EXPLORING FUTURE TECHNOPRENEURS' PERCEPTIONS TOWARD THE GERONTECHNOLOGY MARKET

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ABSTRACT

The elderly population is experiencing significant growth, particularly in developing countries such as Malaysia. This demographic shift, driven by advancements in healthcare, modernization, and increasing life expectancy, presents challenges and opportunities for gerontechnology development. From an entrepreneurial and economic perspective, the rising ageing population offers vast potential for technology-driven innovations to improve older adults' well-being to improve older adults' well-being to improve older adults' well-being. While existing studies highlight the importance of gerontechnology, research remains limited in understanding how future technopreneurs perceive this market segment and their willingness to innovate in this field. This study investigates the awareness and intentions of future technopreneurs regarding the gerontechnology market, particularly as Malaysia is projected to become an ageing nation by 2030. A survey was conducted with 100 final-year students enrolled in the Bachelor of Technopreneurship with Honors (BTEC) program at Universiti Teknikal Malaysia Melaka (UTeM) to assess their knowledge of the ageing process, attitudes toward the elderly market, and perceived barriers to entry in the gerontechnology industry. The findings reveal that while respondents acknowledge the economic potential of gerontechnology, their understanding of ageing-related challenges remains limited, particularly in terms of the health and mobility issues older adults face. This study contributes to the field by identifying key factors influencing technopreneurs' readiness to engage in the gerontechnology sector, highlighting the need for entrepreneurial education and targeted exposure to ageing-related issues. The insights gained from this study can inform policymakers, educators, and industry stakeholders in designing initiatives that foster innovation in eldercare technologies. By addressing the knowledge gap and promoting awareness, this study helps pave the way for integrating technology and entrepreneurship to support Malaysia's transition into an ageing nation.

Keywords: Gerontechnology, ageing population, elderly, ageing nation, silver economy

INTRODUCTION

Background of Study

According to the United Nations (UN), Malaysia is expected to be an ageing nation by 2030 (Abdullah et al., 2024; Ahmad et al., 2022; Chong et al., 2024). The increasing elderly population aged 60 and above in Malaysia has shown consistent growth since 1995. Compared to 1970, when the percentage of the elderly population was approximately 5.4% (539,118 individuals), the percentage rose steadily to 6.0% (1,194,000 individuals) in 1995. By 2000, this figure further increased to 6.6% (Ibrahim & Mohd Nordin, 2020; Md Nor & Ghazali, 2021). This trend aligns with the UN's 1991 projections, which estimated that the elderly population in Malaysia would rise to 11.3%. Furthermore, it is anticipated that the proportion of the elderly will continue increasing, reaching 15% of the total population by 2030 (Abdullah et al., 2024; Chung et al., 2020).

As a result, Malaysia is expected to face new challenges like those encountered by other developed countries worldwide. For instance, Japan, which has already achieved the status of an ageing nation, has dealt with various issues associated with its elderly population. However, based on the researcher's firsthand experience living in Japan, it is evident that this developed nation,

recognised as a global economic power, has distinct advantages in terms of financial resources, infrastructure, technical expertise, skills, and technology to manage the rising number of elderly individuals. For example, the extensive use of robotic technology in Japan has played a significant role in addressing health challenges among the elderly (Vogt & König, 2023).

Technology designed for the elderly, often referred to as gerontechnology, has the potential to minimize the effects of physical limitations, stimulate new interests and activities, facilitate communication, enhance cognitive and emotional capacities, and improve the psychological well-being of older adults (Huang & Oteng, 2023). The increasing demand for elderly-friendly technologies and services—commonly called gerontechnology—has emerged as a necessity in addressing the challenges of an ageing population in Malaysia. At the same time, it presents a significant opportunity for fostering innovation in the form of technology-based products and services, enabling entrepreneurs and technopreneurs to profit while meeting the needs and preferences of the elderly population (Huang & Oteng, 2023; Jumbri et al., 2022; Wei & Chen, 2024). Therefore, it is imperative to equip future technopreneurs in Malaysia with the knowledge and awareness of gerontechnology vast potential for the future.

Problem Statement

Malaysia is recognized as a rapidly developing and competitive nation capable of addressing economic and social challenges, partly through strengthening an entrepreneurial culture. This includes fostering technical and technological entrepreneurship among its population. According to the World Competitiveness Ranking (WCR) conducted by the International Institute for Management Development (IMD) in 2023, Malaysia's rise by five positions to rank 27th, compared to 32nd the previous year (Murugiah, 2023), underscores the nation's growing competitiveness in various domains, including economics, social innovation, and gerontechnology—an area crucial for addressing the needs of the elderly in the future.

The global population of adults aged 60 and above has been steadily increasing, and Malaysia is no exception. The population of Malaysia is expected to be up to 74.9 years old in 2021. By 2030, 14.5% of Malaysia's population is projected to be older adults aged 65 and above, making Malaysia an ageing nation (Redzwan & Ramli, 2024). This demographic shift has significant economic and social implications. As individuals age, they experience cognitive, physical, and social changes. Technology offers substantial opportunities to assist the elderly in managing these changes and simplifying their daily lives. Technological innovations enable older adults to offset physical limitations, maintain cognitive abilities, and foster meaningful social connections with friends and loved ones (Corti et al., 2024).

The emergence of gerontechnology—a field focusing on technologies designed to address the physical and mental challenges of the elderly—offers promising opportunities to enhance their quality of life (Dodds et al., 2024; Huang & Oteng, 2023). The elderly population is among the wealthiest and most demanding consumer segments, seeking improved living standards as they age. For instance, in the United States, senior households spent USD 107 trillion in 2020, making it the third-largest economic market globally. This expenditure is projected to grow, contributing over 50% of the United States' GDP by 2030 (Naor et al., 2021).

In Malaysia, however, knowledge about the ageing process and the market potential of elderly consumers remains underexplored, particularly among future technopreneurs (Jumbri et al., 2022). Raising awareness and knowledge about gerontechnology among technopreneurs not only encourages them to view this sector as a viable business opportunity but also inspires the development of innovative solutions to meet the needs of Malaysia's growing elderly population. Such initiatives can play a pivotal role in helping the nation address the challenges posed by an ageing society in the future.

Currently, there are few technopreneurs in Malaysia focusing on the elderly market, particularly in the field of gerontechnology. Despite the substantial size and significance of the "silver economy," this market segment has not received adequate attention (Oget, 2021; Rialle, 2020). While past studies have explored the economic and technological potential of gerontechnology in developed nations such as Japan and the United States (Huang & Oteng, 2023; Naor et al., 2021), research remains limited in understanding how future technopreneurs in Malaysia perceive this emerging market. Furthermore, researchers have limited knowledge about the factors influencing their willingness to innovate in gerontechnology or the barriers they face when entering this industry. This study aims to bridge this gap by examining how knowledge of the ageing process, subjective norms, and perceived behavioural control shape future technopreneurs' interest in gerontechnology. Given Malaysia's imminent status as an ageing nation by 2030, the consistent growth of the elderly population highlights the urgent need to explore new business ideas and technology-driven innovations tailored to the health and wellness needs of elderly adults.

However, the development of this sector relies heavily on innovative entrepreneurs willing to invest in ageing-related technologies. The Bachelor of Technopreneurship with Honors (BTEC) program at Universiti Teknikal Malaysia Melaka (UTeM) is specifically designed to cultivate and develop technopreneurs by equipping students with the necessary entrepreneurial mindset, technological skills, and innovation-driven approaches. As a result, BTEC students are well-positioned to become future technopreneurs, particularly in emerging fields such as gerontechnology, where they can leverage their expertise to create technology-driven solutions for Malaysia’s ageing population.

Thus, this study explores future technopreneurs' perceptions of the potential for new technological innovations in the elderly market, specifically in gerontechnology. It also examines future technopreneurs' views regarding the ageing process and their understanding of the technological needs of older adults. The Theory of Reasoned Action (TRA) and the Theory of Planned Behaviour (TPB) are employed as theoretical frameworks to explore how these factors influence the readiness of future technopreneurs to consider the "silver economy" as a potential market for the future.

Research Questions

This study explores the factors influencing future technopreneurs' intentions to engage in the gerontechnology market, explicitly examining the role of knowledge of the ageing process, subjective norms, and perceived behavioral control.
The study addresses the following research questions:

1. To what extent does knowledge of the ageing process influence future technopreneurs' intentions to enter the gerontechnology market?

2. How do subjective norms (social and cultural influences) impact on the willingness of future technopreneurs to innovate in gerontechnology?

3. What is the relationship between perceived behavioral control and the intention to develop gerontechnology-based products and services?

4. What are the key barriers and motivations influencing technopreneurs' engagement in the gerontechnology industry?

Research Objectives

This study aims to identify and analyse the determinants of future technopreneurs' engagement in the gerontechnology market by examining their knowledge, social influences, and perceived control over entrepreneurial decision-making.
The specific objectives of this study are:

1. To assess the impact of knowledge of the ageing process on future technopreneurs' intention to develop gerontechnology-based innovations.

2. To evaluate the influence of subjective norms (social and cultural expectations) on technopreneurs' willingness to engage in the gerontechnology market.

3. To examine the relationship between perceived behavioural control and technopreneurs' confidence in entering the gerontechnology sector.

4. To identify the key challenges and opportunities that affect the adoption of gerontechnology entrepreneurship among future technopreneurs.

Significant of the Study

This research is significant as it broadens the understanding of future technopreneurs' intentions toward gerontechnology. The study examines factors influencing these intentions, including knowledge of the ageing process, personal attitudes, subjective norms, and perceived behavioural control, as outlined in the TPB. Additionally, this study compares findings with prior research on technopreneur intentions, particularly about knowledge about the ageing process, attitudes, subjective norms, and perceived behavioural control. Theories and measurement methods proposed in previous studies are applied here and expanded to explore future needs. This research enriches understanding of the factors driving innovation and entrepreneurial focus in this growing market by contributing insights into how intentions can be measured and evaluated, particularly in entrepreneurship and technopreneurship within the gerontechnology segment.

Scope of Study

This study seeks to identify factors influencing the intentions of future technopreneurs to focus on the gerontechnology segment (technology-based products or services). The research involves final-year students from the BTEC program in the FPTT at UTeM. A quantitative survey method was employed, using structured questionnaires distributed to 100 respondents. Researchers recorded and analysed the data using the Statistical Package for the Social Sciences (SPSS) version 25.0.

LITERATURE REVIEW

Entrepreneurs and Technopreneurs

Entrepreneurs initiate and manage new businesses and ventures, playing a crucial role in a nation's economic development by introducing innovative business ideas that stimulate growth (Jabbouri et al., 2024). The concept of entrepreneurship was first introduced by Schumpeter in 1965, defining entrepreneurs as innovators who generate and implement new ideas within businesses and enterprises, ultimately driving rapid economic expansion (Block et al., 2022). Schumpeter's perspective underscores the transformative role of entrepreneurs in fostering innovation and maintaining competitive market dynamics (González-Padilla et al., 2024).

Extensive literature highlights entrepreneurs' key personality traits, including independence, creativity, risk-taking propensity, and a strong need for achievement (Steenkamp et al., 2023). Additionally, role models significantly influence entrepreneurial motivation and behaviour. Hoang et al. (2024) further identified core entrepreneurial characteristics, such as an internal locus of control, risk-taking tendency, and personal values like independence and effective leadership. As the global business landscape evolves, entrepreneurs must embrace technological advancements, assuming roles as technopreneurs who leverage modern technology to develop innovative products and services (Onileowo & Muharam, 2024).

The Oxford Dictionary defines technopreneurs as individuals who establish and run technology-based businesses, often utilizing computers or other digital technologies to develop new products or services. Bomani et al. (2021) emphasize that technopreneurs integrate technical expertise with entrepreneurial acumen, enabling them to create technology-driven enterprises. Koe et al. (2024) further describe technopreneurs as individuals who harness technology to develop innovative solutions for

commercial purposes. Businesses led by technopreneurs typically exhibit high growth potential, involve significant risks, and prioritize scientific advancements and intellectual property. This positions technopreneurs as key drivers of technological innovation, particularly in emerging fields like gerontechnology—a sector focused on enhancing older adults' well-being and quality of life through technology-driven solutions. However, while entrepreneurship and gerontechnology have been explored independently in various studies, limited research has investigated the intersection of these fields, particularly from the perspective of future technopreneurs. Most studies on gerontechnology focus on technological innovations and their impact on elderly users (Dodds et al., 2024; Huang & Oteng, 2023), but there is little emphasis on the role of entrepreneurs in driving these innovations. This study seeks to address this gap by examining future technopreneurs' knowledge, attitudes and perceived behavioural control concerning the gerontechnology market in Malaysia.

Both entrepreneurs and technopreneurs act as catalysts for economic growth, serving as agents of change by introducing new products and services to the market. Technopreneurs play a critical role in disrupting traditional paradigms, fostering technological advancement, and addressing the needs of Malaysia's ageing population. Their open-mindedness and creativity enable them to reimagine older adults' lifestyles and evolving requirements, thereby shaping emerging trends in the silver economy—an expanding market segment catering to individuals aged 60 and above. By leveraging technology-driven innovations, technopreneurs can bridge gaps in elderly care, healthcare, and independent living, ultimately enhancing the quality of life for ageing populations while capitalizing on the economic opportunities presented by demographic shifts.

Stereotypes Toward the Elderly

A common misconception is that older adults slowly adapt to new technologies (Köttl et al., 2021). However, many elderly individuals actively seek and adapt to innovations that help them navigate daily challenges. Negative stereotypes about older adults can influence societal perceptions and impede innovation. For instance, technopreneurs who harbour these biases may be less inclined to develop products or services tailored to the gerontechnology market actively.

Stereotypes about the elderly fall into two primary categories: perceptions of their limitations (Donizzetti, 2019) and assumptions about their technological proficiency (Köttl et al., 2021). Negative stereotypes, such as the belief that older adults are incapable of using technology, contribute to prejudice and discrimination, known as "ageism." This term, introduced by Robert Neil Butler in 1969, refers to systematic prejudice or discrimination against individuals based on age (Levy, 2024). Ageism can exacerbate generational divides and discourage young individuals from engaging with or innovating for the elderly. Furthermore, extreme ageism can create anxiety among younger and middle-aged individuals about ageing and its associated challenges (Goldman & Higgs, 2021). Persistent ageist stereotypes may lead technopreneurs to view ageing as a problem rather than an opportunity, hindering the development of gerontechnology solutions.

Technophobia and the Role of Technopreneurs in Gerontechnology Adoption

When discussing technological innovation, there is often a prevailing assumption that older adults are technophobes or too resistant to change to adopt and utilize new technologies in their daily lives. The digital divide can be defined as a disparity that hinders or limits an individual's or specific group's access to information and communication technology (Chee, 2024). In comparison, smartphone usage has become commonplace, particularly among younger generations. However, among older adults, some exhibit technophobia or a reluctance to use technology due to the perception that they lack the necessary technical skills to operate modern innovations. As a result, the digital divide, including the adoption of gerontechnology (technology designed to support ageing populations), continues to widen among the elderly.

The digital divide is not limited to the gap in technology adoption between younger and older generations. Discriminatory behaviours, such as condescending attitudes or dismissive remarks suggesting that older individuals are "too old to learn something new," further reinforce the stereotype of older adults as technophobes. Such ageist biases, or negative perceptions regarding the ability of older adults to adapt to technology, significantly impact the development of gerontechnology, particularly among young technopreneurs (Köttl et al., 2021). The prevailing cynicism towards ageing and technology adoption discourages young innovators from viewing older adults as a viable consumer segment.

Furthermore, self-perception of ageism among older adults themselves exacerbates this issue. McDonough (2020) suggests that some older individuals internalize ageist stereotypes to the extent that their self-confidence diminishes, leading them to believe that society perceives them as incapable or unwilling to use new technologies. Many technology developers do not design contemporary technological products and systems with older users in mind, which offers a more pragmatic explanation for the digital divide. Challenges such as non-intuitive user interfaces, lack of prior technology exposure, high costs of technology ownership, and limited access to training programs contribute to this digital exclusion.

This inaccessibility issue stems from technopreneurs and designers who fail to recognize or address older users' diverse abilities and needs. In other words, technology innovators often lack the knowledge required to create products and services that cater to the functional and psychological needs of ageing populations. Consequently, many technological solutions fail to gain traction in the elderly market due to a mismatch between product design and user requirements (Mannheim et al., 2019). Ultimately, the widening digital divide is not due to older adults' unwillingness to adopt technology but because the products and services designed for them are not tailored to their needs, often influenced by ageist stereotypes and negative perceptions of ageing populations.

Various practical strategies, such as identifying the needs of older users, can help mitigate the digital divide and ageism. However, technopreneurs' perceptions also influence their willingness to view the ageing population as a viable market. If these misconceptions remain unaddressed, the digital divide driven by age-related stereotypes will persist. Consequently, Malaysia's future gerontechnology landscape may rely heavily on imported solutions rather than those developed and produced by local technopreneurs.

Major social-psychological theories on attitude formation suggest that a lack of knowledge about a particular group can contribute to negative stereotypes and biases. Individuals with limited or no exposure to a specific demographic are more likely to

generalize and attribute homogenous characteristics to that group (Donizzetti, 2019). Research indicates that prior experiences with older adults are critical in shaping attitudes, influencing one's comfort level, self-efficacy, and ability to work or interact with them. In other words, accurate and well-informed knowledge about older adults fosters positive attitudes toward this age group, ultimately increasing one's willingness to engage with and serve their needs (Yasnita et al., 2020).

This study aims to determine whether technopreneurs' understanding of ageing processes influences their willingness to recognize older adults as a target market for technological innovations. Knowledge is fundamental in entrepreneurial decision-making, as access to relevant and practical information varies among individuals. A deeper understanding of the ageing process and the needs of older adults serves as a key determinant in identifying and capitalizing on business opportunities, ultimately driving success in gerontechnology-related ventures.

Theory of Reasoned Action (TRA) and Theory of Planned Behaviour (TPB)

Future technopreneurs' willingness to focus on the gerontechnology market depends on their knowledge, skills, and experiences, which influence their perceived behavioural control. This study employs the Theory of Reasoned Action (TRA), as in Figure 1, and the Theory of Planned Behaviour (TPB), as its theoretical framework (Figure 2).

TRA, developed by Ajzen and Fishbein in 1967, is one of the most influential theories in behavioural research, including studies on entrepreneurial intentions (Chen et al., 2021; Wiguna et al., 2023). It posits that human behaviour is influenced by intention, which is determined by three key factors: attitude, subjective norms, and perceived behavioural control. These factors form the foundation for examining technopreneurs' intentions in the context of gerontechnology.

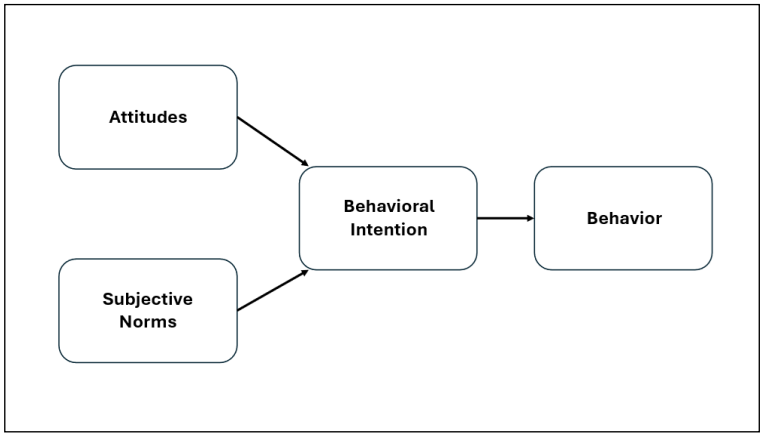

Figure 1: Theory of Reasoned Action (TRA)

Based on this theory, attitude is defined as a person's positive or negative feelings toward performing a particular behaviour. Meanwhile, subjective norm refers to the social pressures exerted by influential individuals such as parents, friends, or relatives, which can affect a person's decision-making process (Abd Rahman et al., 2024; Huwaida et al., 2024). For instance, a potential technopreneur with elderly parents who face physical mobility challenges or disabilities may develop a unique perspective on the need for gerontechnology.

Both factors—attitude and subjective norm—contribute to behavioural intention, subsequently leading to the actual performance of the behaviour. In other words, within the context of this study, technopreneurs' intentions determine their behaviour, and their attitudes and subjective norms influence those intentions. Individuals generally perceive subjective norms as the strength or influence of social pressures to perform or refrain from a behaviour. They act as a guiding framework, advising an individual on whether to undertake a specific action, and they can motivate the individual's willingness to act.

Researchers have found that external social influences, such as support from family members and peers, often heighten entrepreneurial intentions. People commonly refer to these external or social influences as subjective norms. Other studies indicate that entrepreneurial education, whether formal or informal, significantly enhances a person's motivation to pursue entrepreneurship. External factors, categorized as subjective norms, have a meaningful relationship with intentions, ultimately leading to behaviour or action (Huwaida et al., 2024).

In this study, the researcher investigates whether exposing potential technopreneurs to education, training, and clear experiences related to the challenges faced by older adults and the vast potential in gerontechnology can shift their perceptions and encourage more positive behaviours.

Various forms of belief influence subjective norms. These include normative beliefs, which reflect an individual's or group's perception of whether they should perform a behaviour. Referent beliefs further shape normative beliefs, as individuals rely on or trust the opinions of others. For example, an individual may undertake an action because they perceive it to be important or valued by others. Such social norms influence behaviour, particularly when individuals seek approval or alignment with others' expectations (Gavrilets et al., 2024).

Researchers have widely used the TRA as a research model to study attitudes toward behaviour. This model operates on the premise that most individuals act rationally, carefully considering the implications of their actions before engaging in a behaviour. However, the TRA has certain limitations. For instance, the theory does not account for unconscious factors influencing decision-making. To address these limitations, Ajzen and Fishbein introduced an additional factor in 1980, perceived behavioural control, within the TRA (Ababneh et al., 2022; Ardiyanto et al., 2024). The TPB expanded upon the original TRA model, offering

a more comprehensive framework for predicting behaviour. By incorporating variables such as personal traits, attitudes toward specific individuals or groups, and demographic factors, the TPB overcomes the limitations of the original TRA. This enhancement allows for a deeper understanding of behaviour, providing a robust framework for analysing and predicting actions, especially within entrepreneurship and technopreneurship.

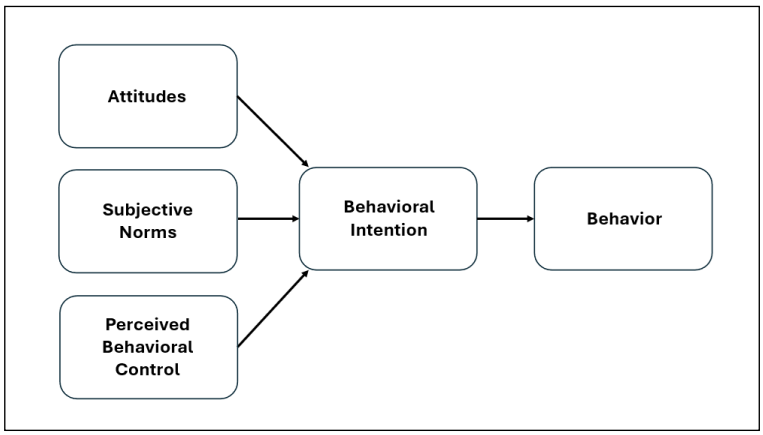

Figure 2: Theory of Planned Behavior (TPB)

Perceived behavioural control typically depends on an individual's voluntary intention to act or engage in a particular behaviour. However, in some cases, this expectation is not solely influenced by personal willingness but rather by the perceived ease or difficulty of executing a specific behaviour. This construct also reflects an individual's belief in their ability to perform a specific action despite potential obstacles. Consequently, behavioural control is often assessed based on past experiences or anticipated barriers that may arise when attempting a particular behaviour. According to the TPB, behavioural control expectancy is a key determinant of intentions and can directly influence specific behaviours (Hagger et al., 2022). Within this theoretical framework, the perception of control over one's ability to act significantly shapes decision-making and behavioural outcomes.

The TPB and related psychological theories suggest that intention is the primary predictor of behaviour. Beck & Ajzen (1991) stated that attitudes shape an individual's intention, which develops based on their initial evaluation or expectation of a given situation—either favourable (positive) or unfavourable (negative). If an individual holds a positive perception, it strengthens their intention to act, ultimately leading to actual behaviour or decision-making favouring the action. Conversely, a negative attitude weakens behavioural intention, reducing the likelihood of engagement in the given activity. Behavioural beliefs shape attitudes and consist of three key components: cognitive, which relates to an individual's knowledge, ideas, and beliefs about a behaviour; affective, which refers to the emotional response or feelings associated with the behaviour; and behavioural, which indicates the tendency or inclination to act in a certain way (Yeo et al., 2024). In the context of this study, the willingness and attitudes of technopreneurs toward older adults, as well as their readiness to address the challenges faced by the ageing population, are crucial factors influencing their behavioural intentions toward gerontechnology development.

This study aims to identify the relationships between knowledge of the ageing process, subjective norms, and perceived behavioural control with the intention of future technopreneurs to engage in gerontechnology. Unlike previous research that primarily examines gerontechnology from a consumer perspective (Dodds et al., 2024), this study focuses on the entrepreneurial aspect, addressing the lack of research on how future technopreneurs perceive and approach this emerging market. The findings will provide new insights into the factors influencing innovation and market entry in gerontechnology, particularly in Malaysia's transition into an ageing nation. Furthermore, the study aims to investigate technopreneurs' understanding of ageing and the specific challenges older adults face, providing insight into how these perceptions influence the development and acceptance of gerontechnology solutions.

METHODOLOGY

Research Design

This study employs a quantitative approach to examine prospective technopreneurs' entrepreneurial intentions regarding the gerontechnology market. Specifically, it investigates how knowledge of the ageing process, subjective norms, and perceived behavioural control influence their willingness to engage in this emerging field. The Theory of Planned Behaviour (TPB) is the theoretical framework that provides a structured approach to understanding the factors shaping entrepreneurial intentions.

The study targeted final-year students from the BTEC program at UTeM. The BTEC program is specifically designed to cultivate and develop technopreneurs by equipping students with the necessary entrepreneurial mindset, technological skills, and innovation-driven approaches. As a result, BTEC students represent future technopreneurs, making them an ideal population for studying perceptions of the gerontechnology market. Their insights provide valuable perspectives on the challenges and opportunities in developing aging-focused technological solutions in Malaysia.

Population and Sampling Strategy

The target population consists of final-year BTEC students at FPTT and UTeM who are at a critical stage in their entrepreneurial development and career decision-making. The sample size was determined using Tabachnick & Fidell's (2007) formula for multiple regression analysis:

$$N > 50 + 8m$$

Where m represents the number of independent variables. Given that this study includes three independent variables (knowledge of ageing, subjective norms, and perceived behavioral control), the minimum required sample size for statistical significance is:

$$N > 50 + (8 \times 3) = 74$$

To enhance the robustness of the findings, a final sample of 100 respondents was selected using stratified random sampling. This technique ensures that students from different academic backgrounds within the program have an equal probability of selection, improving the study's representativeness and generalizability.

Research Instrument and Reliability Testing

The researchers developed a structured questionnaire as the primary research instrument. They divided the questionnaire into six sections:

Section A: Demographic information (e.g., age, gender, marital status).

Section B: Knowledge of the ageing process (measuring awareness of gerontechnology and elderly needs).

Section C: Personal attitudes toward gerontechnology.

Section D: Subjective norms influencing engagement in the gerontechnology market.

Section E: Perceived behavioural control in entering the field of gerontechnology.

Section F: Entrepreneurial intentions toward gerontechnology adoption.

Sections B to F used a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree) to ensure consistency in response measurement and facilitate statistical analysis. To ensure the instrument's content validity, the questionnaire underwent expert evaluation by two academic professionals specializing in technopreneurship and gerontechnology. Their feedback led to minor refinements in question-wording to improve clarity and relevance.

Reliability Testing

The researchers conducted a pilot study with 40 respondents to assess the questionnaire's reliability using Cronbach's Alpha coefficient. The results are presented in Table 1.0.

Table 1.0 Cronbach's Alpha Values for Instrument Reliability in the Pilot Study

Section	Variables and Sub-Variables	Number of Items	Cronbach's Alpha Value
A	De graphics (DF)	6	-
B	Knowledge of the Aging Process (PWE)	5	0.79
C	Personal Attitude (SP)	5	0.82
D	Subject Norms (NS)	5	0.83
E	Perceived Behavioral Control (KTD)	5	0.86
F	Intention Towards Gerontechnology Adoption (NT)	5	0.89
Total		31	

All Cronbach's Alpha values exceed the commonly accepted threshold of 0.70, indicating high internal consistency. These results confirm that the study's constructs and sub-constructs are statistically reliable, ensuring the measurement instrument's robustness.

Data Collection and Ethical Considerations

The researchers collected data through an online questionnaire distributed via Google Forms, ensuring accessibility and ease of participation for respondents. Before participation, all students received informed consent forms explaining the purpose of the study, confidentiality measures, and their voluntary participation rights.

To maintain ethical integrity, the study adhered to the ethical research guidelines of UTeM, ensuring that:

- All responses remain anonymous
- Participants have the right to withdraw from the study at any stage
- Data are used solely for academic research.

Data Analysis Techniques

The collected data were analysed using Statistical Package for the Social Sciences (SPSS) version 25.0. The analysis involved:

a. Descriptive Statistics (mean, frequency, and standard deviation) to summarize demographic data.

b. Normality testing (Skewness and Kurtosis) ensures the data meets the regression assumptions.

c. Pearson Correlation Analysis to determine relationships between independent variables (knowledge, subjective norms, and perceived behavioural control) and the dependent variable (intention toward gerontechnology).

d. Multiple Regression Analysis to evaluate the strength and significance of predictive relationships.

These analytical techniques ensure a comprehensive examination of the factors influencing future technopreneurs' intentions to enter the gerontechnology market.

RESEARCH FINDINGS

This study's findings indicate that most respondents were female students, accounting for 64% (n = 64) of the total sample, while the remaining 36% (n = 36) were male students. This distribution highlights that female students comprise most of the FPTT and UTeM. Regarding age distribution, 64 female students (93.8%) fell between 23 and 27 years old, while only four female students (6.2%) were between 18 and 22. These results show that most final-year female BTEC students at FPTT, UTeM, belong to the 23 to 27 age range, representing over 93.8% of the total female respondents in this study.

Regarding marital status, 98% (n = 98) of final-year BTEC students were single, while only 2% (n = 2) were married. These findings suggest that the proportion of single students is significantly higher than that of married students. Additionally, 88% (n = 88) of respondents agreed, "I have recently learned about the term gerontechnology and the silver economy due to the increasing ageing population in Malaysia." Conversely, only 16% (n = 16) disagreed, indicating that a minority of students had prior exposure to these concepts.

These findings suggest that final-year BTEC students, who represent future technopreneurs, still lack a clear understanding of gerontechnology and the potential for innovation in developing technology-driven products and services catering to older adults. The results further emphasize that many prospective technopreneurs remain unaware of the vast opportunities in gerontechnology despite Malaysia's projected transition into an ageing nation by 2030.

Skewness and Kurtosis Analysis

Table 2.0 *Skewness* and *Kurtosis Value*

Variables	***Skewness***	***Kurtosis***
Knowledge of the Aging Process (PWE)	-.268	-.467
Personal Attitude (SP)	-.365	-.484
Subject Norms (NS)	-.386	-.289
Perceived Behavioral Control (KTD)	-.336	-.385
Technopreneurs' Intention Towards Gerontechnology (NTG)	-.385	-.408

The analysis indicates that a linear relationship exists between independent and dependent variables. The data also follows a normal distribution, as the skewness and kurtosis values fall within the acceptable range of -1 to +1, as shown in Table 2.0.

Pearson Correlation Analysis

Table 3.0 presents the Pearson correlation results, which examined the relationships between knowledge of the ageing process, personal attitude, subjective norms, perceived behavioural control, and technopreneurs' intention toward gerontechnology adoption.

Table 3.0 Pearson Correlation Analysis of Technopreneurs' Intentions Towards Gerontechnology

Hypothesis Results					
Variables	Null Hypothesis (H_0)	Alternative Hypothesis (H_1)	Correlation (r)	H_0/H_1 Decision	Relationship
Knowledge of the Aging Process (PWE)	There is no significant relationship between knowledge of the ageing process and technopreneurs' intention toward gerontechnology.	There is a significant relationship between knowledge of the ageing process and technopreneurs' intention toward gerontechnology.	0.845**	H_0 rejected, H_1 accepted	Significant
Personal Attitude (SP)	No significant relationship exists between personal attitude and technopreneurs' intention toward gerontechnology.	A significant relationship exists between personal attitude and technopreneurs' intention toward gerontechnology.	0.723**	H_0 rejected, H_1 accepted	Significant
Subjective Norms (NS)	There is no significant relationship between subjective norms and technopreneurs' intention toward gerontechnology.	There is a significant relationship between subjective norms and technopreneurs' intention toward gerontechnology.	0.724**	H_0 rejected, H_1 accepted	Significant
Perceived Behavioral Control (KTD)	There is no significant relationship between perceived behavioral control and technopreneurs' intention toward gerontechnology.	A significant relationship exists between perceived behavioral control and technopreneurs' intention toward gerontechnology.	0.619**	H_0 rejected, H_1 accepted	Significant

The results indicate that all independent variables have a significant positive relationship with technopreneurs' intention toward gerontechnology. Specifically, the highest correlation is observed between knowledge of the ageing process and technopreneurs' intention (r = 0.845), followed by personal attitude (r = 0.723), subjective norms (r = 0.724), and perceived behavioural control (r = 0.619). Consequently, the analysis rejected all null hypotheses (H_0), confirming significant relationships. The strong positive correlation (r = 0.845) between knowledge of ageing and technopreneur intention suggests that increasing awareness of ageing-related issues may enhance market engagement in gerontechnology.

Moreover, the findings highlight that knowledge of ageing strongly influences technopreneurs' intention toward gerontechnology. Understanding the challenges and needs of older adults raises awareness of gerontechnology business opportunities and motivates prospective technopreneurs to develop technology-based solutions tailored to ageing populations.

Discussion

This study reveals that increased awareness of the ageing process, the potential of the silver economy, and the need for gerontechnology in addressing elderly healthcare challenges are key factors in influencing future technopreneurs' willingness to target ageing populations. As Malaysia's ageing population grows, there is an urgent demand for new technologies and services to support changing needs, including elderly care, daily assistance, and social well-being. For example, gerontechnology has been widely adopted in Japan to help older adults manage physical and cognitive decline.

Despite the growing business potential in gerontechnology, interest among technopreneurs remains relatively low. The study emphasizes that future technopreneurs need a deeper understanding of the ageing market and gerontechnology opportunities. Experts often link entrepreneurship to innovation, risk-taking, and economic transformation. Encouraging a culture of technopreneurship can actively drive the development of gerontechnology.

As Malaysia moves toward becoming an ageing nation by 2030, it is crucial for the country to not only consume technology but also contribute to technological advancement. Therefore, there is a pressing need to cultivate technologists capable of leveraging technological innovation to drive economic growth in the silver economy. Integrating technology and entrepreneurship plays a pivotal role in positioning technopreneurs as leaders in gerontechnology development.

Additionally, this study highlights that business exposure alone is insufficient in shaping technopreneurs' perceptions of the ageing market. Understanding the physical, mental, and social aspects of ageing is equally critical. Exposure to real-world challenges can stimulate creativity and encourage technopreneurs to develop innovative solutions in gerontechnology. The findings further suggest that those with prior knowledge of ageing processes are more likely to explore the silver economy market.

Research Limitations

This study acknowledges several limitations. First, data collection was limited to 100 final-year BTEC students at FPTT, UTeM, which excludes technopreneurs currently operating in the Malaysian market. Expanding the sample size and incorporating a broader respondent base would enhance the robustness of the findings. Additionally, the current sample may not fully represent active entrepreneurs focusing on gerontechnology. Increasing the sample size would strengthen the statistical significance of the findings, thereby contributing to a more comprehensive understanding of the subject matter. Future research should examine the perspectives of active technopreneurs and industry stakeholders to provide a more comprehensive understanding of market dynamics.

CONFLICT OF INTEREST

The authors declare there was no conflict of interest involved in this study.

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