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SKILLS FOR *HEALTHTECH* ENTREPRENEURS

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ABSTRACT

Objective: To present a set of skills for healthtech entrepreneurs. **Method:** It is applied research, with a qualitative approach and exploratory objectives. The method used was Delphi. The study included the participation of 22 experts, who contributed to understanding the topic investigated. **Main Results:** The results present a set of 22 skills for healthtechs entrepreneurs, categorized into four groups: skills to work in health, skills for startups, skills to undertake in health and skills to innovate in health**. Relevance / Originality:** This study presents an integrated approach to skills in the field of health, innovation and startups. Another original contribution is the use of the Delphi method to study competencies in healthtechs. **Theoretical / Methodological Contributions:** Theoretical/ methodological contributions: This study presents a systematization of essential skills for healthtechs, advancing in relation to previous studies, as it addresses innovation, health and startups in an integrated way.

Keywords: Innovation, Startups, Skills, Health.

COMPETÊNCIAS PARA EMPREENDEDORES DE *HEALTHTECHS*

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RESUMO

Objetivo: Apresentar um conjunto de competências para empreendedores de *healthtechs*. **Método:** É uma pesquisa de natureza aplicada, com abordagem qualitativa e objetivos exploratórios. O método empregado foi o *Delphi*. O estudo contou com a participação de 22 especialistas, os quais contribuíram para compreender a temática investigada. **Principais Resultados:** Os resultados apresentam 22 competências para empreendedores das *healthtechs*, categorizadas em quatro grupos: competências para atuar na saúde, competências para atuar em *startups*, competências para empreender na saúde e competências para inovar na saúde. **Relevância / Originalidade:** Este estudo apresenta uma abordagem integrada das competências no campo da saúde, inovação e startups. Outra contribuição original é o uso do método *Delphi* para estudar competências em *healthtechs*. **Contribuições Teóricas / Metodológicas:** Este estudo apresenta uma sistematização de competências essenciais para *healthtechs*, avançando em relação aos estudos anteriores, pois aborda inovação, saúde e startups de forma integrada.

Palavras-chave: Inovação, *Startups*, Competências, Saúde.

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INTRODUCTION

Competence is the individual's ability to solve a specific problem and achieve their goals, resulting in outcomes for the organization (Hamad, 2020). When it comes to innovative ventures, such as healthtechs, competencies focused on innovation are crucial in enhancing the innovation capabilities of these ventures (Dionello et al., 2020).

Competencies for innovation and their methods of development and measurement in specific areas are underexplored in the literature (Ferreras-Garcia et al., 2021; Keinänen et al., 2018; Marín García et al., 2013; White et al., 2016). They pertain to a set of competencies necessary for individuals to enable the creation of something new, such as creativity, critical thinking, initiative, teamwork, and networking (Andreu-Andrés et al., 2018; Hamad, 2020).

Innovation habitats are environments designed to support the growth of companies focused on innovation. As one of these habitats, startups are enterprises characterized by high degrees of innovation and technology, operating in the market to transform ideas into products. Unlike traditional companies, startups are temporary organizations aiming for a business model that is scalable, profitable, and lucrative (Blank & Dorf, 2014).

In Brazil, the advancement of healthtechs is notable, representing the third-largest segment of startups in the country and reflecting a growing demand for innovative solutions in healthcare (Associação Brasileira de Startups, 2022). According to the Brazilian Association of Startups (Abstartups), this sector has seen the highest volume of financial transactions in recent years (150 operations totaling over R$20 billion (Associação Brasileira de Startups, 2022).

This growth is evident in healthtechs, which emerge as an entrepreneurial opportunity where innovation is used to enhance services and products in the healthcare sector. To fulfill this purpose, healthtechs seek knowledge beyond their domains to develop competencies (Martins, 2020).

Healthtechs offer a range of benefits, including improved efficiency, cost reduction, and increased customer satisfaction, as well as enabling basic and secondary care in underserved areas (OCDE, 2020). This business model has demonstrated the ability to foster innovations that address challenges such as high costs and inefficient use of scarce resources through technology (Chakraborty et al., 2021).

An investigation conducted in the *Scopus* and *Web of Science* databases provided insights into the landscape of research related to competencies for innovation in healthtechs. Using the search term "healthtech" on the *Web of Science* database yielded 456 results, of which only 325 were scientific articles, including articles with early access. Similarly, the *Scopus* search resulted in 116 documents, of which 69 were scientific articles. The titles of the 394 scientific articles were read, and none of them specifically addressed competencies. Among those closest to the theme, one article was identified on physician leadership (Raj, 2021) and another on critical success factors for healthtechs, such as actor knowledge process and communication, service value and effectiveness, robust technological infrastructure, revenue generation capability, and regulatory management capability (Chakraborty et al., 2021). Most studies focused on specific techniques, particularly in the field of medicine. While research on competencies in the healthcare sector was identified (Perez et al., 2021; Peruzzo et al., 2020; Vieira et al., 2019), it was not specifically focused on startups. Therefore, given the importance of healthcare and the growth of healthtechs, coupled with the scarcity of competency studies, it was decided to explore them in this research.

Therefore, due to the relevance of developing specific competencies for these innovative ventures (Dionello et al., 2020), this research aims to answer the following question: what innovation competencies are necessary according to the perception of healthtech entrepreneurs? Thus, the research aims to present a set of competencies for healthtech entrepreneurs, providing a theoretical contribution by systematizing essential competencies for startups operating in the healthcare sector. Whether in the field of competencies, healthcare, or innovation, previous studies have not specifically addressed this issue, linking competencies to innovation, healthcare, and startups.

Another theoretical contribution is the use of the Delphi method to study healthtech competencies, providing an analysis of competencies in the sector studied not only through theory but also by entrepreneurs active in this field. As a practical contribution,

competencies for healthtechs can assist these entrepreneurs in enhancing their competencies, according to those presented in this study. This can increase their chances of internationalization and expanding their activities. Additionally, this study can serve as a benchmark for policymakers in innovation within the healthcare sector.

This article is structured as follows: the next section presents the theoretical foundations of this research. The subsequent section details the methodological aspects that underpinned this study, followed by the presentation of the achieved results and discussion. Finally, concluding remarks are provided, followed by the references.

1. CONSIDERATIONS ON COMPETENCIES

In general terms, competence refers to the set of human abilities that encompass knowledge, abilities, and attitudes, which in turn justify high performance based on intelligence and personality (Fleury & Fleury, 2001; Hamad, 2020; Marín García et al., 2013; Montero-Fleta, 2013). According to Man and Lau (2000), competence relates to characteristics that include various personality traits, abilities, and knowledge influenced by individual experiences, education, training, and personal life.

The literature presents competencies in two spheres: individual and organizational. Individual competence can be defined as responsible action by an individual who translates their knowledge into results, thereby enabling problem-solving and task execution (Pranciulytė-Bagdžiūnienė & Petraitė, 2019). On the contrary, organizational competencies refer to the application of individual competencies to organizational activities. Individuals within organizations use their competencies to create value, both internally and externally, for the company. It is important to note that competence is only truly recognized when it generates value for the organization or society (Fleury & Fleury, 2001; Gomes Júnior, 2013). Value creation occurs when individuals develop their competencies, share them, and thereby increase their knowledge and improve their competencies through the co-creation of knowledge with the team (Sveiby, 2000).

Although competencies are inherent to individuals, they need to be aligned with job demands to foster a dynamic of sharing, creating, and transforming individual competencies that strengthen organizational competencies. Therefore, organizations need to take responsibility for developing teams with the necessary competencies to achieve their goals (Stefano et al., 2020).

It is the competencies of individuals that enable organizations to solve problems and create innovative solutions (Stefano et al., 2020), with individual competencies leading to the development of organizational competencies (Cassol et al., 2017; Oliveira et al., 2019). Companies dealing with innovation, such as those in the technology sector, require specific competencies (Alves Filho et al., 2019), which will be discussed next.

1.1. Competencies for innovative companies

The competencies for innovation can be presented in three dimensions: individual, interpersonal, and network (Ferreras-Garcia et al., 2021; Keinänen et al., 2018; Marín García et al., 2013). In the individual dimension, abilities such as creativity, perseverance, divergent thinking, and attitude emerge, abilities that assist in the innovation process, since creating ideas is not the same as applying them. Thus, it is necessary to be able to deal with different unforeseen events and problems that require innovative thinking and reactions to overcome difficulties. The interpersonal dimension is related to teamwork, leadership, and communication. In the network dimension, it is possible to build collective ideas, create cooperation networks for innovation, establish cooperation in multidisciplinary and multicultural contexts, and work with local, regional, and international enterprises (Ferreras-Garcia et al., 2021; Keinänen et al., 2018; Marín García et al., 2013).

From another perspective, Noronha et al. (2022) mapped the competencies of startups in the literature and identified eight groups: (1) market competence; (2) construction and reconfiguration competence; (3) innovation competence; (4) networking competence; (5) digital competence; (6) technological competence; (7) leveraging competence; and (8) expansion competence. They also identified that these competencies are mentioned for the exploration of international markets.

Innovative environments need to demonstrate openness to obtain insights, the ability to gener-

ate ideas, the promotion of creative solutions, as well as facilitating interpersonal relationships, conflict management, and the link between managerial competencies and creativity (Alves Filho et al., 2019). Innovative companies need to transform knowledge into innovative ideas (Keinänen et al., 2018; Oliveira et al., 2011; Pranciulytė-Bagdžiūnienė & Petraitė, 2019).

Additionally, in their management process, leadership, market vision of the business, and attention to internal communication within the company are important. The development of innovative projects requires abilities and competencies associated with negotiation, teamwork, and conflict resolution (Alves Filho et al., 2019; Malec & Stańczak, 2022). To transform knowledge into innovative ideas (Hsiao et al., 2019; Keinänen et al., 2018; Oliveira et al., 2011; Pranciulytė-Bagdžiūnienė & Petraitė, 2019), technology-based companies need creativity, critical thinking, quick learning, initiative, teamwork, resilience, and networking (Andreu-Andrés et al., 2018; Pranciulytė-Bagdžiūnienė & Petraitė, 2019; Toyin & Modupe, 2023).

The management process of innovative projects requires abilities in negotiation, evaluation of the commercial potential of innovations, the development of an operational plan, and the organization of innovation activity management, as well as the management of all phases of the innovation project, working with partners, and controlling measures to promote innovations in the market (Kurmanov et al., 2021; Toyin & Modupe, 2023).

In the context of technology-based companies, the use of digital technologies is relevant, as they contribute to establishing a complex and nonlinear relationship of interdependence between these technologies and abilities, with both co-evolving (Ciarli et al., 2021). Developing digital competencies for these companies is important for internationalization and expansion (Cahen & Borini, 2020). Besides the use of technologies, the development of new ideas requires external knowledge, such as from suppliers, universities, customers, consulting firms, competitors, external inventors, research institutes, and the so-called brokers (Salter et al., 2014). Therefore, innovators need to stay updated with market and technological changes (Alves Filho et al., 2019).

It is also important to emphasize that technology-based companies are susceptible to internationalization, and in this regard, Kurmanov et al. (2021) consider that writing and negotiation abilities, proficiency in foreign languages and cultures, ethics, presentation abilities, and the ability for multifunctional and interdisciplinary interaction are important.

Table 1 summarizes the competencies for innovation mentioned by the authors.

It is worth noting that each organization will require distinct abilities that will complement the competencies mentioned in Table 1, thus forming a set of abilities necessary for the performance of organizational activities (Andreu-Andrés et al., 2018).

1.2. Competencies for innovating in health

Competencies are understood as a set of knowledge, abilities, and attitudes essential for managers working in the healthcare sector (Peruzzo et al., 2020). According to Peruzzo et al. (2020) and Perez et al. (2021), strategies are needed to develop managers in health services, aiming to improve their management capabilities, given that competencies in health directly impact the efficiency of processes, the quality of care provided, as well as patient satisfaction and the effectiveness of health policies (Perez et al., 2021; Peruzzo et al., 2020).

Competencies for innovation are crucial to overcoming the challenges present in health management (Ferreras-Garcia et al., 2021; Keinänen et al., 2018; Marín García et al., 2013). Chakraborty et al. (2021) highlight the need for new forms of health management and the integration of informational technologies.

Human and material resources are fundamental for healthtechs, which are innovating in traditional areas such as hospital management and electronic medical records (Chakraborty et al., 2021). The COVID-19 pandemic accelerated the development and adoption of technological solutions in healthcare, such as telemedicine (Pereira et al., 2021). Technological transformation is revolutionizing how healthcare is managed and delivered, with benefits such as smarter decision-making, time optimization, and improved quality of care (Araujo et al., 2024). Beyond telemedicine, other digital technologies are being applied in healthcare, including the Internet of Things, blockchains, additive manufacturing, big data, artificial

Table 1. Innovation competencies.

Competence	Concept
Creativity, development of new ideas, and critical thinking	They are considered the most relevant component of the competence for innovation since a different perspective is necessary for problem-solving, through which it is possible to visualize diverse scenarios, combine ideas, make analogies, recognize possible meanings that are not obvious, and thus overcome apparent limits.
Leadership, teamwork, and conflict management	The innovation competence is highly dependent on leadership abilities, since no innovation occurs in isolation, requiring the mobilization of specialists and the collaboration of those involved in the process so that organizational objectives are achieved.
Creative self-efficacy	It is the belief in oneself demonstrated by the individual concerning their knowledge, abilities, and attitudes (competencies) necessary to solve a given task; it is the degree of confidence demonstrated by the person to solve problems creatively.
Persistence and resilience	To develop an innovation activity, a clear vision of the destination is necessary, which requires persistence, proactive behavior, vigor, commitment, motivation, and willingness.
Network building	Networks foster cooperation and enable people to identify and explore opportunities, in addition to favoring the expansion of knowledge and internationalization.
Calculated risk propensity	In organizations, problems are ambiguous, complex, and lack a clear answer, and risk avoidance can make people reluctant regarding the innovation process, thus, people who are more willing to take risks are more likely to innovate.
Ability to solve ambiguous and complex problems	A person's willingness to innovate comes from a shift in a complex and ambiguous web of problems. The capacity to innovate is cultivated when that person is challenged by an issue marked by ambiguities and unsolved difficulties.
Digital and cultural competencies	Technology-based companies need to incorporate digital resources into their activities and are more likely to internationalize, so they need to develop cultural competencies.

Source: Prepared by the authors based on Cahen and Borini (2020), Ferreras-Garcia et al. (2021), Kurmanov et al. (2021), Ovbiagbonhia et al. (2019), and Salter et al. (2014).

intelligence, cloud computing, and augmented and virtual reality (Ciarli et al., 2021).

Technology companies operating in healthcare, such as healthtechs, need to handle unforeseen events and promote innovative thinking, teamwork, leadership, and effective communication while maintaining internal control and continuous monitoring and improvement (Chakraborty et al., 2021). These companies need to cultivate a culture that promotes creativity, collaboration, and adaptability (Pereira et al., 2021).

Other competencies in the healthcare field include resource administration and management, knowledge of healthcare, interpersonal communication, and leadership (Perez et al., 2021; Peruzzo et al., 2020).

Vieira et al. (2019) identified a set of 20 technical competencies for the healthcare sector, distributed across five thematic axes: economy and demography; health policy, planning, and evaluation; workforce management and health education; administration and accounting; and structural methodologies. Among the technical competencies, the authors identified the knowledge of health policies, economics, and health education, as well as health planning and evaluation. Regarding behavioral competencies, ethics, teamwork, resilience, and interpersonal relationships stand out. In the case of healthtechs, entrepreneurial competencies are also important due to the significant role of entrepreneurs in these companies.

Cualheta et al. (2020) proposed a measurement framework for entrepreneurial competencies, analyzing five factors: (a) competencies for developing business models; (b) competencies for sales and risk-taking; (c) competencies to identify opportunities; (d) competencies for accepting mistakes; and (e) teamwork competencies.

Thus, competencies for healthtechs encompass competencies for innovative companies and companies aiming to internationalize, as well as specific entrepreneurial competencies in the healthcare field. They all play a crucial role in the ability to deal with

the complex challenges and transformative opportunities provided by technology. By developing and strengthening these competencies, professionals and organizations can not only address current challenges but also thrive in an ever-evolving environment with increasing demand.

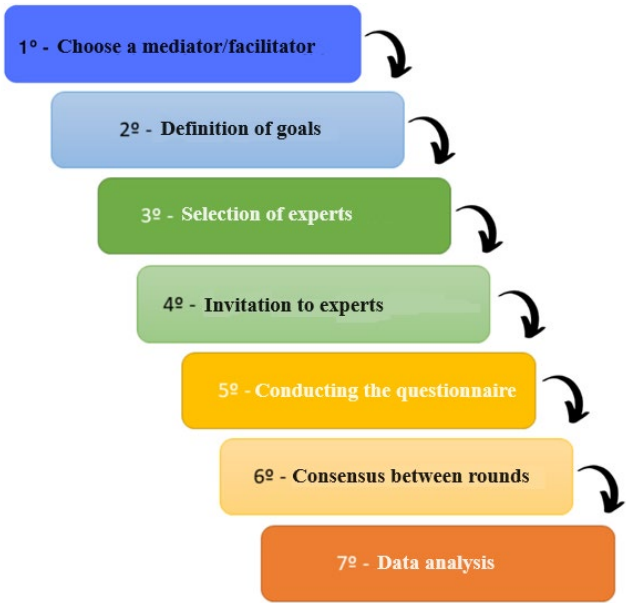
2. METHODOLOGICAL PROCEDURES

This is an applied research with a qualitative approach and exploratory objectives, supported by a literature review and the implementation of the Delphi method.

The Delphi method was conducted to achieve consensus among a group of experts through rounds of questionnaires interspersed with feedback, regarding which competencies are relevant for working in healthtechs. Delphi provides a structured way to facilitate effective group communication and enable individuals to address complex issues (Linstone & Turoff, 2002). It is a systematic technique for collecting expert opinions and scientifically validating them (Meyrick, 2003; Munaretto et al., 2013; Wright & Giovinazzo, 2000). In the medical field, this method has been widely used to estimate the need and feasibility of research initiatives, as well as to use historical data to determine disease incidence and the success rate of various treatments (Linstone & Turrof, 2002).

There are several phases to conducting the Delphi method in research. Costa (2021), Haughey (2010), Marques and Freitas (2018), and Skulmoski et al. (2007) indicate seven essential steps: (1) selection of a mediator responsible for contacting experts, sending questionnaires, analyzing data, and providing feedback; (2) clear establishment of the research problem and objectives; (3) selection of experts; (4) invitation of experts to participate in the research (after a brief explanation); (5) conducting rounds of questionnaires and providing feedback between rounds; (6) seeking consensus in two to four rounds of consultation, aiming for 75% agreement; and (7) data analysis and preparation of the final report after consensus has been established. These steps are represented in Figure 1.

In the first stage of the Delphi method (the choice of mediator), the researchers facilitated the method, being responsible for contacting the experts, sending out the questionnaires, conducting data analysis,



Source: Prepared by the authors (2023).
Figure 1. Delphi method steps.

and providing feedback between rounds. In the second stage, the objectives were determined according to the aim of this research, which is to present a set of competencies for innovation for entrepreneurs in healthtechs. Furthermore, in the third stage (selection of experts to participate in the questionnaire rounds), a search was conducted on Google using the terms "healthtechs in Paraná," "healthcare startups in Paraná," and "healthtechs in the state of Paraná." In this search, five healthtechs were identified, in addition to the website startupbase.com.br, where it is possible to filter startups by segment and state, including 29 healthtechs located on this website, totaling 34 healthtechs from Paraná.

In the fourth stage (invitations to the experts), an email was sent to the 34 identified healthtechs in Paraná from the previous step, inviting them to participate in the questionnaire rounds; 22 responded positively, and, therefore, 65% of healthtech entrepreneurs agreed to participate in the first round of questionnaires. The second round of questionnaires involved 20 of these entrepreneurs, as two did not respond to the contacts made.

For the fifth stage, conducting the questionnaire, initially, this instrument was developed based on competencies identified in the literature and contributions from healthtech entrepreneurs and researchers from higher education institutions (HEIs) involved

in Graduate Programs in health and/or innovation. They were invited to participate in interviews to provide information for questionnaire development. This stage involved seven healthtech entrepreneurs and five researchers. According to Minayo and Costa (2018), interviewees can provide subjective information and perceptions that constitute their representation of reality, expressed through opinions, behaviors, ideas, and actions, which help in understanding the investigated reality.

To select researchers, a search was conducted on the websites of two *stricto sensu* Graduate Programs in Paraná state, one in the health field from a private institution and another in the innovation field from a public institution. The choice of these programs was based on intentional selection, where, according to Saunders and Townsend (2019), researchers intend to select participants and therefore seek people with specific profiles based on their judgment, aligned with the research problem. Subsequently, the curriculum vitae of researchers affiliated with these programs were analyzed to verify if their research focus aligned with the objectives of this study. Five researchers were selected, two from the health field and three from the innovation field. An email was then sent to these researchers requesting their participation in the study, and all responded positively. In total, 12 individuals participated in the interview for questionnaire development (five researchers and seven healthtech entrepreneurs).

The interviews were scheduled in advance and conducted remotely via Google Meet in November 2022. A script composed of four questions was used: (1) Based on your experience, what competencies are needed to work in the healthcare field? (2) Based on your experience, what competencies are needed to work in a startup? (3) Based on your experience, what competencies are needed to undertake entrepreneurship in the healthcare field? and (4) Based on your experience, what competencies are needed to work with innovation in healthcare?

The interviews with the 12 experts were transcribed, totaling 21 pages. Through thematic analysis of this data, a set of 34 competencies was identified, and categorized into four groups: (a) five competencies for working in the healthcare field; (b) seven for working in startups; (c) nine for entrepreneurship in healthcare; and (d) 13 for working with innovation in healthcare, as systematized in Figure 2.

Subsequently, based on the competencies identified in the literature and indicated by healthtech entrepreneurs and researchers from HEIs, the first questionnaire for the Delphi process was developed using Google Forms. It was structured into five sections with 14 questions, including (a) six open-ended questions related to identifying the startup and the

Working in the healthcare sector in general	Working at a startup	Entrepreneurship in the health sector	Working with innovation in healthcare
- Empathy - Ethics - Technical training - Humanization - Teamwork	- Creativity - Discipline - Empathy - Focus on results - Fluent English - Emotional intelligence - Proactivity	- Legal understanding - Enthusiasm - Experience in healthcare - Negotiation - Persistence - Proactivity - Interpersonal relationship - Resilience - Market vision	- Communication - Creativity - Abilities with technological tools - Leadership and social influence - Negotiation - Business networking - Disruptive thinking - Persistence - Proactivity - Interdisciplinary relationships - Complex problem-solving - Teamwork - Market vision

Source: Prepared by the authors (2023).

Figure 2. Competencies identified in the interviews.

survey respondent; (b) four Likert scale questions asking respondents to rate the importance level of competencies needed for each of the four categories—working in healthcare, working in startups, entrepreneurship in healthcare, and innovation in healthcare; and (c) four open-ended questions asking respondents to indicate if there were any competencies considered necessary that were not listed in each category.

The Likert scale used in the affirmative questions ranged from 1 (not important) to 5 (very important). Likert scales are designed to measure attitudes or opinions, traditionally using five points to assess the intensity of agreement or disagreement with a set of statements (Antonialli et al., 2016). This questionnaire was emailed to the 22 healthtech entrepreneurs who accepted the invitation to participate in the research, as part of the fourth stage of the method.

Based on the results of this first questionnaire, a second questionnaire containing graphical feedback (Appendix 1) from the first round was developed subsequently using Google Forms and sent via email to the 22 healthtech entrepreneurs. This questionnaire consisted of eight questions: four closed, dichotomous questions asking whether the entrepreneurs agreed or disagreed with the competencies listed in each category and four open-ended questions asking respondents to provide any criticism or suggestions regarding the order of importance of the competencies listed. A total of 20 healthtech entrepreneurs responded to this questionnaire.

The sixth stage of the Delphi method (consensus between rounds of consultation with healthtech entrepreneurs) was executed following the method's recommended percentage, i.e., a minimum of 75% agreement for each competency listed in the questionnaire. If this threshold was not met, the competency would be disregarded for the next round of questionnaires. Two rounds were necessary to establish consensus among healthtech entrepreneurs. As stated by Gallego et al. (2008), the more rounds conducted, the slower the convergence among experts. Other studies (Lima et al., 2008; Linstone & Turoff, 2002; Munaretto et al., 2013) that utilized the Delphi method confirm that the recommended number of rounds is typically two or three.

Finally, in the seventh and last stage of the Delphi process (analysis of data obtained from conducting the method), the results from the first questionnaire were exported to a *Microsoft Excel* spreadsheet, and numerical values were assigned to each level of importance on the Likert scale, as shown in Table 2. This numerical assignment was necessary to identify the percentage of importance level for each competency investigated.

To establish consensus on each competency from the first questionnaire, it was considered that at least 75% of the experts should rate it as important or very important. The results were presented using column charts, which are simple and efficient in demonstrating outcomes (Loch, 2006).

The analysis of the second questionnaire data involved verifying expert consensus regarding the results obtained from the first questionnaire. Consensus was also established when 75% of the experts agreed with the list of suggested competencies.

Finally, it should be noted that this research was approved by a research ethics committee to safeguard the dignity, rights, safety, and well-being of the research subjects. Participants were provided with an Informed Consent Form, outlining ethical aspects such as participant confidentiality, anonymity assurance, and voluntary participation in the research.

3. RESULTS AND DISCUSSION

The results from the first and second rounds of the Delphi method are presented in the following subsections.

3.1. Delphi method: first round

Healthtechs have been in operation for a maximum of 5 years, have only a few employees, and primarily offer solutions in the well-being segment

Table 2. Numerical value assigned to Likert scale importance levels.

Importance level	Numerical value
Not important	0.00
Of little import	0.25
Reasonably important	0.50
Important	0.75
Very important	1.00

Source: Prepared by the authors (2023).

for individuals. Their founders are between 20 and 29 years old and have academic backgrounds in various areas outside of health.

3.1.1. Competencies to work in healthcare

To understand the viewpoint of healthtech entrepreneurs regarding the importance of competencies needed to work in healthcare, they were asked to indicate the level of importance of the following competencies: empathy, ethics, technical training, humanization, and teamwork. The results show that all five competencies were considered very important. There was unanimity regarding ethics being a very significant competency for working in healthcare. Table 3 shows the research results with healthtech entrepreneurs for competencies evaluated as important and very important, along with their respective percentages.

As seen in Table 3, there was consensus among healthtech entrepreneurs regarding competencies to work in healthcare, which is closely related to the services provided in this field. Cangussu et al. (2020) explain that humanization in healthcare involves a resurgence of caring methods that respect the basic principles of ethics and patient rights. Empathy, according to these authors, is necessary in teamwork to share knowledge and provide quality service to patients.

Regarding teamwork, Peduzzi et al. (2020) point out that it involves collaborative interprofessional practice that contributes to improving quality access to healthcare, with the potential to achieve better outcomes in patient care for families and the community.

3.1.2. Competencies to work in startups

To understand the viewpoint of healthtech entrepreneurs regarding the importance of competencies needed to work in startups, they were asked to indicate the importance level of the following competencies: creativity, discipline, empathy, results orientation, fluent English, emotional intelligence, and proactivity. Table 4 shows the research results with healthtech entrepreneurs for competencies assessed

Table 3. Percentage of competencies to work in healthcare.

Competencies	Competencies assessed as important or very important (%)
Humanization	100
Ethics	100
Empathy	100*
Technical training	95
Teamwork	82

*Very important.
Source: Prepared by the authors (2023).

Table 4. Percentage of competencies to work in startups.

Competencies	Competencies assessed as important or very important (%)
Discipline	100
Proactivity	100
Focus on results	95
Emotional intelligence	95
Creativity	91
Empathy	68
Fluent English	50

Source: Prepared by the authors (2023).

as important and very important, along with their respective percentages.

The data from Table 4 show consensus among healthtech entrepreneurs regarding creativity, discipline, focus on results, emotional intelligence, and proactivity as necessary competencies for working in startups, whereas consensus was not reached regarding empathy and fluency in English. For 50% of the participants, fluency in English is not necessary for working in startups, and for 32%, empathy is not essential. However, this result does not imply that empathy is not important in startups, but rather that its importance is perceived to be lower compared to the other competencies listed. Fluency in English was mentioned in the interviews as a necessary competency if the startup intends to expand its business to other countries.

Proactivity and creativity are essential competencies for working in startups, as these are innovative enterprises that undergo constant changes. Authors like Ferreras-Garcia et al. (2021) and Ovbiagbonhia et al. (2019) emphasize that creativity is a key competency for innovation, making it particularly relevant in this type of venture. On the contrary, discipline is essential for any enterprise. A disciplined person follows orders, methods, or rules, synonymous with being orderly, methodical, organized, and systematic (Disci, 2023).

Emotional intelligence refers to an individual's ability to manage their emotions and reflect on regulating these emotions for emotional and intellectual growth (Costa et al., 2023). Lastly, focus on results pertains to the ability to coordinate efforts to achieve objectives and goals; however, to attain the expected outcome, there must be an initial focus, an origin for action (Rahn, 2017).

3.1.3. Competencies for entrepreneurship in healthcare

To understand the viewpoint of healthtech entrepreneurs regarding the importance of competencies needed for entrepreneurship in healthcare, they were asked to indicate the level of importance of the following competencies: legal understanding, enthusiasm, experiences in healthcare, negotiation, persistence, proactivity, interpersonal relationships, resilience, and market vision. The results show that these nine competencies were considered very important. Table 5 presents the survey results with the competencies rated as important and very important, along with their respective percentages.

The results presented in Table 5 show that there was consensus among healthtech entrepreneurs that proactivity, resilience, market vision, persistence, and interpersonal relationships are necessary competencies for entrepreneurship in healthcare. This consensus did not occur regarding negotiation, enthusiasm, experience in healthcare, and legal understanding. The competencies that achieved consensus are generally essential for any entrepreneurship, not just those in healthcare. As Braum and Nassif (2018) assert, for an entrepreneur to achieve their goals and take risks when launching a new product, they need creativity and market vision for new businesses. Additionally, proactive potential in actions assists in advancing professional practices (Richter et al., 2019),

Table 5. Percentage of competencies to undertake in health.

Competencies	Competencies assessed as important or very important (%)
Proactivity	100
Resilience	100
Market vision	100
Persistence	95
Interpersonal relationship	95
Negotiation	68
Enthusiasm	64
Experience in healthcare	63
Legal understanding	59

Source: Prepared by the authors (2023).

and resilience is considered decisive because, without it, an entrepreneur might abandon the business during crises.

As for interpersonal relationships, Eloia et al. (2019) emphasize their importance in healthcare work to establish healthy bonds that generate positive feelings and facilitate harmony among people. Persistence is also considered a competency for entrepreneurship, as due to the difficulties in starting a business, entrepreneurs need to remain persistent in pursuing their goals. Sánchez-García and Suárez-Ortega (2017) mention that persistence is related to not giving up in the face of obstacles posed to one's business and striving to achieve established goals.

Regarding the competencies that did not achieve consensus among healthtech entrepreneurs, namely negotiation, enthusiasm, experience in the healthcare sector, and legal understanding, 68% of the survey participants indicated that negotiation is important or very important. This is justified as negotiation is a competency linked to entrepreneurship. Negotiation is a relevant factor for business development, as entrepreneurs do not work alone and there is a need to establish partnerships. Therefore, it is essential to understand the complexities involved in a negotiation process to establish lasting and advantageous relationships for both parties.

Despite not reaching consensus percentages among participants, healthtech entrepreneurs agree that enthusiasm is a necessary competency for entrepreneurship in healthcare, as 64% consider this competency as important or very important. Enthusiasm is related to determination, which translates into dedication and focus on what one aims to achieve. Thus, maintaining enthusiasm for an idea allows engagement in achieving established goals.

However, experience in the healthcare sector was indicated as important or very important by 63% of the participants, which aligns with Barbosa's (2018) description of entrepreneurship in healthcare. Barbosa (2018) highlights that the traditional requirement of having a healthcare-related education is no longer necessary to work in the healthcare sector, as innovations through healthtechs can positively impact the sector by aligning technology with healthcare services. However, in this study, the result may be explained by the fact that only 30% of healthtech entrepreneurs have a background in healthcare.

Regarding legal understanding, 59% of healthtech entrepreneurs indicated it as important or very important. Understanding the laws that govern business activities is essential in any industry, particularly in healthcare, where there are protocols and regulations to be adhered to. However, for entrepreneurship in healthcare, while it is important for individuals to have a basic understanding of legal aspects, they can also seek specialized external assistance.

3.1.4. Competencies for innovating in health

To understand the perspective of healthtech entrepreneurs regarding the importance of competencies needed for innovation in healthcare, they were asked to indicate the level of importance of the following competencies: communication, creativity, leadership and social influence, negotiation, abilities with technological tools, business networking, disruptive thinking, persistence, proactivity, interdisciplinary relationships, complex problem-solving, teamwork, and market vision. The results showed that these 13 competencies were considered very important by all participants in the survey. Table 6 presents the results of the survey with healthtech entrepreneurs for competencies assessed as important and very important for innovating in healthcare, along with their respective percentages.

As can be seen in Table 6, there was a consensus (above 75%) among the participants regarding the 13 competencies. This result confirms the literature, as eight of these competencies (creativity, complex problem-solving, business networking, communication, abilities with technological tools, leadership and social influence, teamwork, and interdisciplinary relationships) were identified as competencies for innovation, as presented in Table 7.

Therefore, the 13 competencies (Table 6) identified by healthtech entrepreneurs as necessary for innovating in the healthcare sector align with what is identified in the literature on innovation competencies. The other five highlighted by these entrepreneurs (persistence, market vision, proactivity, negotiation, and disruptive thinking) align with competencies for entrepreneurship and innovation.

Table 6. Percentage of competencies to innovate in healthcare.

Competencies	Competencies assessed as important or very important (%)
Leadership and social influence	100
Business networking	100
Interdisciplinary relationships	100
Solutions to complex problems	100
Communication	95
Creativity	95
Persistence	95
Teamwork	95
Market vision	95
Proactivity	91
Negotiation	82
Abilities with technological tools	82
Disruptive thinking	77

Source: Prepared by the authors (2023).

Table 7. Competencies for innovation identified in the literature.

Competence	Author	Concept
Creativity	Hsiao et al. (2019); Oliveira et al. (2011); Pranciulytė-Bagdžiūnienė and Petraitė (2019)	It enables the visualization of different scenarios, combinations of ideas, making analogies, recognizing possible meanings that are not obvious, and thus overcoming apparent limits.
Complex problem-solving	Ferreras-Garcia et al. (2021); Ovbiagbonhia et al. (2019)	The ability to innovate is cultivated when that person is challenged by an issue marked by ambiguities and unsolved problems.
Business networking	Ferreras-Garcia et al. (2021); Keinänen et al. (2018); Marín García et al. (2013)	Ability to effectively utilize an existing network of contacts to build new networks that will support innovation.
Communication	Ferreras-Garcia et al. (2021); Keinänen et al. (2018); Marín García et al. (2013)	Essential for the process of collective construction of ideas and subsequent processing, evaluation, and/or argumentation.
Abilities with technological tools	Oliveira et al. (2011)	As innovative abilities derive from successful experiences built through the introduction of technological changes, the development of these abilities becomes essential, as innovation requires the interaction of different scientific and technological areas.
Leadership and social influence	Ferreras-Garcia et al. (2021); Keinänen et al. (2018); Marín García et al. (2013); Ovbiagbonhia et al. (2019)	Ability to mobilize specialists and the collaboration of those involved in the process so that organizational objectives are achieved.
Teamwork	Ferreras-Garcia et al. (2021); Keinänen et al. (2018); Marín García et al. (2013); Ovbiagbonhia et al. (2019)	It is related to communicating effectively with others and the ability to collaborate with other team members to deliver results.
Interdisciplinary relationships	Ferreras-Garcia et al. (2021); Keinänen et al. (2018); Marín García et al. (2013); Saatci and Ovaci (2020)	They are the source and target for the dissemination of all resources, ideas, and practices. They are crucial in providing information on innovative practices. Furthermore, they are essential for creating mutual benefits, as they have a variety of roles.

Source: Prepared by the authors (2023).

3.2. Delphi method: second round

The second round of questionnaires consisted of verifying the consensus among experts regarding the results obtained from the first questionnaire. This round involved the participation of 20 experts. The results are summarized in Figure 3.

In Figure 3, it can be observed that there is consensus among the experts regarding the competencies present in each of the four categories. Competencies for operating in startups (creativity, discipline, focus on results, emotional intelligence, and proactivity) had the highest consensus (95%), as 19 out of 20 healthtech entrepreneurs indicated agreement with these competencies. The competencies for entrepreneurship in healthcare (persistence, proactivity, interpersonal relationships, resilience, and market vision) achieved 85% consensus. In this category, 17 out of 20 entrepreneurs agreed. Competencies for working in healthcare (empathy, ethics, technical expertise, humanization, and teamwork) achieved 80% consensus, with 16 out of 20 healthtech entrepreneurs stating agreement with these competencies.

Finally, the competencies for innovating in healthcare (communication, creativity, abilities with technological tools, leadership and social influence, negotiation, business networking, disruptive thinking, persistence, proactivity, interdisciplinary relationships, complex problem-solving, teamwork, and market vision) achieved a lower consensus rate of 75%.

Thus, following the Delphi method's recommendation, consensus among the research participants was established, resulting in 28 competencies (Figure 3), which were analyzed to identify the competencies for operating in healthtechs.

3.3. Competencies for entrepreneurship in healthtechs

The 28 competencies that reached consensus among healthtech entrepreneurs were alphabetically ordered, and duplicates (6) were excluded, leaving 22 competencies that, according to these entrepreneurs, are considered necessary for operating in healthtechs. These 22 competencies align with those listed in the literature as necessary for innovation development. Among these, 13 are considered competencies for innovation, as detailed in Table 8.

The last two competencies presented in Table 8 are essential to operate in healthcare (Peruzzo et al.,

Competencies to work in the health sector	Competencies for entrepreneurship in the health sector	Competencies for entrepreneurship in the health sector	Competencies to innovate in healthcare
- Empathy - Ethics - Technical training - Humanization - Teamwork	- Creativity - Discipline - Focus on results - Emotional intelligence - Proactivity	- Persistence - Proactivity - Interpersonal relationship - Resilience - Market vision	- Communication - Creativity - Abilities with technological tools - Leadership and social influence - Negotiation - Business networking - Disruptive thinking - Persistence - Proactivity - Interdisciplinary relationships - Complex problem-solving - Teamwork - Market vision
Consensus 80%	Consensus 95%	Consensus 85%	Consensus 75%

Source: Prepared by the authors (2023).

Figure 3. Results of the responses to the second questionnaire.

Table 8. Competencies for innovation with consensus among experts and respective authors.

N.	Competencies	Authors
1	Communication	Ferreras-Garcia et al. (2021); Keinänen et al. (2018); Marín García et al. (2013)
2	Creativity	Hsiao et al. (2019); Oliveira et al. (2011); Pranciulytė-Bagdžiūnienė and Petraitė (2019)
3	Technical training	Hsiao et al. (2019)
4	Ability with technological tools	Oliveira et al. (2011)
5	Leadership and social influence	Ferreras-Garcia et al. (2021); Keinänen et al. (2018); Marín García et al. (2013); Ovbiagbonhia et al. (2019)
6	Business networking	Ferreras-Garcia et al. (2021); Keinänen et al. (2018); Marín García et al. (2013)
7	Disruptive thinking	Ferreras-Garcia et al. (2021); Ovbiagbonhia et al. (2019)
8	Persistence	Oliveira et al. (2011); Pranciulytė-Bagdžiūnienė and Petraitė (2019)
9	Interpersonal relationship	Ferreras-Garcia et al. (2021); Keinänen et al. (2018)
10	Interdisciplinary relationships	Ferreras-Garcia et al. (2021); Keinänen et al. (2018); Marín García et al. (2013); Saatci and Ovaci (2020)
11	Resilience	Oliveira et al. (2011); Pranciulytė-Bagdžiūnienė and Petraitė (2019)
12	Solving complex problems	Ferreras-Garcia et al. (2021); Ovbiagbonhia et al. (2019)
13	Teamwork	Ferreras-Garcia et al. (2021); Keinänen et al. (2018); Marín García et al. (2013)

Source: Prepared by the authors (2023).

2020). However, entrepreneurs did not consider mastery of technologies (Ciarli et al., 2021) and digital competencies (Cahen & Borini, 2020; Noronha et al., 2022) as important competencies for innovating in healthcare. Another point that was undervalued was proficiency in the English language and cultural aspects, which are cited in the literature as crucial competencies for enhancing internationalization levels (Kurmanov et al., 2021).

It is also observed that among the competencies representing consensus, there is no mention of assessing the market potential of innovations (Kurmanov et al., 2021; Toyin & Modupe, 2023). Finally, Chakraborty et al. (2021) and Vieira et al. (2019) emphasize the importance of monitoring and continuous improvement in healthcare, as well as knowledge of health policies, planning, and evaluation, which were not indicated by healthtech entrepreneurs.

4. DISCUSSION

This study involved innovation and health experts, as well as healthcare startup entrepreneurs, aiming to present a set of competencies for innovation for healthtech entrepreneurs. The results revealed a set of 22 competencies for healthtech entrepreneurs, as depicted in Figure 4.

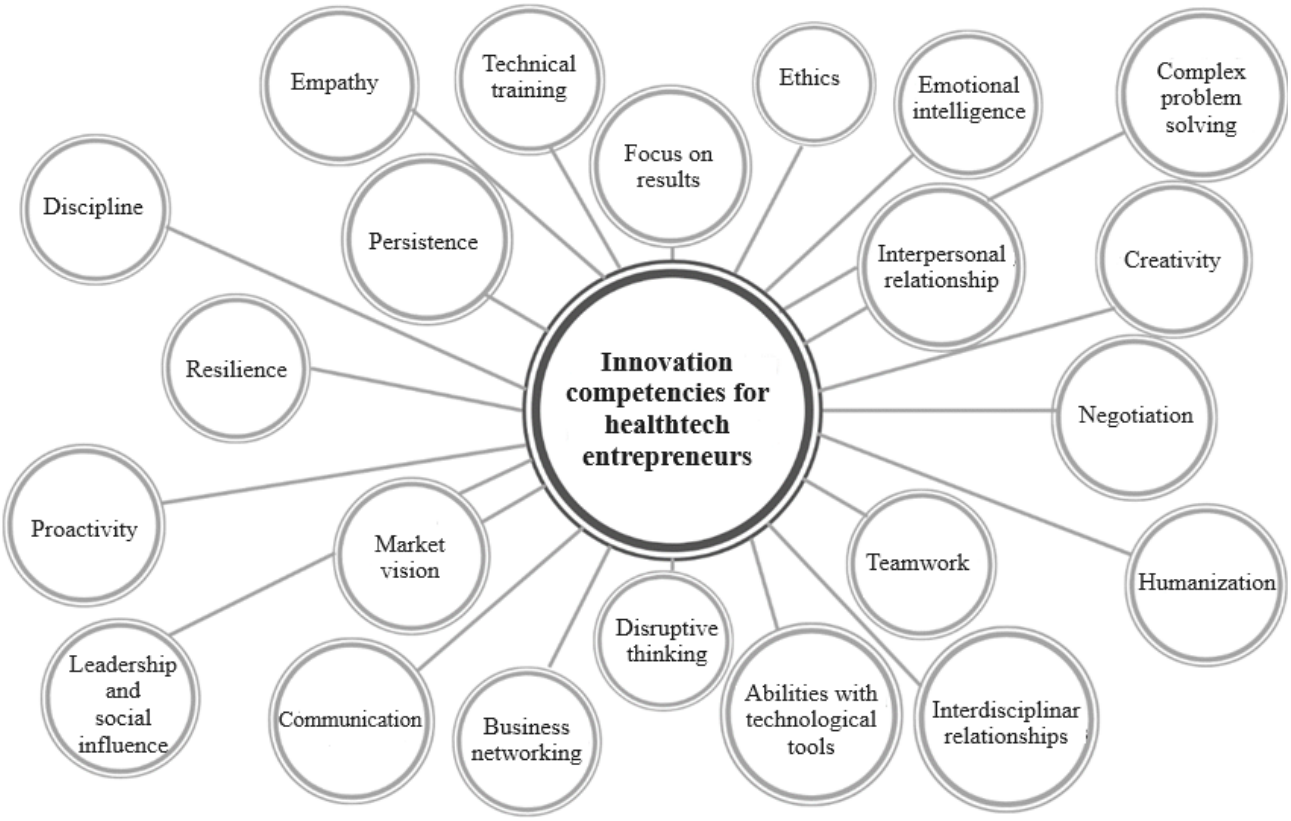
This set of competencies is multidimensional, encompassing knowledge required for healthcare practice, and startups, as well as knowledge for entrepreneurship and innovation. These competencies demonstrate that healthtech entrepreneurs need to seek knowledge beyond their domains to develop competencies (Martins, 2020).

Considering the advancement of healthtechs in Brazil and consequently increasing competitiveness, the preparation of entrepreneurs in this sector through competencies can improve their processes and/or create new healthcare management approaches, integrating informational technologies (Chakraborty et al., 2021).

The competencies suggested in Figure 4, when developed, will bring practical contributions to companies, healthcare, and entrepreneurs, as can be observed below.

4.1. Practical contributions

At a macro level, improving the competencies of healthtech entrepreneurs can impact the quality of



Source: Prepared by the authors (2023).
Figure 4. Competencies with consensus among experts.

care provided, patient satisfaction, and the effectiveness of public health policies (Perez et al., 2021; Peruzzo et al., 2020). A significant contribution that startups can offer to healthcare, in general, is the agility in solving problems through technology, and in this sense, enhancing these competencies tends to favor agility in solving complex and critical healthcare issues (Sartori et al., 2023).

At a micro level, the competencies of healthtechs listed in this study can be developed within teams, aiming for high performance. Understanding which abilities are necessary in innovative environments can strengthen team knowledge and innovation levels, as well as the co-creation process (Sveiby, 2000), which is crucial for startups. For entrepreneurs, the suggested competencies tend to favor the following aspects:

- Deal with unforeseen events, create value, and innovative solutions (Gomes Júnior, 2013; Stefano et al., 2020);
- Deal with resource scarcity (Chakraborty et al., 2021);
- Improve negotiation abilities and relationships with teams and partners (Alves Filho et al., 2019; Malec & Stańczak, 2022; Toyin & Modupe, 2023);
- Transform knowledge into innovative ideas (Hsiao et al., 2019; Keinänen et al., 2018);
- Develop the organization's competencies (Oliveira et al., 2019);
- Create cooperation networks (Keinänen et al., 2018);
- Improve preparation to interact with technologies, since the interaction between abilities and technologies promotes the co-evolution process of these startups (Ciarli et al., 2021);
- Improve entrepreneurial competencies (Man & Lau, 2000);
- Develop sensitivity to solve social problems (Perez et al., 2021; Peruzzo et al., 2020).

Table 9 illustrates the association between the competencies of the model suggested in this research and their applicability for healthtech entrepreneurs.

Finally, as a practical contribution, this competency framework for healthtechs can be utilized by oth-

Table 9. Applicability of the model's competencies.

Applicability of competencies to entrepreneurs	Competence for healthtechs
Dealing with unforeseen events, creating value and innovative solutions.	Creativity, disruptive thinking, complex problem-solving, and technical training.
Dealing with resource scarcity.	Negotiation and disruptive thinking.
Improve negotiation abilities and relationships with teams and partners.	Negotiation, empathy, and communication.
Transform knowledge into innovative ideas.	Creativity, disruptive thinking, and interdisciplinary relationships.
Develop the organization's competencies.	Market vision, teamwork, proactivity, leadership and social influence, ethics, focus on results, and discipline.
Create cooperation networks.	Business networking and interpersonal relationships.
Improve preparation to interact with technologies.	Ability with technological tools.
Improve entrepreneurial competencies.	Resilience, persistence, and negotiation.
Develop sensitivity to solving social problems.	Ethics, humanization, and emotional intelligence.

Source: Prepared by the authors (2023).

er innovation environments (ecosystems, incubators, technology parks) in the training processes of entrepreneurs who are currently operating or intending to operate in this sector.

4.2. Theoretical contributions

The results of this research contribute to the study of competencies, exploring the topic in a specific context, that of healthtechs. Thus, the findings of this research identified competencies for innovation, acting in the healthcare sector, and startup entrepreneurs, presenting an original perspective not explored in previous studies. While other studies have discussed competencies in the healthcare sector, such as Perez et al. (2021), Peruzzo et al. (2020), and Vieira et al. (2019), they did not focus on startups. Considering that these operate with a different dynamic compared to medium and large enterprises, requiring the promotion of creativity, collaboration, and adaptability (Pereira et al., 2021) and that the entrepreneur plays a central role in them, this study provides a focused approach to competencies in these spaces, specifically within the healthcare field.

Another theoretical contribution of this research relates to the use of the Delphi method, which was not identified in previous studies on competencies in healthcare. By bringing together the evaluation of entrepreneurs and experts on competencies necessary for operating in healthtechs, this study presents elements of reality and the Brazilian context, thus providing a contextualized analysis of the phenomenon through the lenses of entrepreneurs and specialists working in this field.

Finally, this study offers important insights into understanding innovation in Brazilian startups by highlighting perceptions of healthtech entrepreneurs about the necessary capabilities to create something new, corroborating previous studies that emphasized the importance of teamwork and networking (Andreu-Andrés et al., 2018; Hamad, 2020) for innovation. Additionally, the results of this research, through the perceptions of entrepreneurs, reinforce the importance of competencies such as humanization, ethics, and empathy (Vieira et al., 2019) for operating in healthcare, as well as the value of abilities with technological tools, which are essential for innovative companies in the healthcare field (Chakraborty et al., 2021).

4.3. Limitations and future research

The main limitation of this study is associated with the fact that the entrepreneurs from startups and the experts involved were only from the state of Paraná. Other states with more established companies may provide new insights on the topic, including competencies related to internationalization, which did not emerge in this study.

Another limitation concerns consensus-seeking with experts and healthtech entrepreneurs. Future studies could include healthcare users and policymakers, broadening the external perspective on the competencies crucial for operating in healthtechs.

As a future study, it is worth noting that healthtechs do not represent a homogeneous segment. Therefore, sector-specific studies can highlight other unique aspects to be observed regarding healthtech competencies. Another research avenue could focus on assessing the effects of these competencies on the expansion of healthtechs, which may occur within other innovation environments.

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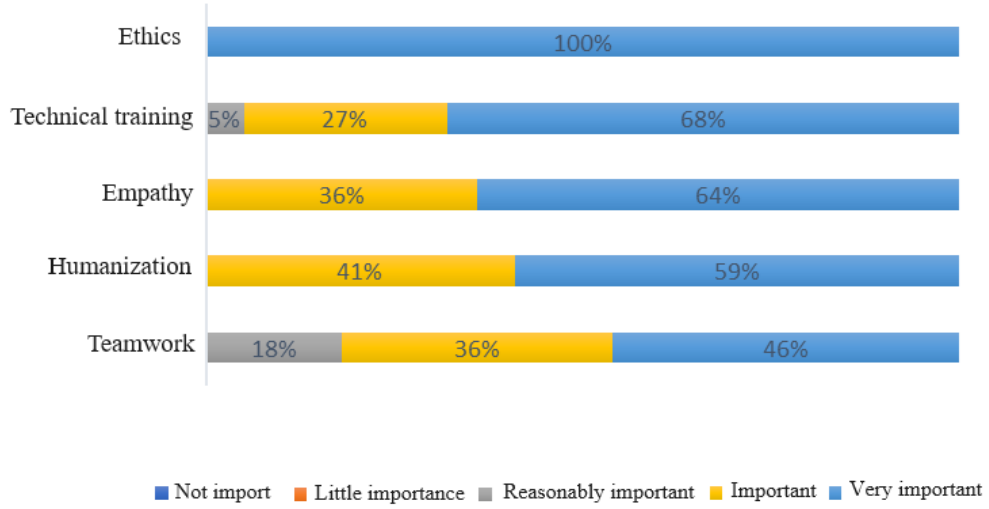
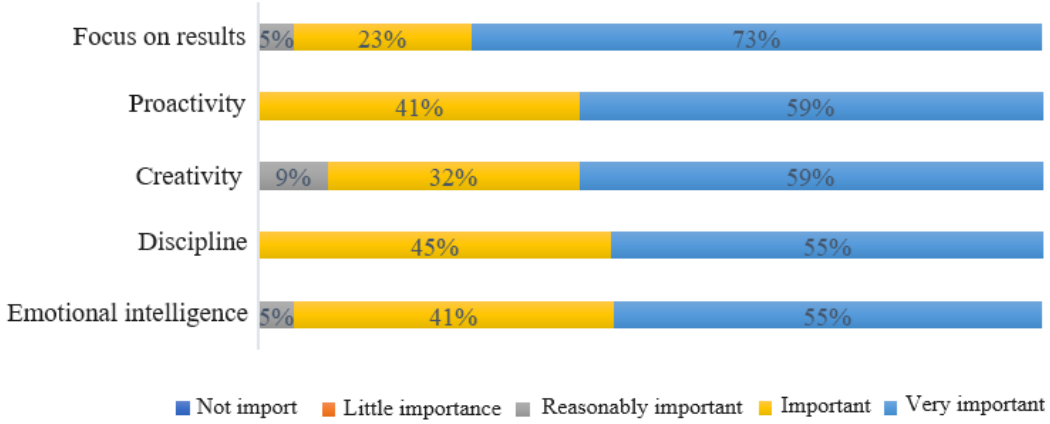
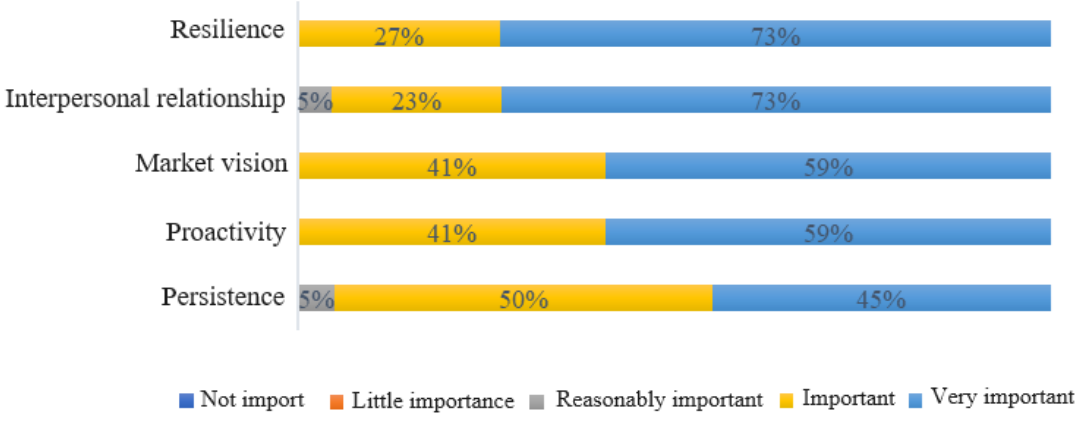
Appendix 1. Results of the first round of the questionnaire.



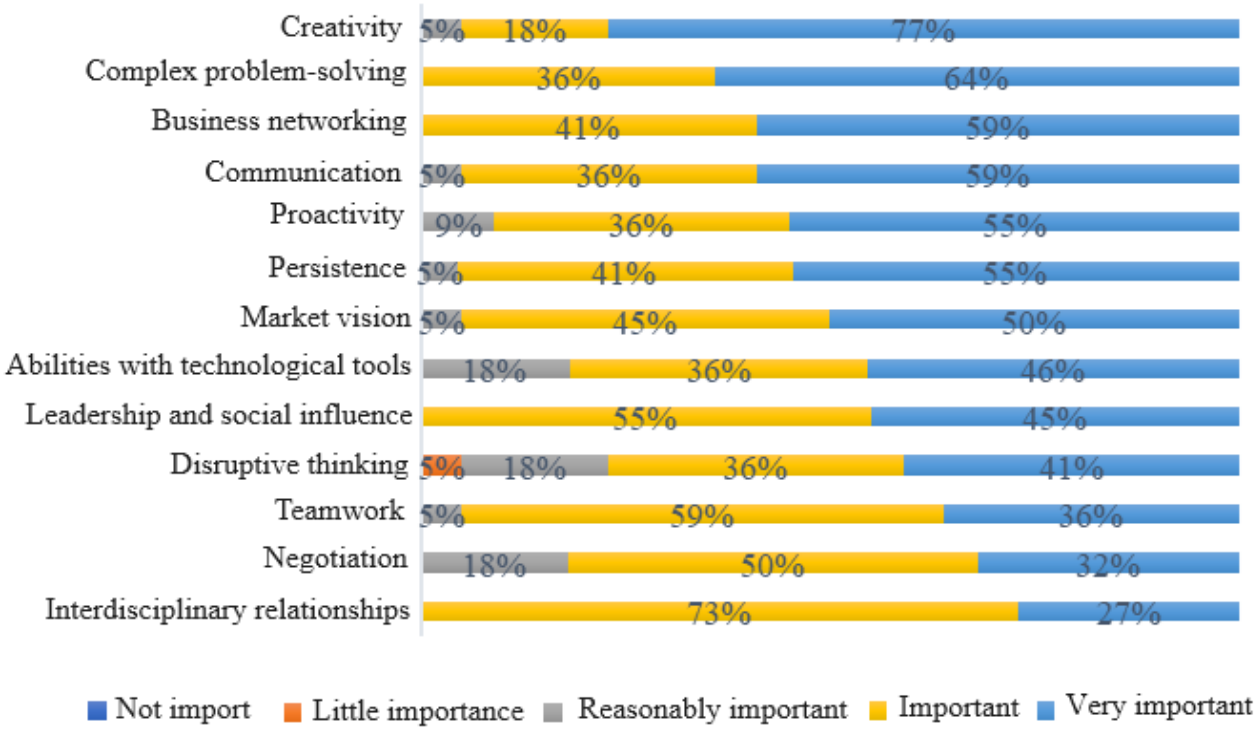
Source: Prepared by the authors (2023).
Figure A1. Necessary competencies to work in the health sector.



Source: Prepared by the authors (2023).
Figure A2. Necessary competencies to work in a startup.



Source: Prepared by the authors (2023).
Figure A3. Necessary competencies for entrepreneurship in the healthcare sector.



Source: Prepared by the authors (2023).

Figure A4. Necessary competencies to innovate in the health sector.