

Research on the Evaluation of High-Quality Development of Elderly Education in Xi'an Empowered by Digitalization

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Abstract: With the acceleration of population aging and the deep penetration of digital technology, elderly education, as an important approach to actively respond to aging, cannot achieve high-quality development without the empowerment and support of digital technology. This paper takes Xi'an City as the research object, focusing on the construction and practical application of the evaluation system for the high-quality development of elderly education empowered by digital technology. Through methods such as literature research, Delphi method, and AH-fuzzy comprehensive evaluation, an evaluation system including 31 specific indicators is constructed from five dimensions: influence scope, software and hardware, process and result, development quality, and digital empowerment. And conduct an empirical evaluation of the current situation of digital development of elderly education in Xi'an. Research has found that Xi'an has shortcomings in areas such as elderly-friendly design, learners' digital literacy, and personalized services. Based on this, countermeasures such as optimizing the supply structure of digital resources, strengthening the research and development of aging-friendly technologies, and establishing a dynamic evaluation mechanism are proposed, providing theoretical references and practical paths for promoting the high-quality development of elderly education in Xi'an and even the whole country.

Keywords: Digital Empowerment; Elderly Education; High-Quality Development; Evaluation System; Xi'an

1. Introduction

By 2024, the proportion of people aged 60 and above in Xi'an had reached 21.3%, marking the city's entry into a stage of deep aging. The demands of the elderly for education have shifted from traditional cultural entertainment to

diversified, personalized and high-quality directions. Digital technology offers the possibility to break through the time and space limitations of elderly education and enhance service efficiency. The State Council has explicitly put forward the requirement of "promoting the digital transformation of elderly education", demanding that digital empowerment be used to expand the coverage of elderly education and improve its quality [1]. Against this backdrop, how to scientifically evaluate the enabling effect of digital technology on the high-quality development of elderly education has become an urgent theoretical and practical issue to be addressed.

2. Analysis of the Current Situation of Digital Development in Elderly Education in Xi'an

There are currently 137 senior universities (including community branches) in Xi'an City. Among them, 78% of the institutions offer online education, with over 420 online courses developed, covering areas such as health preservation, culture and art, and digital skills. In 2023, the number of elderly people learning online in the city exceeded 800,000, an increase of 150% compared with 2020, and the application of digital technology has begun to take shape [2].

The digital resources for elderly education in Xi'an are widely covered. Relying on the "Xi'an Lifelong Learning Network", digital learning terminals have been fully covered in urban communities. Local cultural courses, such as Stele Forest calligraphy and Tang Dynasty culture, account for 30%, forming regional characteristics. The policy support is also considerable. In 2022, the "Action Plan for the Digital Development of Elderly Education in Xi'an City" was issued, setting up a special fund with an average annual growth rate of 12% to promote the pilot construction of "Smart Elderly Universities".

The potential market demand for elderly education is huge^[3]. However, one of the

prominent issues in elderly education in Xi'an is the insufficient design for the elderly. 65% of elderly students have reported that the operation of the platform is complicated, such as small fonts and pop-up advertisements. The coverage rate of elderly-friendly terminals in rural areas is only 38%, with a significant gap between urban and rural areas. Second, personalized services are lacking. The recommended usage rate of AI courses is less than 20%, and 80% of the courses still follow a uniform progress, which is difficult to meet the needs of the elderly and those with low educational qualifications. Thirdly, there is a shortcoming in digital literacy. 45% of elderly students only master basic smartphone operations and have difficulty using functions such as online payment and course replay, which affects their learning outcomes.

3. Empirical Analysis on the Evaluation of High-Quality Development of Elderly Education in Xi'an Empowered by

Table 1. Summary Table of Weights for Evaluation Indicators of Digital Empowerment for High-Quality Development of Elderly Education in Xi'an

Different levels (Target Layer)	First-level indicators and weights (Criterion layer)	Second-level indicators and weights (indicator layer)	Comprehensive weights
Scope of influence	Evaluation of the popularization of elderly education 0.092	1.Number of elderly education participants 0.102	0.009
		2. The enrollment rate for elderly education 0.275	0.025
		3.The participation rate of elderly education 0.421	0.039
		4. The coverage rate of elderly education 0.202	0.019
Hardware and software	Evaluation of elderly education infrastructure 0.168	1. Sufficiency of digital facilities 0.121	0.020
		2.The number of teaching points 0.058	0.010
		3. Rationality of funding input 0.186	0.031
		4.Richness of digital course resources 0.091	0.015
		5.The number of resources such as teaching materials 0.059	0.010
		6.The student-to-teacher ratio 0.092	0.015
		7.Policy and institutional support 0.244	0.041
		8. Timeliness of technical support services 0.162	0.027
Process and result	Evaluation of the process and outcome of Elderly education 0.107	1.Digital efficiency of management &services 0.168	0.018
		2. Digital convenience of interaction between teachers and students 0.199	0.021
		3. Digital Innovation in Teaching Methods 0.210	0.022
		4. The overall satisfaction rate of the trainees 0.223	0.024
		5. The number of re-employed people 0.20	0.021
Development quality	Evaluation of High-Quality Development of Elderly Education 0.305	1. Growth rate of funding input 0.118	0.036
		2. Timeliness of course content updates 0.047	0.014
		3. Satisfaction with learning outcomes 0.109	0.033
		4. The number of award-winning projects 0.152	0.046
		5.Resource utilization rate 0.065	0.020
		6. The number of demonstration teaching points 0.128	0.039
		7. The growth rate of students 0.190	0.058
		8. Social recognition and influence 0.190	0.058
Digital empowerment	Evaluation of Digital empowerment of elderly	1. Coverage rate of digital informatization 0.118	0.039
		2. Digital resource construction 0.109	0.036

Digitalization

3.1 Establish an Indicator System and Determine the Weights

At present, no generally recognized, unified and effective evaluation standard has been formed for elderly education^[4]. This paper uses questionnaire survey method, Delphi method and structured interview method to analyze the specific constituent elements of the "Digital Empowerment for High-Quality Development Evaluation of Elderly Education in Xi'an" index system. After repeated revision and argumentation, a reasonable and operable evaluation index system for digital empowerment for high-quality development of elderly education in Xi'an has been formed. This study uses the AHP (Analytic Hierarchy Process) to determine the index weights. After calculation, the index system weights are shown in Table 1 as follows.

results	Education 0.328	3.The digital literacy level of the teaching staff 0.124	0.041
		4. Popularization of digital teaching 0.193	0.063
		5. Digital convenience of interaction between teachers and students 0.228	0.075
		6. Students' adaptability to digital learning 0.213	0.070

3.2 Evaluation is Conducted Using the Fuzzy Comprehensive Evaluation Method

This study selected the fuzzy comprehensive evaluation method to conduct a comprehensive assessment of the high-quality development of digital-empowered elderly education. Questionnaires were sampled and distributed to elderly students, various elderly education institutions, elderly education teachers, elderly education management departments, and social enterprises through both online and offline

channels. The distribution of questionnaires covered all districts and counties in Xi'an, excluding remote rural and mountainous areas for the time being. A total of 500 questionnaires were distributed, and 420 valid questionnaires were retrieved, with an effective recovery rate of 84%. After data processing, the initial quantitative values of different indicators' evaluations were obtained, as detailed in Table 2 below. Then, the fuzzy comprehensive evaluation method was used for the comprehensive assessment.

Table 2. Weights and Evaluation Criteria of Digital Empowerment for High-Quality Development of Elderly Education in Xi'an

Different levels (Target Layer)	First-level indicators and weights (Criterion layer)	Second-level indicators and weights (indicator layer)	Comprehensive weight	Evaluation opinion			
				good	relatively good	average	poor
Scope of influence	Evaluation of the popularization of elderly education 0.092	1.Number of elderly education participants 0.102	0.009	114	125	108	73
		2. The enrollment rate for elderly education 0.275	0.025	130	115	96	79
		3.The participation rate of elderly education 0.421	0.039	118	126	89	87
		4. The coverage rate of elderly education 0.202	0.019	106	124	128	62
Hardware and software	Evaluation of elderly education infrastructure 0.168	1. Sufficiency of digital facilities 0.121	0.020	105	118	137	60
		2.The number of teaching points 0.058	0.010	75	106	147	92
		3. Rationality of funding input 0.186	0.031	85	108	125	102
		4.Richness of digital course resources 0.091	0.015	83	104	109	124
		5.The number of resources such as teaching materials 0.059	0.010	102	114	119	85
		6.The student-to-teacher ratio 0.092	0.015	74	102	158	86
		7.Policy and institutional support 0.244	0.041	92	107	125	96
		9. Timeliness of technical support services 0.162	0.027	104	127	116	73
Process and result	Evaluation of the process and outcome of Elderly education 0.107	1.Digital efficiency of management &services 0.168	0.018	116	143	120	41
		6. Digital convenience of interaction between teachers and students 0.199	0.021	134	138	96	52
		7. Digital Innovation in Teaching Methods 0.210	0.022	92	121	137	70
		8. The overall satisfaction rate of the trainees 0.223	0.024	121	146	89	64
		9. The number of re-employed people 0.20	0.021	95	116	126	83

Development quality	Evaluation of High-Quality Development of Elderly Education 0.305	1. Growth rate of funding input 0.118	0.036	80	103	114	123
		5. Timeliness of course content updates 0.047	0.014	93	112	118	97
		6. Satisfaction with learning outcomes 0.109	0.033	123	152	83	62
		7. The number of award-winning projects 0.152	0.046	76	97	105	142
		5.Resource utilization rate 0.065	0.020	96	110	121	93
		6.The number of demonstration teaching points 0.128	0.039	82	102	123	113
		7.The growth rate of students 0.190	0.058	113	126	99	82
		8. Social recognition and influence 0.190	0.058	106	145	104	65
Digital empowerment results	Evaluation of Digital empowerment of elderly Education 0.328	1.Coverage rate of digital informatization 0.118	0.039	115	142	106	62
		2.Digital resource construction 0.109	0.036	85	117	126	92
		6.The digital literacy level of the teaching staff 0.124	0.041	95	105	120	100
		7.Popularization of digital teaching 0.193	0.063	103	118	110	89
		8.Digital convenience of interaction between teachers and students 0.228	0.075	126	147	105	42
		6. Students' adaptability to digital learning 0.213	0.070	96	150	125	49

After collecting and processing the data, an evaluation matrix of the indicator factors is formed. Normalizing the data yields the judgment matrix. Based on the judgment matrix, the fuzzy comprehensive evaluation values of each layer of indicators are calculated.

$$PC1=RC1 \circ WC1=(0.102,0.275,0.421,0.202) \begin{bmatrix} 0.2714 & 0.2796 & 0.2571 & 0.1738 \\ 0.3095 & 0.2738 & 0.2286 & 0.1881 \\ 0.2810 & 0.3 & 0.2119 & 0.2071 \\ 0.2524 & 0.2952 & 0.3048 & 0.1476 \end{bmatrix}=(0.2821,0.2897,0.2399,0.1865) \quad (1)$$

The final result is as follows:

$$PA=WA \circ RA=(0.092,0.168,0.107,0.305,0.328) \begin{bmatrix} 0.2821 & 0.2897 & 0.2399 & 0.1865 \\ 0.2203 & 0.2685 & 0.3074 & 0.2175 \\ 0.2654 & 0.3159 & 0.2692 & 0.1495 \\ 0.2312 & 0.2867 & 0.2528 & 0.2282 \\ 0.2468 & 0.3136 & 0.2688 & 0.1594 \end{bmatrix}=(0.2428,0.2959,0.2678,0.1916) \quad (2)$$

According to the principle of maximum membership degree, the membership degree of the "relatively good" indicator is 0.2959, which is the maximum value in the comment set. Therefore, it is determined that the evaluation result of digital empowerment for the high-quality development of elderly education in Xi'an mainly falls within the category of "relatively good". To more intuitively reflect the comprehensive assessment results, a quantitative assessment is conducted by calculating the comprehensive score. Each evaluation element of the evaluation set $V = \{V1, V2, V3, V4\} = \{\text{good, relatively good, average, poor}\}$ is

assigned values, that is, they are respectively assigned values of 90, 75, 60, and 50. The evaluation results of digital empowerment for the high-quality development of elderly education in Xi'an were obtained. The evaluation set $= 90 \times 0.2428 + 75 \times 0.2929 + 60 \times 0.2678 + 50 \times 0.1916 = 69.5$. This evaluation result is higher than "average" but lower than "good", falling between the two.

3. Analysis of Evaluation Results

(1) Based on the results of the above fuzzy calculation, the comprehensive evaluation value of the fuzziness of digital empowerment for the

high-quality development of elderly education in Xi'an is 69.5. This evaluation result is higher than "average" but lower than "good", falling between the two. The participants in the survey generally held a positive attitude towards the high-quality development of elderly education in Xi'an empowered by digital technology. The evaluation results to some extent reflect the current situation of the development of elderly education in Xi'an. One possible reason for obtaining this evaluation value is that it might be related to the initial establishment of the evaluation index. The evaluation, which started from scratch, may cause evaluators to develop a mentality that "it's better to be able to evaluate than not to be able to", and the score assigned for the evaluation may also be somewhat deviated. Secondly, elderly education in Xi'an is still in its infancy. In many surrounding counties and rural areas, elderly education lags far behind, which has pulled down the overall score. The rating result is still far from "good", which means there is still huge room for improvement in digital empowerment for the high-quality development of elderly education in Xi'an.

(2) From the results of the fuzzy comprehensive analysis, the evaluation results are basically in line with the actual situation. Among the first-level indicators, the comprehensive score for "Evaluation of the Popularization of Elderly Education" is 6.4, the comprehensive score for "Evaluation of Elderly Education Infrastructure" is 11.7, the comprehensive score for "Evaluation of the Process and Outcome of Elderly Education" is 7.4, and the comprehensive score for "Evaluation of High-Quality Development of Elderly Education" is 21.2. The comprehensive score of "Digital Empowerment of Elderly Education evaluation" is 22.8. Among the first-level indicators, the comprehensive score of "Evaluation of the Popularization of Elderly Education" is the lowest, indicating that elderly education in Xi'an has not yet been widely popularized. This is also in line with the reality. Among the first-level indicators, the comprehensive analysis value of "Digital Empowerment of Elderly Education Evaluation" is the highest, which is also greater than the evaluation values of several other dimensions. This indicates that the digital environment in Xi'an is relatively better and has the conditions to empower elderly education. Among the secondary indicators, "Participation Rate of Elderly Education" is the indicator item with the

highest score (2.7) under the primary indicator "Evaluation of Popularization of Elderly Education", indicating that elderly students are still relatively willing to participate in elderly education. Among the first-level indicators "Evaluation of Elderly Education Infrastructure", the one with the highest score is "Policy and Institutional Support Intensity" (2.8), indicating that the most significant influencing factor in elderly education is the policy and institutional support intensity. Only with corresponding policy and institutional support can the high-quality development of elderly education have a basis and support. "Student growth rate" (1.7) and "comprehensive student satisfaction" (1.7) are the highest scores among the first-level indicators "Evaluation of the Process and Results of Elderly Education". Obviously, if students are not satisfied, the development of elderly education will face numerous difficulties. If the number of students keeps growing, elderly education can continue to survive. "Social Recognition and Influence" (4.0) is the highest score in the first-level indicator "Evaluation of High-Quality Development of Elderly Education", indicating that no matter what type of education it is, it must be recognized by society. Only when society recognizes elderly education can it have the significance of existence and the possibility of continued development. The last first-level indicator, "Digital Empowerment of Elderly Education Evaluation", has the highest score for "Digital Convenience of Teacher-Student Interaction" (5.2), which precisely confirms the nature of education. No matter how far society develops, the interaction in education is irreplaceable. Without interaction, education would have no need to exist. The conclusions of these top-scoring items are in line with people's cognitive habits in real life, which also indicates that this evaluation has not been divorced from reality.

(3) Among the numerous indicators, there are also some that have relatively the lowest evaluation score values, such as "the number of elderly education students (0.6), the number of teaching points (0.7), the number of resource constructions such as teaching materials (0.7), and the timeliness of course content updates (1.0)", etc. These evaluation results can actually also enable elderly education institutions to reflect on the gains and losses of their work, think about which weak links still need to be

strengthened in their work, and which aspects have not been worked hard enough or done well enough. Especially the "number of elderly education students" and the "timeliness of course content updates", these are the most realistic issues worthy of attention. If the number of elderly education students cannot increase, the continuation of elderly education will encounter problems. However, if the course content is not updated, students who come will not be retained. Therefore, these two issues are the most crucial and primary problems for the survival of elderly education.

4. Countermeasures and Suggestions for Empowering the High-Quality Development of Elderly Education in Xi'an with Digitalization

4.1 Optimize the Supply of Digital Resources and Enhance Their Adaptation to the Needs of the Elderly and Localization

It is necessary to establish an "age-friendly resource library", simplify the platform interface

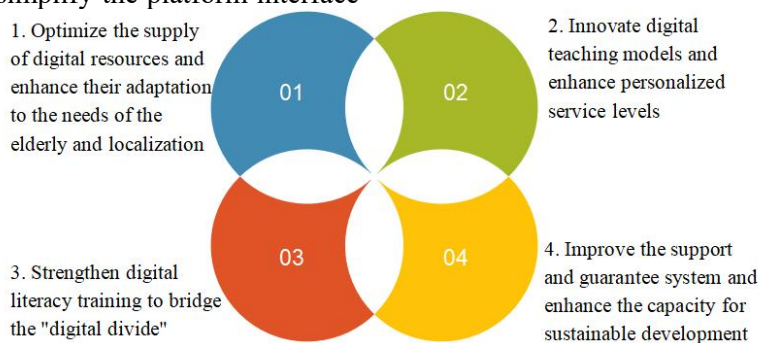


Figure 1. Four Countermeasure Suggestions

4.3 Strengthen Digital Literacy Training to Bridge the "Digital Divide"

Digital technology can be utilized to assist the elderly with wisdom [7]. The training courses are designed in a stratified manner. For the low-education group, the "Smartphone Basics Class" is offered, while for the high-demand group, practical courses such as "Health Code Usage" and "Online Medical Treatment" are provided. Give full play to the inter-generational support role of families, carry out the "Children teach Parents to Use Mobile Phones" activity, and incorporate families into the digital empowerment system [8].

4.4 Improve the Support and Guarantee System and Enhance the Capacity for Sustainable Development

(such as voice navigation, large font mode), and develop "one-step operation" courses (such as short video teaching) [5]. And it is necessary to deepen the integration of local culture, and in collaboration with institutions such as the Shaanxi History Museum and Xi'an Museum, develop distinctive courses like "Digital Cultural Relics Appreciation" and "Qin Opera Cloud Classroom" to enhance cultural identity.

4.2 Innovate Digital Teaching Models and Enhance Personalized Service Levels

It is necessary to promote the "AI + human" dual-teacher teaching model, where AI is responsible for course recommendation and progress tracking, while teachers focus on personalized tutoring (such as one-on-one online Q&A). and it is necessary to build a hybrid teaching model of "online + offline", and for the elderly, carry out paired assistance by "community digital counselors" to achieve the combination of "online learning and offline practical operation" [6].

It is necessary to improve standards and norms, formulate the "Xi'an Digital Platform for Elderly Education Elderly-Friendly Design Standards", and clearly define technical parameters and service requirements. And it is necessary to promote social collaboration, introduce enterprise participation (such as technology companies developing age-friendly technologies) and support from universities and think tanks (such as conducting demand research), and form a pattern of "government-led and multi-party participation" [9]. Four countermeasure suggestions are shown in Figure 1.

5. Conclusions and Prospects

5.1 Research Conclusion

The digital empowerment evaluation system for the high-quality development of elderly

education constructed in this paper covers five dimensions: influence scope, software and hardware, process and result, development quality, and digital empowerment result, which conforms to the regional characteristics of Xi'an and the needs of the elderly group. Empirical evaluations show that the digital empowerment of high-quality development of elderly education in Xi'an is in the process of transitioning from "average" to "good". Its advantages lie in resource supply and policy support, while its shortcomings are mainly concentrated in elderly-friendly services and personalized teaching.

5.2 Research Prospects

Deficiency: The indicator system may not fully cover technological iterations (such as the application of metaverse technology), and the sample range is limited to Xi'an. Its universality needs further verification.

Outlook: In the future, the dynamics of the evaluation indicators can be expanded, and the impact of emerging technologies can be incorporated. Conduct cross-regional comparative studies (such as comparisons with Beijing and Shanghai) to provide broader references for the digital development of elderly education across the country.

Acknowledgement

Fund projects: Xi 'an Social Science Planning Fund Project in 2025: "Research on the Evaluation of High-Quality Development of Elderly Education in Xi'an Empowered by Digitalization (project number:25JY177)", This paper is the result of stage research.

References

- [1] State Council. The 14th Five-Year Plan for the Development of National Aging Services and the Elderly Care Service System [Z]. 2021.
- [2] Xi'an Education Bureau. Xi'an Report on the Development of Elderly Education (2023) [R]. 2024.
- [3] Xianping Cheng . Path Selection for High-Quality Development of Elderly Education in China Pointing to the Future [J]. China Vocational and Technical Education, 2021.5.
- [4] Jie Wu . Research on the Standards for the Development Effectiveness of Elderly Education [J]. Journal of Guangzhou City Polytechnic, 2019 .3.
- [5] Daguang Wu, et al. Transformation and Innovation of Elderly Education in the Digital Age [J]. Educational Research, 2023 (5).
- [6] Bo Chen, et al. Construction and Empirical Research on the Quality Evaluation System of Elderly Education Services [J]. Population and Development, 2022 (2).
- [7] Yihui Yao. The Path of Elderly Education Facilitating the "Smart Assistance for the Elderly" Initiative [J], Journal of Liaoning Open University, 2021.3.
- [8] Jianjun Zhou , Sheng Huijuan, Zhou Manyi. Digital Empowerment for High-Quality Development of Elderly Education [J], New Countryside, 2023.4.
- [9] Hua Fan . The Practical Demands, Intrinsic Requirements and Key Measures for the High-Quality Development of Elderly Education in the New Era [J]. Education and Career, November 2023.