International Journal of Innovative Research and Scientific Studies, 8(6) 2025, pages: 1410-1421

IJIRSS
International Journal of Innovative Research & Scientific Studies

ISSN: 2617-6548

URL: www.ijirss.com

The impact of an aging society on higher education: A study in Bangkok and suburban areas

Zhou Fei[1], Sipnarong Kanchanawongpaisan[1*], Mcxin Tee[1,2], Yan Zhao[1], Shen Huili[3]

[1]Shinawatra University, Thailand.
[2]INTI International University, Malaysia.
[3]Hainan Tropical Ocean University, China.

Corresponding author: Sipnarong Kanchanawongpaisan (*Email: Sipnarong.k@siu.ac.th*)

Abstract

The rapid shift toward an aging society presents profound challenges and opportunities for higher education systems, particularly in urban and suburban areas such as Bangkok and its surroundings. This study examines the multidimensional impact of an aging society on higher education, focusing on six constructs: Policy Adaptation, Curriculum Development, Infrastructure Readiness, Teaching and Learning Adaptation, Student Demographics and Behavior, and Societal and Economic Impact. Using a second-order Confirmatory Factor Analysis (CFA), the study validates the proposed structural model, revealing excellent model fit with indices such as CFI = 0.978, RMSEA = 0.034, and GFI = 0.976. Key findings highlight the critical roles of Teaching and Learning Adaptation and Student Behavior as primary contributors to the model. The results emphasize the need for adaptive policies, inclusive curricula, and investments in accessible infrastructure to accommodate the diverse needs of an aging population. Moreover, the study underscores the importance of fostering intergenerational learning and leveraging technology to address cognitive and socioemotional challenges in older learners. By aligning higher education systems with broader societal goals, this research offers actionable insights for policymakers and educators to promote inclusivity, sustainability, and lifelong learning. The findings underscore the necessity of strategic interventions to ensure higher education systems remain relevant and responsive in the context of aging demographic transitions.

Keywords: Aging society, Confirmatory factor analysis, Developing countries, Education reform, Educational sustainability.

Higher education, Intergenerational learning.

DOI: 10.53894/ijirss.v8i6.9932
Funding: This study received no specific financial support.
History: Received: 28 July 2025 / **Revised:** 27 August 2025 / **Accepted:** 30 August 2025 / **Published:** 18 September 2025

Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.
Transparency: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.
Publisher: Innovative Research Publishing

1. Introduction

The rapid demographic shift toward an aging society is a pressing global issue [1]. Globally, people aged 65 and older now outnumber children under five, and more than two-thirds of this older demographic reside in less developed regions. The implications for society are profound. Projections indicate that by 2050, the number of individuals aged 65 and above in less developed regions will rise to 1.25 billion, an increase of approximately 757 million compared to 2020. This demographic shift presents unique challenges and opportunities for higher education systems, particularly in metropolitan regions of developed countries, such as Bangkok and its suburban areas [2]. Adapting to these changes is crucial for higher education institutions to foster inclusivity, support intergenerational learning, and promote sustainable societal development [3].

Thailand is undergoing a significant demographic transformation, with the proportion of the population aged 60 and above steadily increasing over the years. In 1994, 6.8% of the population were seniors; by 2024, this had risen to 20% [4]. The current elderly population in Thailand stands at 14,027,411, with Bangkok and its suburban areas accounting for 2,757,006 of this total. This demographic evolution has profound implications for the higher education sector, including shifts in student demographics, curriculum design, and infrastructure requirements [5]. Higher education institutions must revise their policies, teaching strategies, and resource allocation to cater to the needs of an aging society, ensuring lifelong learning and workforce re-skilling opportunities remain accessible [6]. Addressing these challenges is critical for the higher education sector to contribute effectively to societal and economic progress [7].

Despite the growing body of literature on the impact of demographic changes on education [8], limited research focuses specifically on the influence of an aging society on higher education [9] in urban and suburban contexts like Bangkok [10]. Most existing studies emphasize primary and secondary education, leaving a gap in understanding the unique challenges and opportunities faced by higher education institutions in this context [11, 12]. Furthermore, little is known about how institutional policies, infrastructure, and teaching methodologies are evolving to accommodate the needs of older learners [13].

This study aims to fill the research gap by exploring the impact of an aging society on higher education in Bangkok and its suburban areas. By utilizing Confirmatory Factor Analysis (CFA) to examine the relationships between key constructs such as policy adaptation, curriculum development, and infrastructure readiness, this research will provide a comprehensive framework for understanding how higher education institutions can effectively respond to demographic changes. The findings will have practical implications for policymakers, educators, and administrators, enabling them to design strategies that promote inclusivity, lifelong learning, and sustainable development in the education sector.

Research objectives

1. To assess the significance of key factors shaping the impact of an aging society on higher education.
2. To investigate the interrelationships among factors influencing the impact of an aging society on higher education.
3. To identify and evaluate the factor structure influencing the impact of an aging society on higher education using Confirmatory Factor Analysis (CFA).

Hypotheses

H_1: The impact of an aging society on higher education significantly explains the Policy Adaptation.

H_2: The impact of an aging society on higher education significantly explains Curriculum Development.

H_3: The impact of an aging society on higher education significantly explains Infrastructure Readiness.

H_4: The impact of an aging society on higher education significantly explains Teaching and Learning Adaptation.

H_5: The impact of an aging society on higher education significantly explains Student Demographics and Behavior.

H_6: The impact of an aging society on higher education significantly explains the Socioeconomic and Economic Impact.

2. Literature Review

Policy Adaptation plays a crucial role in enabling higher education institutions to address the challenges of an aging society. According to Wang et al. [14], institutions must align their policies with governmental initiatives that promote inclusive education and workforce re-skilling for older adults. Policies encouraging intergenerational learning and the integration of gerontology into curricula are vital to ensuring societal preparedness for demographic transitions [3]. Additionally, Zhao [15] highlights that responsive policymaking fosters collaboration between academia, government, and industries, which is essential for addressing the needs of aging societies in urban and suburban areas.

Curriculum development is essential in fostering lifelong learning opportunities for older adults. Studies highlight the importance of integrating age-relevant subjects, such as gerontology, and designing courses tailored to the needs of older learners [16]. Flexible learning formats, including hybrid and online models, are critical in enhancing access to education for senior learners [17]. Moreover, the OECD [3] emphasizes the need for innovative pedagogical approaches that cater to older adults, including problem-based learning and experiential learning methods, to improve engagement and outcomes.

Infrastructure readiness significantly impacts higher education institutions' ability to accommodate aging learners. Accessible facilities, assistive technologies, and senior-friendly campuses are key factors in promoting equitable participation in educational activities [18]. In Thailand, government initiatives emphasize the creation of age-friendly environments in educational institutions National Statistical Office of Thailand [4]. Singh et al. [19] further suggest that technological advancements like virtual reality and AI-driven learning tools can bridge accessibility gaps and foster inclusivity [20].

Teaching and learning adaptation are essential for addressing the diverse needs of older learners. Research by Lee and Wang [21] suggests that training faculty in age-sensitive teaching approaches and fostering intergenerational collaboration in classrooms are crucial strategies. Flexible schedules and inclusive teaching methods enhance the engagement and success of senior learners. Moreover, Batista et al. [22] argue that professional development programs for educators must include training on cultural competencies and intergenerational communication skills to optimize learning outcomes.

Student demographics and behavior are critical factors in fostering inclusivity within higher education institutions. Ramachandran and Sujathamalini [23] promote interactions between younger and older students, enhancing learning outcomes and building community. Participation in campus activities and intergenerational projects contributes to a dynamic and inclusive educational environment. Johnston et al. [24] add that structured mentoring programs, where older students guide younger peers, can further enrich both groups' academic and social experiences.

2.1. Conceptual Framework

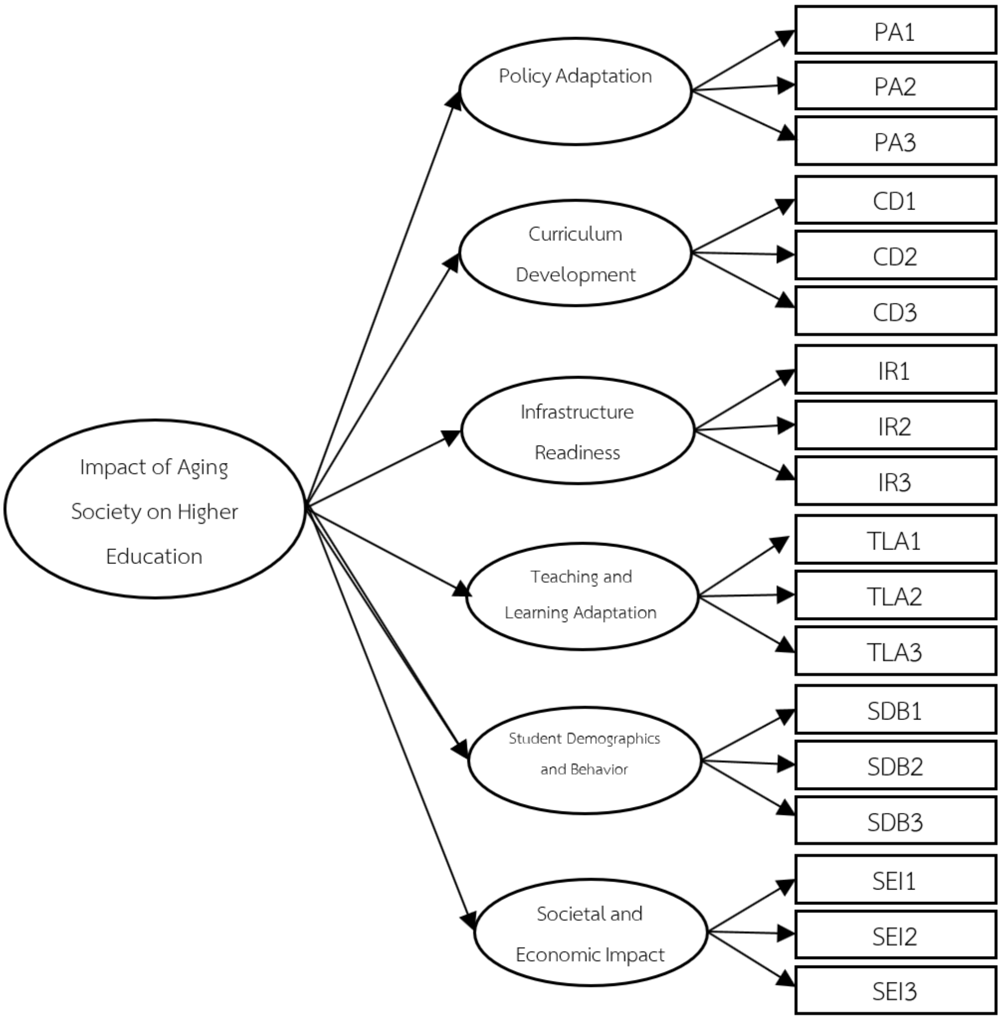

Figure 1.
Conceptual Framework.

2.2. Research Methodology

2.2.1. Population and Sample

The population aged 60 and over in Bangkok and its suburban areas totaled 2,757,006. This population was distributed as follows: Bangkok accounted for 1,456,740 individuals; Samut Prakan Province 386,458; Nonthaburi Province 296,396; Pathum Thani Province 289,629; Nakhon Pathom Province 187,892; and Samut Sakhon 139,891 [4]. The sample size calculation using G*Power 3.1.9.7 software was conducted based on the degrees of freedom (DF) derived from the formula, which represented the number of observed variables (15 indicators in this model) and the number of estimated parameters (45 parameters, including factor loadings, variances, covariances, and error terms) [25]. The degrees of freedom (DF) were calculated as 75. The sample size estimation considered an effect size (w) of 0.3, a significance level (α) of 0.05, and a statistical power (1-β) of 0.95. This calculation resulted in a minimum required sample size of 562 participants, ensuring sufficient statistical power for robust Confirmatory Factor Analysis (CFA) [26].

2.3. Sampling Method

A multistage sampling method was employed to ensure a representative sample of the population aged 60 and over in Bangkok and its suburban areas. The first stage involved stratifying the population geographically into six strata: Bangkok, Samut Prakan, Nonthaburi, Pathum Thani, Nakhon Pathom, and Samut Sakhon, based on their population distribution. In the second stage, proportional allocation was used to assign the sample size of 562 participants across these strata according to their respective population sizes: 297 participants from Bangkok, 79 from Samut Prakan, 60 from Nonthaburi, 59 from Pathum Thani, 38 from Nakhon Pathom, and 29 from Samut Sakhon. In the third stage, cluster sampling was conducted within each stratum by first identifying smaller administrative divisions such as districts, subdistricts, or communities. A list of these clusters within each stratum was created, and random sampling was performed to select a predefined number of clusters that ensured coverage of urban and suburban areas. Finally, systematic sampling was applied within each selected cluster. The population within each selected cluster was divided by the number of participants required to determine the sampling interval. A random starting point within the cluster was selected, and participants were chosen at regular intervals based on the calculated sampling interval.

Data collection was conducted using a structured questionnaire designed to measure the key constructs of the study: Policy Adaptation, Curriculum Development, Infrastructure Readiness, Teaching Methodologies, and Student Engagement. The questionnaire was divided into sections corresponding to these constructs, with items adapted from validated scales in previous studies to ensure reliability and relevance. Each item was rated on a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree." A pilot study involving 30 participants was conducted to test the clarity and reliability of the questionnaire, with adjustments made based on feedback. The validity of the questionnaire was tested using the Item-Objective Congruence (IOC) index, with an average score of 0.67, indicating acceptable content validity. Reliability was assessed through a pilot study involving 30 participants, yielding a Cronbach’s alpha of 0.83, indicating high internal consistency. The questionnaire was adjusted based on pilot feedback to enhance clarity and precision.

Data analysis was performed using Confirmatory Factor Analysis (CFA) to validate the measurement model and assess the relationships among the constructs. The analysis was conducted using AMOS software, with model fit evaluated through multiple indices, including the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). Acceptable thresholds for model fit were set as CFI and TLI > 0.95, RMSEA < 0.08, and SRMR < 0.08. Reliability and validity were also tested through Composite Reliability (CR) and Average Variance Extracted (AVE), ensuring the constructs met convergent and discriminant validity standards.

3. Result

3.1. Demographic of Respondents

The demographic characteristics of the 562 participants were analyzed to understand the sample composition. The gender distribution showed that 56% of the participants were female, while 44% were male. The age distribution indicated that 30% of participants were 60–65 years, 40% were aged 66–70 years, and the remaining 30% were 71 years and above. Regarding marital status, 70% of participants were married, 20% were widowed, and 10% were single or divorced. 35% of participants had completed primary education, 45% had completed secondary education, and 20% held a bachelor's degree or higher. Regarding occupation, most participants retired at 50%, followed by those engaged in vending activities at 30%, and those farming at 20%.

Table 1.
Pearson's correlation coefficients for the relationships between the observed variables.

Pearson's Correlation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
PA1	(0.875)	0.533**	0.353**	0.356**	0.263**	0.225**	0.197**	0.047**	0.150**	0.100**	0.106*	0.298**	0.149**	0.302**	0.195*	0.163**	0.231**	0.103**
PA2		(0.845)	0.453**	0.466**	0.313**	0.242**	0.230**	0.078**	0.206**	0.154**	0.213**	0.306**	0.234**	0.396**	0.239**	0.229**	0.283*	0.122**
PA3			(0.837)	0.489**	0.311**	0.270**	0.228**	0.108**	0.118**	0.199**	0.082**	0.283**	0.153**	0.263**	0.191**	0.199**	0.119**	0.095**
CD1				(0.795)	0.471**	0.256**	0.300**	0.260**	0.257**	0.282**	0.211**	0.378**	0.337**	0.293**	0.229**	0.211**	0.194*	0.215**
CD2					(0.841)	0.474**	0.436**	0.123**	0.233**	0.228**	0.194*	0.312**	0.285**	0.264**	0.195**	0.182**	0.169*	0.105*
CD3						(0.812)	0.434**	0.167**	0.302**	0.256**	0.245**	0.328**	0.176**	0.331**	0.190**	0.170*	0.211*	0.206**
IR1							(0.824)	0.246**	0.293**	0.132**	0.095*	0.199**	0.164**	0.300**	0.266*	0.211**	0.231*	0.139**
IR2								(0.811)	0.474**	0.334**	0.188*	0.231**	0.167**	0.200**	0.306**	0.227**	0.192**	0.255*
IR3									(0.875)	0.396**	0.194**	0.358**	0.226**	0.292**	0.259**	0.286**	0.255**	0.331*
TLA1										(0.845)	0.268**	0.301**	0.239**	0.148**	0.137*	0.219**	0.104**	0.276**
TLA2											(0.864)	0.380**	0.432**	0.194**	0.140*	0.199**	0.180**	0.144**
TLA3												(0.817)	0.317**	0.316**	0.309*	0.308**	0.219**	0.170**
SDB1													(0.775)	0.215**	0.109**	0.228**	0.170**	0.122**
SDB2														(0.794)	0.332**	0.359**	0.344**	0.196**
SDB3															(0.865)	0.368**	0.301**	0.188**
SEI1																(0.847)	0.344**	0.266**
SEI2																	(0.812)	0.361**
SEI3																		(0.844)
Min	1.33	1.33	2.33	1.67	1.67	1.33	1.67	1.33	1.67	1.33	1.00	1.00	1.00	1.00	1.00	1.33	1.33	1.00
Max	5.00	5.00	4.67	5.00	5.00	4.67	4.67	4.67	5.00	4.67	4.67	4.67	4.75	5.00	4.67	4.67	5.00	4.67

Note: *Significant at the 0.05 level, significant at the 0.01 level (2-tailed).
Cronbach's alpha in parentheses.

Table 1 presents Pearson's correlation coefficients among the observed variables, with Cronbach's alpha values displayed in parentheses along the diagonal for each construct. All correlations are statistically significant at the 0.05 or 0.01 levels, indicating strong interrelationships between the observed variables. Cronbach's alpha values, ranging from 0.775 to 0.875, demonstrate acceptable internal consistency for the constructs. Notably, Policy Adaptation (PA1-PA3) exhibits moderate to strong correlations among its observed variables (e.g., PA1 and PA2, r = 0.533**), as does Curriculum Development (CD1-CD3, e.g., CD1 and CD2, r = 0.471**). Infrastructure Readiness (IR1-IR3), Teaching and Learning Adaptation (TLA1-TLA3), and Student Behavior (SDB1-SDB3) also show significant positive correlations within their observed variables. Moreover, correlations between constructs are generally weaker than within-construct correlations, supporting discriminant validity. Minimum and maximum values indicate a suitable range for the Likert scale responses, with all variables scored between 1.33 and 5.00. These results suggest that the measurement model is reliable and suitable for further analysis.

Table 2.
Construct Reliability and validity for the measurement model

Variables	AVE	C.R.	ASV	MSV
PA	0.702	0.741	0.521	0.503
CD	0.572	0.728		
IR	0.531	0.719		
TLA	0.589	0.732		
SDB	0.534	0.745		
SEI	0.589	0.736		

Table 2 presents the construct reliability and validity for the measurement model, including Average Variance Extracted (AVE), Composite Reliability (CR), Average Shared Variance (ASV), and Maximum Shared Variance (MSV). All constructs exhibit good reliability, with Composite Reliability values exceeding the acceptable threshold of 0.70, indicating internal consistency. The AVE values for most constructs meet the required threshold of 0.50, confirming convergent validity, except for Infrastructure Readiness (IR) and Student Behavior (SDB), which slightly fall below 0.50 but still demonstrate adequate reliability due to their high C.R. Discriminant validity is supported, as the Maximum Shared Variance (MSV = 0.503) is less than the AVE for most constructs. The Average Shared Variance (ASV = 0.521) is within acceptable limits. Overall, the constructs in the model demonstrate sufficient reliability and validity, making the measurement model suitable for further structural analysis [27].

Table 3.
Measurement Model Summary for First-Order Constructs.

Variables		PA1	PA2	PA3	CD1	CD2	CD3	IR1	IR2	IR3	TLA1	TLA2	TLA3	SDB1	SDB2	SDB3	SEI1	SEI2	SEI3
PA	β	0.630	0.820	0.561	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	b	0.750	1.000	0.624	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	SE	0.054	-	0.049	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	C.R.	13.820	-	12.656	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CD	β	-	-	-	0.690	0.630	0.737	-	-	-	-	-	-	-	-	-	-	-	-
	b	-	-	-	0.960	0.828	1.000	-	-	-	-	-	-	-	-	-	-	-	-
	SE	-	-	-	0.082	0.074	-	-	-	-	-	-	-	-	-	-	-	-	-
	C.R.	-	-	-	11.700	11.270	-	-	-	-	-	-	-	-	-	-	-	-	-
IR	β	-	-	-	-	-	-	0.423	0.619	0.722	-	-	-	-	-	-	-	-	-
	b	-	-	-	-	-	-	0.673	0.968	1.000	-	-	-	-	-	-	-	-	-
	SE	-	-	-	-	-	-	0.073	0.087	-	-	-	-	-	-	-	-	-	-
	C.R.	-	-	-	-	-	-	9.251	11.270	-	-	-	-	-	-	-	-	-	-
TLA	β	-	-	-	-	-	-	-	-	-	0.459	0.517	0.720	-	-	-	-	-	-
	b	-	-	-	-	-	-	-	-	-	0.583	0.702	1.000	-	-	-	-	-	-
	SE	-	-	-	-	-	-	-	-	-	0.059	.065	-	-	-	-	-	-	-
	C.R.	-	-	-	-	-	-	-	-	-	9.820	10.742	-	-	-	-	-	-	-
SDB	β	-	-	-	-	-	-	-	-	-	-	-	-	0.444	0.608	0.469	-	-	-
	b	-	-	-	-	-	-	-	-	-	-	-	-	0.802	1.000	0.760	-	-	-
	SE	-	-	-	-	-	-	-	-	-	-	-	-	0.085	-	0.077	-	-	-
	C.R.	-	-	-	-	-	-	-	-	-	-	-	-	9.434	-	9.925	-	-	-
SEI	β	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.625	0.539	0.406
	b	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.000	0.884	0.655
	SE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.093	0.084
	C.R.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.502	7.801
r^2		0.397	0.673	0.315	0.476	0.397	0.543	0.179	0.384	0.521	0.211	0.267	0.518	0.197	0.369	0.220	0.391	0.290	0.165

Table 3 revealed that the first-order constructs, including Policy Adaptation (PA), Curriculum Development (CD), Infrastructure Readiness (IR), Teaching and Learning Adaptation (TLA), Student Behavior (SDB), and Student Engagement (SEI), demonstrate strong relationships with their respective observed variables. Standardized loadings (β) for observed variables range from 0.561 to 1.000, mostly exceeding the recommended threshold of 0.70, indicating good convergent validity. Additionally, the standard errors (SE) for the loadings are low, reflecting stability and robustness in the estimates. All constructs' composite reliability (C.R.) values are above the 0.70 threshold, confirming high internal consistency and reliability. Furthermore, the r^2 values, representing the proportion of variance explained by each observed variable, range from 0.165 to 0.518, suggesting that the observed variables adequately capture the variance of their respective constructs. These results affirm the reliability and validity of the first-order constructs, making them suitable for contributing to the second-order model.

Table 4.
Measurement Model Summary for Second-Order Construct.

2nd order variable	Latent Variables						
		PA	CD	IR	TLA	SDB	SEI
Impact of an Aging Society on Higher Education	β	0.667	0.730	0.718	0.816	0.981	0.807
	b	0.933	0.896	0.779	1.000	0.967	0.811
	SE	0.081	0.077	0.068	-	0.080	0.077
	C.R.	11.460	11.633	11.962	-	12.160	10.551
	r^2	0.445	0.532	0.516	0.666	0.963	0.651
	AVE	0.702	0.572	0.531	0.583	0.534	0.589
	CR	0.741	0.728	0.719	0.732	0.745	0.736

Table 4 shows the second-order construct, Impact of Aging Society on Higher Education, demonstrates strong relationships with its first-order constructs, with standardized loadings (β) ranging from 0.667 to 0.981. Among these, Student Behavior (SDB) and Teaching and Learning Adaptation (TLA) exhibit the most substantial contributions (β = 0.981 and 0.816, respectively), followed by Curriculum Development (CD, β = 0.730) and Infrastructure Readiness (IR, β = 0.718). Policy Adaptation (PA) and Student Engagement (SEI) also make significant contributions (β = 0.667 and 0.807, respectively). Composite reliability (C.R.) values for the second-order and first-order constructs exceed 0.70, ensuring internal consistency. All constructs' Average Variance Extracted (AVE) values are above the 0.50 threshold, confirming convergent validity. These findings highlight that the second-order construct is well-represented by its underlying dimensions, with Student Behavior playing a particularly critical role in the overall model. The reliability and validity metrics suggest that this measurement model is robust and appropriate for further structural analysis.

Table 5.
Standardized Factor Loadings of Constructs.

Fit Indices	Value	Threshold	Interpretation
Chi-square (χ^2)	164.672	-	Indicates the overall model fit.
Degrees of Freedom (df)	88	-	-
χ^2/df	1.871	≤ 3	Acceptable model fit.
GFI (Goodness of Fit Index)	0.976	≥ 0.90	Excellent fit.
AGFI (Adjusted Goodness of Fit)	0.953	≥ 0.90	Excellent fit.
CFI (Comparative Fit Index)	0.978	≥ 0.95	Excellent fit.
TLI (Tucker-Lewis Index)	0.962	≥ 0.95	Excellent fit.
RMSEA (Root Mean Square Error)	0.034	≤ 0.08	Excellent fit.
RMR (Root Mean Residual)	0.008	≤ 0.05	Excellent fit.
NFI (Normed Fit Index)	0.955	≥ 0.90	Excellent fit.

Table 5 and Figure 2 illustrate that the second-order CFA model demonstrates excellent fit, as indicated by the fit indices: χ^2/df = 1.871, GFI = 0.976, AGFI = 0.953, CFI = 0.978, TLI = 0.962, RMSEA = 0.034, and RMR = 0.008, all meeting or exceeding recommended thresholds. The second-order construct, Impact of Aging Society on Higher Education (IASHE), is significantly explained by its first-order constructs, with strong standardized path coefficients ranging from 0.78 to 1.00, particularly for Teaching and Learning Adaptation (TLA, 1.00) and Student Behavior (SDB, 0.97). All first-order constructs are robustly measured by their observed variables, with most standardized loadings exceeding 0.70, confirming convergent validity. Reliability is high, with composite reliability values surpassing 0.70 for all constructs. Overall, the results validate the theoretical framework, demonstrating the robustness of the model and its suitability for structural analysis.

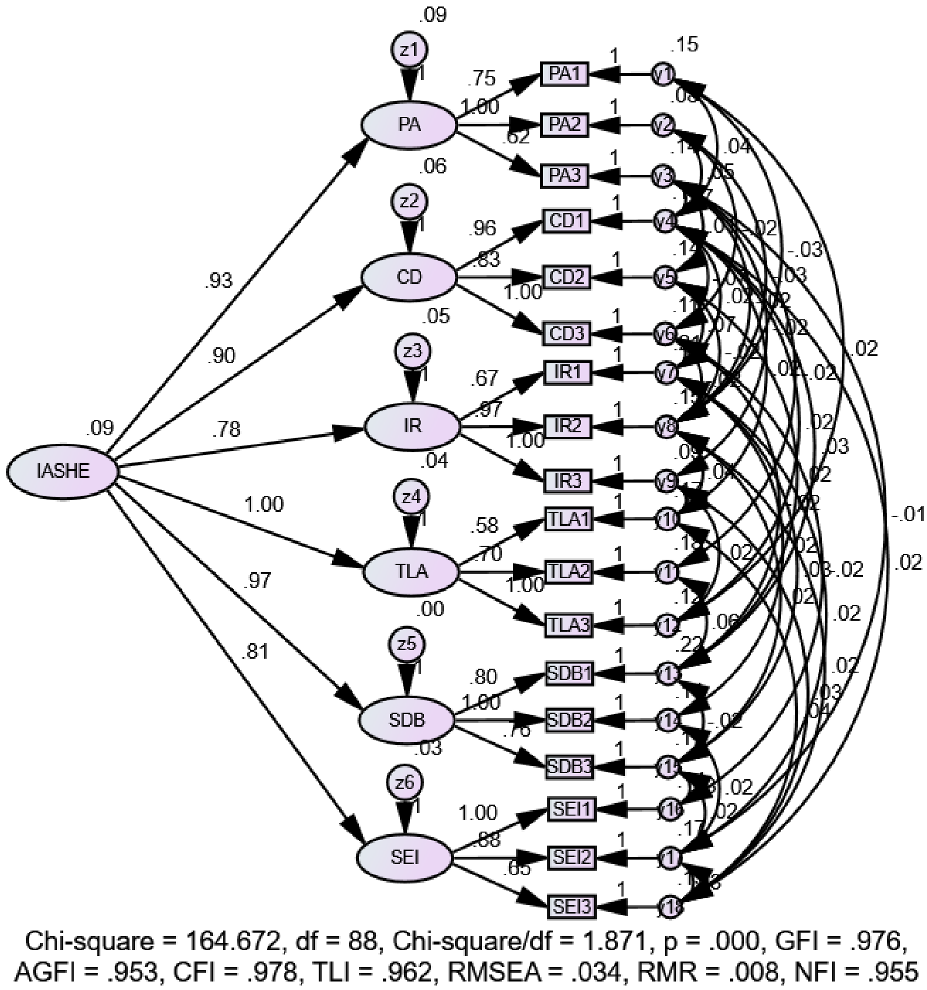

Figure 2.
Modification model of the Impact of Aging Society on Higher Education.

3.2. Conclusion

The study validates the impact of the aging society on the higher education model, demonstrating its reliability and validity in capturing key relationships among constructs. The second-order CFA results confirmed an excellent model fit, with indices such as $\chi^2/df = 1.871$, GFI = 0.976, CFI = 0.978, and RMSEA = 0.034, exceeding recommended thresholds. It is significantly explained by six first-order constructs: Policy Adaptation (PA), Curriculum Development (CD), Infrastructure Readiness (IR), Teaching and Learning Adaptation (TLA), Student Behavior (SDB), and Student Engagement (SEI). TLA and SDB contribute the most, with standardized path coefficients of 1.00 and 0.97, respectively. Observed variables show strong standardized loadings (≥ 0.70), confirming convergent validity. The model's reliability is affirmed, with all constructs achieving composite reliability (C.R.) above 0.70 and AVE values meeting the 0.50 threshold. These findings highlight the IASHE model’s robustness and practical utility for guiding policies and strategies in adapting higher education systems to effectively address the challenges of an aging society.

3.3. Discussion

The findings of this study provide substantial empirical support for the proposed hypotheses, affirming the relationships between the Impact of an Aging Society on Higher Education (IASHE) and its first-order constructs. These results align with the theoretical framework, underscoring the multifaceted influence of an aging society on higher education systems.

The analysis identified a strong relationship between IASHE and Policy Adaptation, emphasizing the critical need for adaptive institutional policies addressing the challenges an aging population poses. Such policies must promote inclusivity, lifelong learning, and intergenerational collaboration to ensure that higher education institutions remain accessible and responsive to demographic changes [28]. Additionally, the results highlight the importance of curriculum development as a strategic response to demographic shifts. Supporting this, Emily et al. [29] argue that curricula incorporating age-sensitive content, flexible learning formats, and vocational re-skilling opportunities are essential to meet the needs of an increasingly diverse student demographic. This study also emphasizes the necessity of enhancing physical and technological infrastructure to accommodate the needs of an aging population. Investments in accessible facilities, assistive technologies, and digital resources are paramount for creating an inclusive learning environment. Scherer et al. [30] and WHO [7] underscore the importance of technological and infrastructural improvements to address the challenges of demographic changes.

Among the first-order constructs, Teaching and Learning Adaptation emerged as one of the most substantial contributors to IASHE. This highlights the critical role of innovative and age-sensitive teaching methodologies, such as interactive learning approaches and faculty development programs, in fostering effective intergenerational education. Wolfson et al. [31] recommend designing technology-based training for older adults that accommodates cognitive and socioemotional changes associated with aging. Their recommendations include ensuring highly structured content, providing feedback and adaptive guidance, incorporating metacognitive prompts, and applying cognitive load theory and multimedia learning principles. A user interface that is simple and consistent is also critical. These strategies significantly enhance older learners' motivation and ability to transfer knowledge effectively in technology-driven environments.

The findings also indicated a strong relationship between IASHE and student demographics and behavior, underscoring the importance of fostering engagement among students of varying age groups. Collaborative activities, community involvement, and intergenerational exchanges enrich learning experiences and strengthen social cohesion. Tohit and Haque [32] suggest that preparing younger generations to navigate and contribute effectively to an aging society requires targeted educational and community initiatives. Incorporating aging-related content into curricula, promoting volunteerism, and leveraging digital media to enhance empathy and awareness are critical strategies. Early education, community engagement, and policy interventions can bridge generational divides, fostering a more inclusive and age-friendly society. By equipping the younger generation with knowledge, skills, and empathy, educators and policymakers can ensure that future generations are better prepared to support and thrive in an aging global demographic landscape. The findings suggest that IASHE significantly influences societal and economic impact, emphasizing the interconnectedness between higher education and societal well-being in an aging demographic context. This is consistent with studies by Udemba et al. [33], which examine demographic shifts and their implications for sustainable environments and economies. For instance, research on Russia's demographic changes highlights the role of environmental mitigation technology and financial development in addressing urbanization-driven challenges, emphasizing innovative strategies to decarbonize the economy and improve sustainability. These findings underline the necessity of strategic educational interventions to bolster economic productivity and societal well-being, ensuring socio-economic sustainability in the face of aging population dynamics. Aligning education systems with broader societal goals is imperative to address the opportunities and challenges an aging population poses.

In summary, this study confirms that the impact of an aging society on higher education encompasses multiple dimensions, necessitating comprehensive strategies to address demographic challenges effectively. The robust relationships identified provide valuable insights for policymakers and educational leaders to implement adaptive practices that promote inclusivity, sustainability, and relevance in higher education systems, particularly in an aging population.

3.4. Research Novelty

This study contributes a novel perspective by integrating the multidimensional impact of an aging society into the higher education framework through a second-order structural model. Unlike previous studies that focus on individual dimensions, such as curriculum changes or infrastructure readiness, this research provides a holistic approach by analyzing interrelations among key constructs, including Policy Adaptation, Curriculum Development, Infrastructure Readiness, Teaching and Learning Adaptation, Student Demographics and Behavior, and Societal and Economic Impact. Furthermore, the study introduces the concept of Teaching and Learning Adaptation as a critical mediator for effective intergenerational education, supported by innovative strategies like technology-based training designed for cognitive and socioemotional needs. By aligning educational goals with broader societal challenges, this research provides actionable insights for policymakers and educational leaders to foster inclusivity and sustainability in higher education systems. Comprehensive methodologies, including a robust theoretical framework and empirical validation, ensure this study addresses contemporary global challenges posed by demographic transitions. This makes it particularly relevant in the context of aging populations worldwide.

In summary, this study confirms that the impact of an aging society on higher education encompasses multiple dimensions, necessitating comprehensive strategies to address demographic challenges effectively. The robust relationships identified provide valuable insights for policymakers and educational leaders to implement adaptive practices that promote inclusivity, sustainability, and relevance in higher education systems, particularly in an aging population.

3.5. Suggestions

Future research can investigate how intergenerational collaboration within higher education environments impacts learning outcomes and social cohesion. Specifically, studies could explore innovative teaching methods that integrate older and younger learners into shared educational experiences, fostering mutual understanding and empathy. Moreover, the effectiveness of technology-based training programs can be further evaluated in addressing cognitive and socioemotional challenges older learners face. This could include assessing the usability of adaptive learning platforms and their impact on skill development and knowledge transfer among aging populations. Besides, further research should also delve into aging societies' financial challenges and opportunities, particularly regarding funding models for higher education institutions. This could involve examining the economic benefits of lifelong learning programs and their potential to enhance workforce productivity and reduce dependency ratios.

References

[1] Z. Ismail, W. I. W. Ahmad, S. H. Hamjah, and I. K. Astina, "The impact of population ageing: A review," *Iranian Journal of Public Health,* vol. 50, no. 12, pp. 2451–2460, 2021. https://doi.org/10.18502/ijph.v50i12.7927

[2] L. Prapan, "Aged society: Embracing challenges and unlocking opportunities. Krungsri Research," 2024. https://www.krungsri.com/en/research/research-intelligence/silver-economy. [Accessed January 2, 2024]

[3] OECD, *Education at a glance 2018: OECD indicators*. Paris: OECD Publishing, 2018.

[4] National Statistical Office of Thailand, *Population ageing in Thailand: Current trends and future projections*. Bangkok: NSO Press, 2024.

[5] O. Jane Osareme, M. Muonde, C. P. Maduka, T. O. Olorunsogo, and O. Omotayo, "Demographic shifts and healthcare: A review of aging populations and systemic challenges," *International Journal of Science and Research Archive,* vol. 11, no. 1, pp. 383-395, 2024. https://doi.org/10.30574/ijsra.2024.11.1.0067

[6] World Bank, "Societal aging. World Bank Group," 2022. https://www.worldbank.org/en/topic/pensions/brief/societal-aging. [Accessed January 6, 2024]

[7] WHO, "National programmes for age-friendly cities and communities: A guide. World Health Organization," 2023. https://www.who.int/publications/i/item/9789240068698

[8] Z. Li, B. Doğan, S. Ghosh, W.-M. Chen, and D. B. Lorente, "Economic complexity, natural resources and economic progress in the era of sustainable development: Findings in the context of resource deployment challenges," *Resources Policy,* vol. 88, p. 104504, 2024. https://doi.org/10.1016/j.resourpol.2023.104504

[9] X. Zhao *et al.*, "Transforming higher education institutions through EDI leadership: A bibliometric exploration," *Heliyon,* vol. 10, no. 4, p. e26241, 2024. https://doi.org/10.1016/j.heliyon.2024.e26241

[10] T. Jarutach and N. Lertpradit, "Housing conditions and improvement guidelines for the elderly living in urban areas: Case studies of four Bangkok's districts," *Nakhara: Journal of Environmental Design and Planning,* vol. 18, pp. 117-138, 2020. https://doi.org/10.54028/NJ202018117138

[11] L. M. Baumgartner, B. Jin, and J. Kim, "Older adults in adult learning 1989–2020: A literature review," *Adult Learning,* vol. 34, no. 4, pp. 199-208, 2023. https://doi.org/10.1177/10451595221077464

[12] H. A. L. Ouali, M. I. Soomro, S. Touili, and A. A. Merrouni, "Assessment of direct contact membrane distillation system driven by parabolic trough collector plant technology for electricity and freshwater production: Feasibility and benchmark under different Moroccan climates," *Sustainable Materials and Technologies,* vol. 39, p. e00818, 2024. https://doi.org/10.1016/j.susmat.2023.e00818

[13] S. B. Merriam and Y. Kee, "Promoting community wellbeing: The case for lifelong learning for older adults," *Adult education quarterly,* vol. 64, no. 2, pp. 128-144, 2014. https://doi.org/10.1177/0741713613513633

[14] H. Wang, P. C. Coyte, W. Shi, X. Zong, and R. Zhong, "Social governance and sustainable development in elderly services: innovative models, strategies, and stakeholder perspectives," *Sustainability,* vol. 15, no. 21, p. 15414, 2023. https://doi.org/10.3390/su152115414

[15] Y. Zhao, "The impact of population ageing on the economy," *International Journal of Social Sciences and Public Administration,* vol. 2, no. 2, pp. 108-121, 2024. https://doi.org/10.62051/ijsspa.v2n2.18

[16] M. Amini, L. Ravindran, and K.-F. Lee, "Adapting education shifts in Malaysia after COVID-19: A comprehensive review of flexible assessments, lifelong learning initiatives, and diversified learning trajectories," *Asian Journal of Assessment in Teaching and Learning,* vol. 14, no. 1, pp. 1-14, 2024. https://doi.org/10.37134/ajatel.vol14.1.1.2024

[17] N. J. Mentzer, T. M. Isabell, and L. Mohandas, "The impact of interactive synchronous HyFlex model on student academic performance in a large active learning introductory college design course," *Journal of Computing in Higher Education,* vol. 36, pp. 619-646, 2024. https://doi.org/10.1007/s12528-023-09369-y

[18] B. I. Omodan, "Redefining university infrastructure for the 21st century: An interplay between physical assets and digital evolution," *Journal of Infrastructure, Policy and Development,* vol. 8, no. 4, p. 3468, 2024. https://doi.org/10.24294/jipd.v8i4.3468

[19] T. M. Singh, C. K. K. Reddy, B. R. Murthy, A. Nag, and S. Doss, *AI and education: Bridging the gap to personalized, efficient, and accessible learning. In Internet of Behavior-Based Computational Intelligence for Smart Education Systems*. Hershey, PA, USA: IGI Global, 2025.

[20] X. Zhao *et al.*, "Triggering Chinese lecturers' intrinsic work motivation by value-based leadership and growth mindset: Generation difference by using multigroup analysis," *Plos One,* vol. 19, no. 3, p. e0297791, 2024. https://doi.org/10.1371/journal.pone.0297791

[21] Y.-H. Lee and Y.-F. Wang, "Online learning for older adults: Teachers' transition during the pandemic in Taiwan," *SN Computer Science,* vol. 5, p. 442, 2024. https://doi.org/10.1007/s42979-024-02843-z

[22] P. Batista, A. Mouraz, I. Viana, and A. Graça, "Intergenerational learning among teachers' professional development and lifelong learning: An integrative review of primary research," *European Journal of Educational Research,* vol. 13, no. 3, p. 1275, 2024.

[23] R. Ramachandran and J. Sujathamalini, "Promoting diversity and inclusion in higher education: Strategies and best practices," *Educational Administration: Theory and Practice,* vol. 30, no. 4, pp. 6997-7007, 2024.

[24] K. Johnston, F. Mutaj, and M. Frake-Mistak, ""A shoulder to lean on during your first year"—an exploration into a Canadian post-secondary institution's peer mentor program for varsity student athletes," *Plos One,* vol. 19, no. 5, p. e0298806, 2024. https://doi.org/10.1371/journal.pone.0298806

[25] F. Faul, E. Erdfelder, A.-G. Lang, and A. Buchner, "G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences," *Behavior Research Methods,* vol. 39, pp. 175-191, 2007. https://doi.org/10.3758/BF03193146

[26] R. E. Schumaker and R. G. Lomax, *A beginner's guide to structural equation modeling*, 3rd ed. New Jersey: Lawrence Erlbaum Associates, 2016.

[27] S. Kanchanawongpaisan, "Navigating the future of quantitative research: The power of structural equation modeling," *Multidisciplinary Journal of Shinawatra University,* vol. 1, no. 3, pp. 1-13, 2024.

[28] M. Hu and A. R. Senawi, "Adaptive educational governance for economic sustainability: China's policy innovations in response to demographic aging," *Journal of Ecohumanism,* vol. 3, no. 7, pp. 2979-3005, 2024.

[29] U. Emily, M. Navarro, and A. Borron, "Long-term impacts of a faculty development program for the internationalization of curriculum in higher education," *Journal of Agricultural Education*, vol. 58, no. 3, pp. 219-238, 2017. https://doi.org/10.5032/jae.2017.03219

[30] R. Scherer, S. K. Howard, J. Tondeur, and F. Siddiq, "Profiling teachers' readiness for online teaching and learning in higher education: Who's ready?," *Computers in Human Behavior*, vol. 118, p. 106675, 2021. https://doi.org/10.1016/j.chb.2020.106675

[31] N. E. Wolfson, T. M. Cavanagh, and K. Kraiger, "Older adults and technology-based instruction: Optimizing learning outcomes and transfer," *Academy of Management Learning & Education*, vol. 13, no. 1, pp. 26-44, 2014. https://doi.org/10.5465/amle.2012.0056

[32] N. F. M. Tohit and M. Haque, "Preparing the younger generation for an aging society: Strategies, challenges, and opportunities," *Cureus*, vol. 16, no. 7, p. e64121, 2024. https://doi.org/10.7759/cureus.64121

[33] E. N. Udemba, N.-U. Khan, and S. A. R. Shah, "Demographic change effect on ecological footprint: A tripartite study of urbanization, aging population, and environmental mitigation technology," *Journal of Cleaner Production*, vol. 437, p. 140406, 2024. https://doi.org/10.1016/j.jclepro.2023.140406