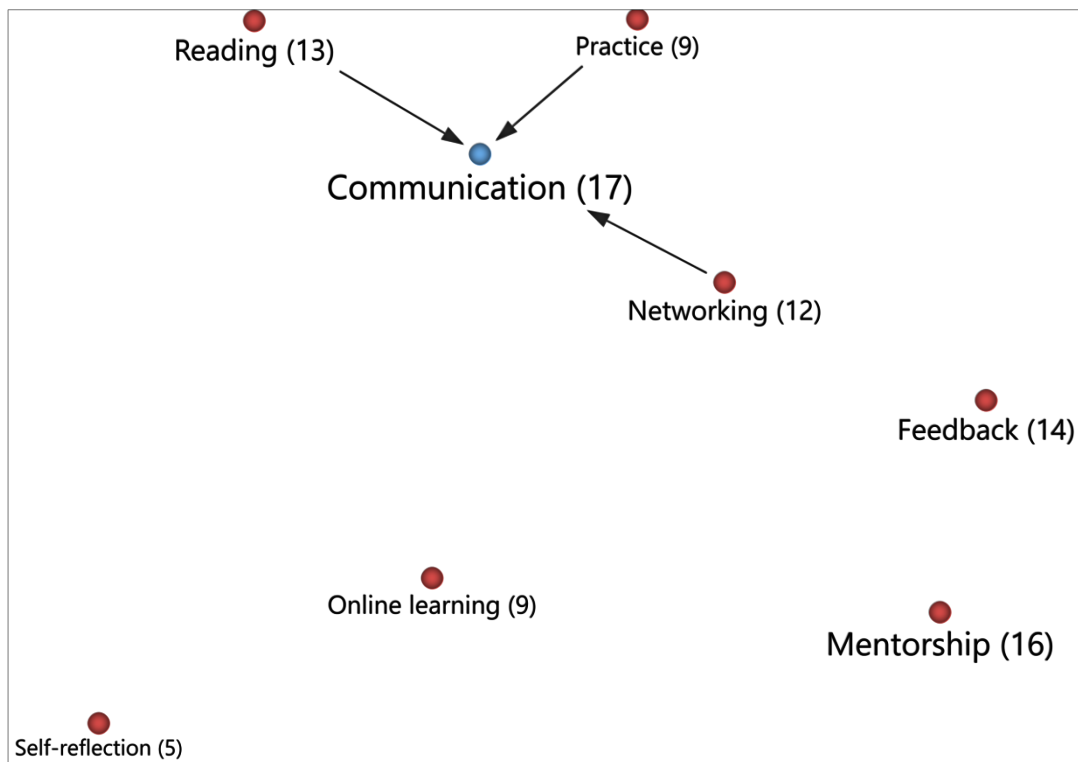
Figure 14. Map of communication competence and development methods.

Figure 15 shows the relationship between the competence of marketing knowledge and methods of competence development. It can be seen from the graph that the main methods of improving the competence of marketing knowledge are networking, mentoring and online learning.

The relationship between marketing knowledge competence and networking as a method of competence development is based on the following quotes from research participants:

"<…> we have acquaintances in all fields <...> one call and you already know the answer <…>"

"<…> I go through acquaintances and call. Just in the places where I get stuck, I try to get knowledge from somewhere who knows."

The connection between marketing know-how competence and mentoring is based on the opportunity to receive valuable information from a mentor who informs and advises on the most difficult issues of startup development:

"<…> everything is fine when you have a serious mentor <...> after going through that path, they just tell you what not to do, where not to go wrong <…>"

"We have <...> marketing specialists <...>"

"<…> we had too many mentors at that hackathon. Each mentor had an hour to talk to him and stuff like that. You clarify the idea with the mentors, they give you some kind of feedback <…>"

Using an online learning method to acquire marketing knowledge was also mentioned by the research participants:

"<…> during lectures we talk about creating a personal brand <...>

"<…> I needed someone to look at how to advertise <...> I basically learned through a "YouTube" video <...>"

"<…> just marketing <...> I basically learn it from <...> courses, podcasts <...>"

The graph also shows the relationship of other competence development methods, such as self-reflection, reading, feedback assessment and practice, with the competence of marketing knowledge. These methods are also used by research participants to improve their competence in marketing knowledge, but less often.
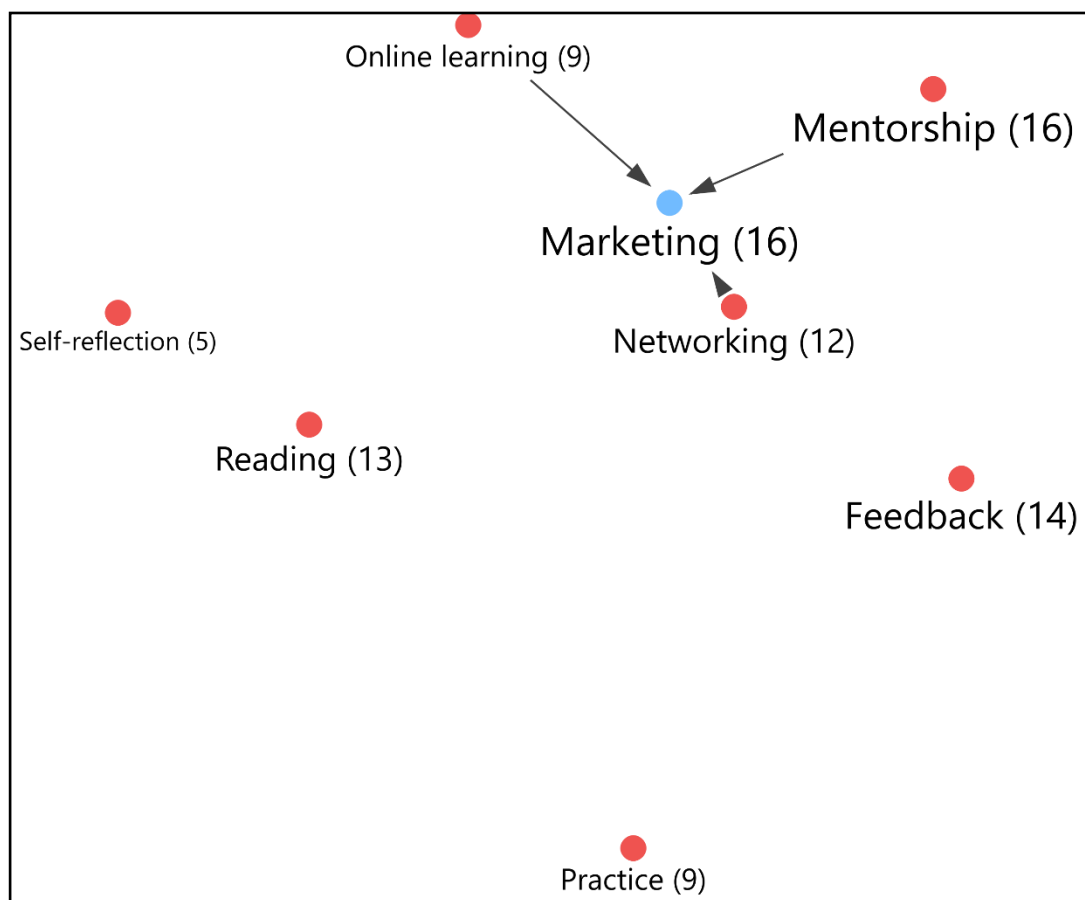

Figure 15. Map of marketing competence and development methods.

Figure 16 shows the relationship between leadership competency and competency development methods. It can be seen from the graph that Lithuanian digital health care entrepreneurs develop their leadership competence mostly through reading and practice methods.

The improvement of leadership competence by the reading method is based on the information obtained from the literature about the characteristics and behavior of the leader:

"<…> came from books <...> good books that helped to understand about leadership <…>"

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"<…> in this place, I bow my head to all the books that helped me come to terms with myself <...> I talk a lot about books because I learned a lot about people, about communication <...>" The development of leadership competence during practice is based on the experience gained in communicating with people over a long period of time:

"<...> understand about leadership <...> time also helps <...> you get to know people over a longer period of time and you better understand how to communicate with them, what motivates them <...>"

Competencies development methods such as self-reflection, networking, online learning or feedback assessment are also used to develop leadership competence, but less often, according to research participants.
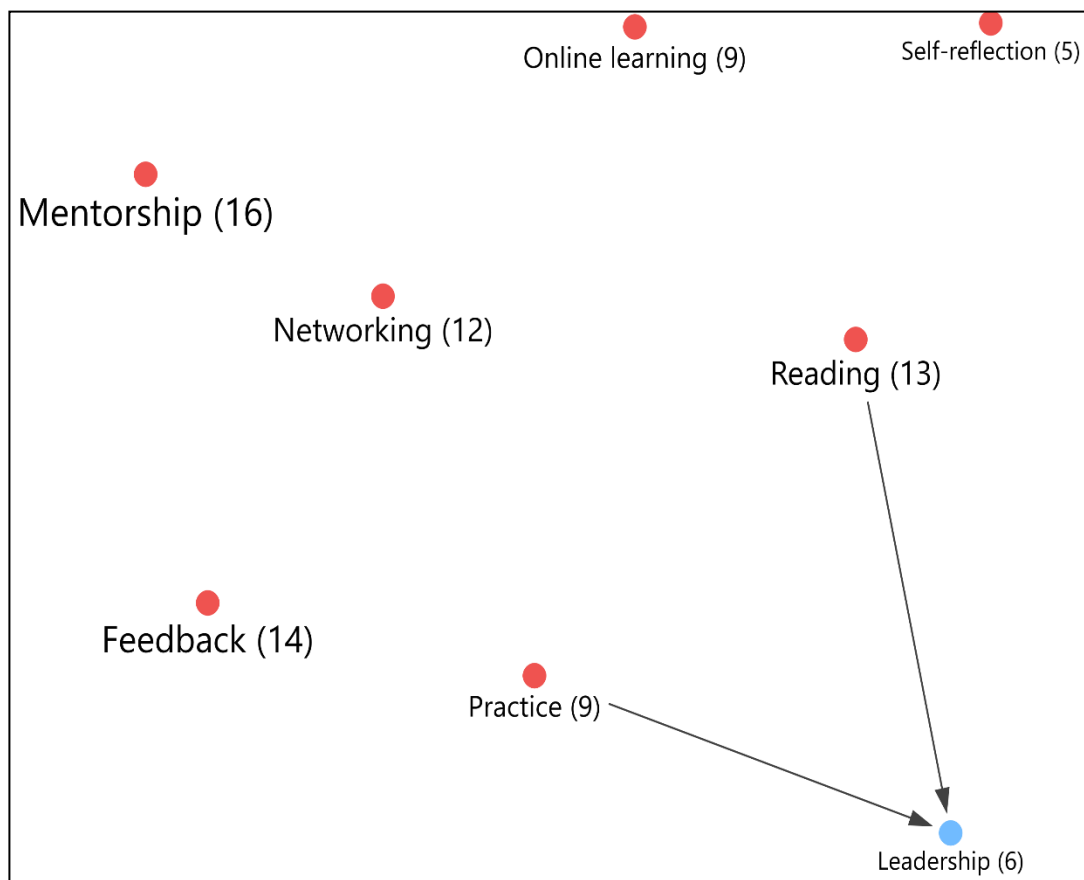

Figure 16. Map of leadership competence and development methods.

Figure 17 presents a code map that symbolizes possible improvement methods for the remaining competencies identified by the research participants. All competence development methods shown in the figure can be applied to the development of all competences identified by the research participants. The distance and distance arrows show which method, based on the analyzed information provided by the research participants, is likely to be chosen to develop a particular competency.
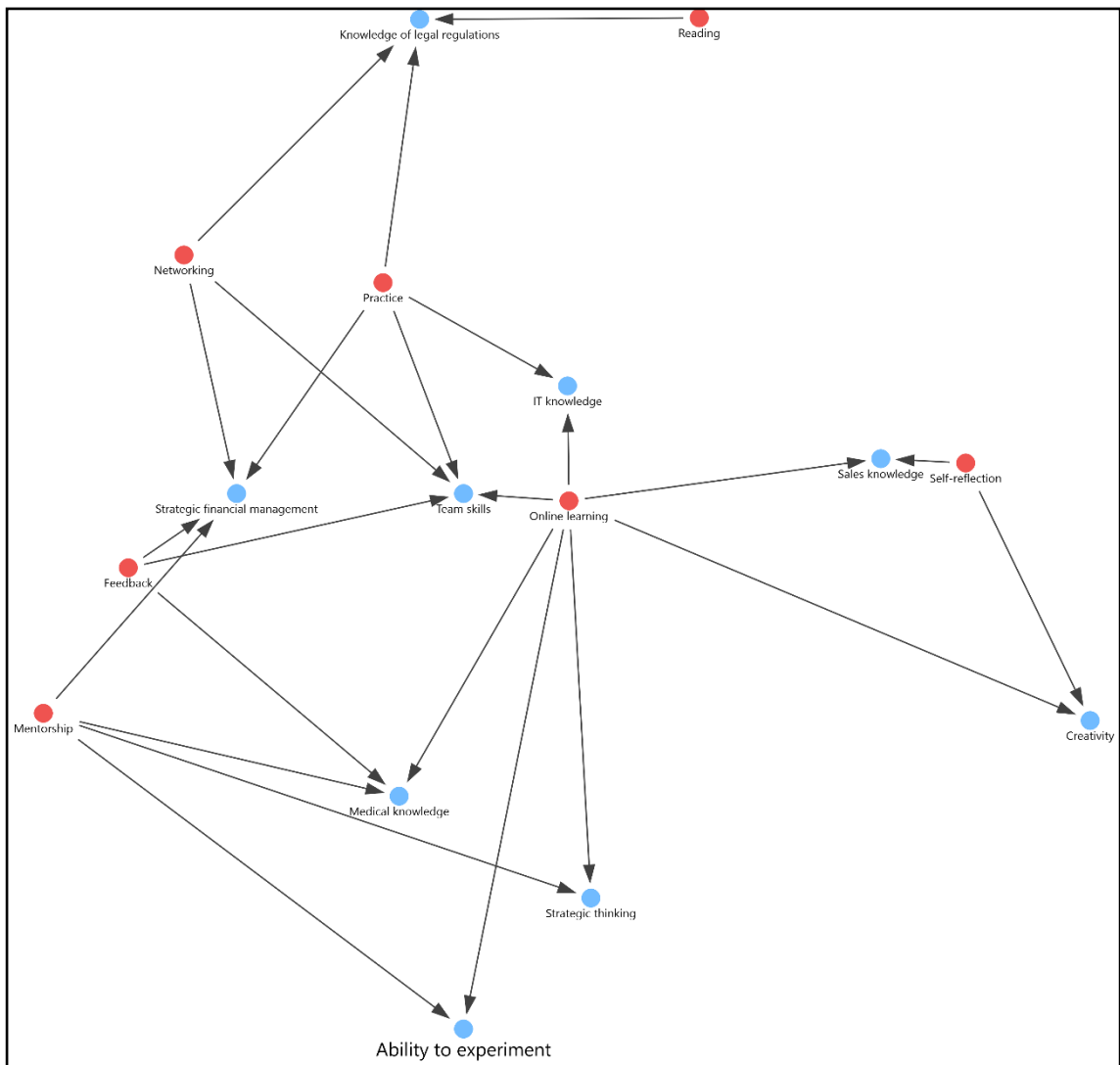
Figure 17. Map of other competencies and development methods.

The information in the figure shows that:

- In order to improve the competence of knowledge of legal regulation, the entrepreneur is most likely to choose the methods of reading, networking and practice.
- In order to improve IT knowledge competence, it is most likely that the entrepreneur will choose practice and online learning methods.
- In order to improve the competence of team skills, it is most likely that the entrepreneur will choose online learning, practice and feedback assessment methods.
- In order to improve the competence of strategic financial management, it is most likely that the entrepreneur will choose networking, feedback evaluation and practice methods.
- In order to improve medical knowledge competence, it is most likely that the entrepreneur will choose online learning, feedback assessment and mentoring methods.
- In order to improve the competence of strategic thinking, it is most likely that the entrepreneur will choose online learning and mentoring methods.
- In order to improve creativity competence, it is most likely that the entrepreneur will choose online learning and self-reflection methods.

- In order to improve sales knowledge competence, it is most likely that the entrepreneur will choose self-reflection and online learning methods.

Taking into account the results obtained during the study, Table 25 presents the competencies and possible methods of their improvement.

Table 24. A set of competencies identified during the research and possible methods of their development.

Competencies / Self directed learning methods	Creativity	Strategic thinking	IT knowledge	Sales knowledge	Medical knowledge	Strategic financial management	Market knowledge	Leadership	Team skills	Marketing	Knowledge of legal regulations	Ability to experiment	Communication
Self-reflection	X	X	X	X	X	X	X	X	X	X	X	X	X
Reading	X	X	X	X	X	X	X	X	X	X	X	X	X
Practice		X	X	X	X	X	X	X	X	X	X	X	X
Feedback		X	X	X	X	X	X	X	X	X	X	X	X
Networking		X	X	X	X	X	X	X	X	X	X	X	X
Mentorship		X	X	X	X	X	X		X	X	X	X	X
Online learning	X	X	X	X	X	X	X	X	X	X	X	X	X

"X" indicates that the specified competence is named and associated with a certain method of competence development. The link between the competence and the improvement method may be indirect, but during the semi-structured interview with the research participants, the adjacent links that connect the competence with a certain improvement method were observed and evaluated.

4.2. Recommendations on the Competencies and Their Development Methods for Digital Health Entrepreneurs

The result of the theoretical solution showed that digital health care entrepreneurs need such competencies as creativity, analytical thinking, market knowledge, strategic financial management, team leadership and technical knowledge.

In order to verify the necessity of these competencies, a qualitative study was conducted with Lithuanian digital health care entrepreneurs. During the research, the need for 13 competencies was identified, which include creativity, strategic thinking, knowledge of information technology, sales knowledge, medical knowledge, strategic financial management, market knowledge, leadership, team skills, marketing knowledge, knowledge of legal regulations, ability to experiment and communication.

The conducted qualitative research confirmed the need for such competences as creativity, market knowledge, strategic financial management and leadership identified during the theoretical decision.

Of all the competencies identified during the research, which are important for digital health care entrepreneurs, all research participants identified communication, leadership and marketing knowledge as the most important.

Based on the theoretical result and the result of the qualitative research, recommendations are made that the digital health care entrepreneur must consider the most important and necessary competencies in the process of developing digital health care innovations. The **most important competences are creativity, market knowledge, strategic financial management, leadership, communication and marketing knowledge.**

In order to acquire or improve these competencies, digital health care entrepreneurs should apply the self-directed learning method that is suitable for individual self-assessment of missing competence and management of the improvement process. Below are the competence development methods that were obtained as a result of the theoretical solution and verified by the practical experience of Lithuanian digital health care entrepreneurs.

As a result of the theoretical solution, eight competence development methods were determined, of which the most widely applied and used are online learning, reading, networking, mentorship and self-reflection.

The result of the research conducted on the competence improvement methods applied by Lithuanian digital health care entrepreneurs showed that the entrepreneurs who participated in the study apply seven methods to improve competences in practice, which are self-reflection, reading, practice, feedback, networking, mentorship, online learning.

Taking into account the result of the theoretical solution, which was checked with Lithuanian digital health care entrepreneurs, such **competence development methods as online learning, reading, networking, mentorship and self-reflection are recommended.** The result of the study showed that **practice and feedback assessment are also frequently used methods of competence development.**

Online learning, mentoring, feedback assessment and networking are the most applied and used of these competence development methods.

Methods such as self-reflection, reading and practice also play an important role in the competence development process, but their use, based on the case of Lithuanian digital health care entrepreneurs, is not so extensive.

However, after conducting a study of the competences of Lithuanian digital health care entrepreneurs and their improvement methods, it is important to mention that all the named competences and their improvement methods are typical of the research participants who took part in the study. Different digital healthcare entrepreneurs may face different needs for competencies and the applicability of the most appropriate methods to develop them. In order to provide more accurate recommendations that meet the need for competencies of digital health care entrepreneurs of a certain specialization and their improvement methods, the study should be refined with a target group of digital health care entrepreneurs.

Future research directions. The obtained result of the research reveals what basic competence needs are faced by digital health entrepreneurs and what methods they use to improve them. This provides an opportunity to carry out further and deeper research, with the help of which it would be possible to answer how much the possession of a certain competence gives a positive result in the development of digital health innovations, and vice versa, how much the lack of a certain competence gives a negative influence in the development of innovations in this field. With the help of further research, it would also be possible to assess the contribution of competence development methods obtained as a result of the research to the development of competence, in order to measure the practical effectiveness of the method in developing a certain competence.

Conclusions

1. After analyzing the problematic issue about the set of competencies of digital health entrepreneurs and their development methods, it can be stated that the literature does not provide clear guidelines on what competencies are necessary for digital healthcare entrepreneurs and what methods are best suited for the development of these competencies. The relevance of this problem directly affects the development of digital health innovations, which depend on the ability to control and prevent various diseases for the ever-growing number of people in the world. The problem part highlights important issues such as the ability to identify and bridge gaps between patients and health care providers. Also, the ability to ensure the supply of financial and other important resources, the ability to smoothly navigate the regulatory environment and the creation of partnerships that ensure a smooth and faster process of implementing an innovation for everyday use. All these challenges and issues require specific competences and abilities from entrepreneurs, who are usually at the forefront of creating and developing innovations in the field of digital health. After evaluating the contribution of digital health entrepreneurs to the creation of innovations in the field of medicine and the lack of structured information about the necessary competencies and their development methods, especially in the case of Lithuanian startups, there is a clearly visible problem, the solution of which would allow recommendations on the necessary competencies and their development methods for digital health entrepreneurs.

2. A theoretical review was carried out, during which a theoretically based set of competencies and methods of their improvement for digital health entrepreneurs were compiled. The set of competencies is composed of six competencies, which include creativity, analytical thinking, market savvy, strategic financial management, team leadership and technical knowledge. Together with the set of competences, a set of methods for developing competences is provided with literary sources, which consists of eight methods, such as brainstorming, opposing points consideration, logical games, online courses, reading, networking, mentorship and self-reflection. After evaluating the set of competences and their development methods, it can be concluded that certain competence development methods are more applicable than others. For example, methods such as online learning and reading are suitable for developing all competences obtained in the theoretical result, while the brainstorming method is only suitable for creativity competence, opposing point consideration and logical games methods are only suitable for developing analytical thinking competence. Networking, mentorship and self-reflection competence development methods are partially divided between suitability for developing a certain competence, but are widely applicable.

3. An empirical research methodology was developed, during which the aim was to investigate the competences necessary for Lithuanian digital health entrepreneurs and the applied methods for their development. Successful Lithuanian digital health entrepreneurs, whose created innovation performs an important and useful function in society, were invited to participate in the study. Five participants took part in the study, four of whom are founders and co-founders of startups developing digital health innovations and the founder of the Lithuanian health tech accelerator. The data required for the study were collected from the study participants during a semi-structured interview, following the pre-prepared question guidelines. Data were collected in compliance with confidentiality requirements. The collected data were transcribed and analyzed using the MAXQDA tool.

   After conducting interviews with successful Lithuanian digital health entrepreneurs, the most important competences that are required for creating digital health innovations were revealed. A

total of thirteen competences were identified, which Lithuanian digital health entrepreneurs are in need of, but three competences, which were named by all research participants, need to be singled out the most. These competencies are communication, marketing knowledge and leadership. Competence development methods used by Lithuanian entrepreneurs creating digital health innovations were also determined. A total of seven competence improvement methods were identified, but the analysis of the collected data showed that the most important of them are feedback analysis, networking, mentorship and online learning.

4. Recommendations are presented taking into account the set of competencies and methods of their development obtained during the theoretical result, which were tested in the case of successful Lithuanian digital health entrepreneurs. Based on these two results, it was determined that the most important competencies that a digital healthcare entrepreneur must have are creativity, market knowledge, strategic financial management, leadership, communication and marketing knowledge. The most acceptable and suitable methods for developing these competencies are online learning, reading, networking, mentorship, self-reflection, practice and feedback evaluation.

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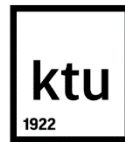
Appendices

Appendix 1. Link to interview transcripts

The transcribed data of the information collected in the interview is placed in the provided link. The data is provided in the link due to the large volume.

https://drive.google.com/drive/folders/19aFNmo4kIb0AjjxyGV2JwhHBLYcn57PI?usp=sharing

Appendix 1. Invitation to participate in the research

An invitation that was sent to digital health antepreneurs to participate in the study is presented. The invitation is written in Lithuanian, as the study was conducted with Lithuanian digital health entrepreneurs.

Figure 18. Invitation to participate in the research.