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Review Article

Artificial Intelligence Techniques for Quality of Life Analysis: Systematic Mapping

Técnicas de Inteligencia Artificial para el análisis de calidad de vida: Mapeo Sistemático

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Spanish version

Abstract

Introduction: Quality of life encompasses multiple dimensions, such as health, education, and economic and social well-being. In recent years, several researchers have employed Artificial Intelligence (AI) techniques to analyze large volumes of data and better understand the factors that influence it. Although they have developed multiple applications in this field, they still face challenges integrating diverse approaches and heterogeneous data sources.
Objective: This study examines how researchers use AI to assess quality of life. The main techniques employed, their areas of application, and gaps in the literature are identified. Based on these findings, new lines of research are proposed.
Methods: A systematic review was conducted following Kitchenham's methodology. Studies were compiled from scientific databases such as Scopus, IEEE Xplore, and Google Scholar. Inclusion and exclusion criteria were established, and research questions were formulated to select the most relevant papers.
Results: It was found that researchers most frequently apply algorithms such as Decision Trees (DT), Random Forest (RF), Neural Networks, and Support Vector Machines (SVM) in areas such as health, education, and socioeconomic conditions. However, it was observed that most analyze these factors in isolation, without integrating multiple dimensions together.
Conclusions: AI has great potential for assessing quality of life. However, researchers must develop integrative approaches that combine different data sources and reflect the inherent complexity of this concept.

Keywords: Artificial Intelligence, Quality of Life, Machine Learning, Deep Learning,

Resumen

Introducción: La calidad de vida abarca múltiples dimensiones, como la salud, la educación y el bienestar económico y social. En los últimos años, diversos investigadores han empleado técnicas de Inteligencia Artificial (IA) para analizar grandes volúmenes de datos y comprender mejor los factores que influyen en ella. Aunque han desarrollado múltiples aplicaciones en este campo, aún enfrentan desafíos al integrar enfoques diversos y fuentes de datos heterogéneas.
Objetivo: Esté estudio examina cómo los investigadores utilizan la IA para evaluar la calidad de vida. Se identifican las principales técnicas empleadas, las áreas de aplicación y los vacíos existentes en la literatura. A partir de estos hallazgos, se proponen nuevas líneas de investigación.
Métodos: Se realizó una revisión sistemática siguiendo la metodología de Kitchenham. Se recopilaron estudios de bases científicas como Scopus, IEEE Xplore y Google Scholar. Se establecieron criterios de inclusión y exclusión, y se formularon preguntas de investigación para seleccionar los trabajos más relevantes.
Resultados: Se identificó que los investigadores aplican con mayor frecuencia algoritmos como Árboles de Decisión (DT), Random Forest (RF), Redes Neuronales y Máquinas de Soporte Vectorial (SVM) en áreas como salud, educación y condiciones socioeconómicas. Sin embargo, se observó que la mayoría analiza estos factores de forma aislada, sin integrar múltiples dimensiones de manera conjunta.
Conclusiones: La IA tiene un gran potencial para evaluar la calidad de vida. No obstante, los investigadores deben desarrollar enfoques integradores que combinen distintas fuentes de datos y reflejen la complejidad inherente a este concepto.

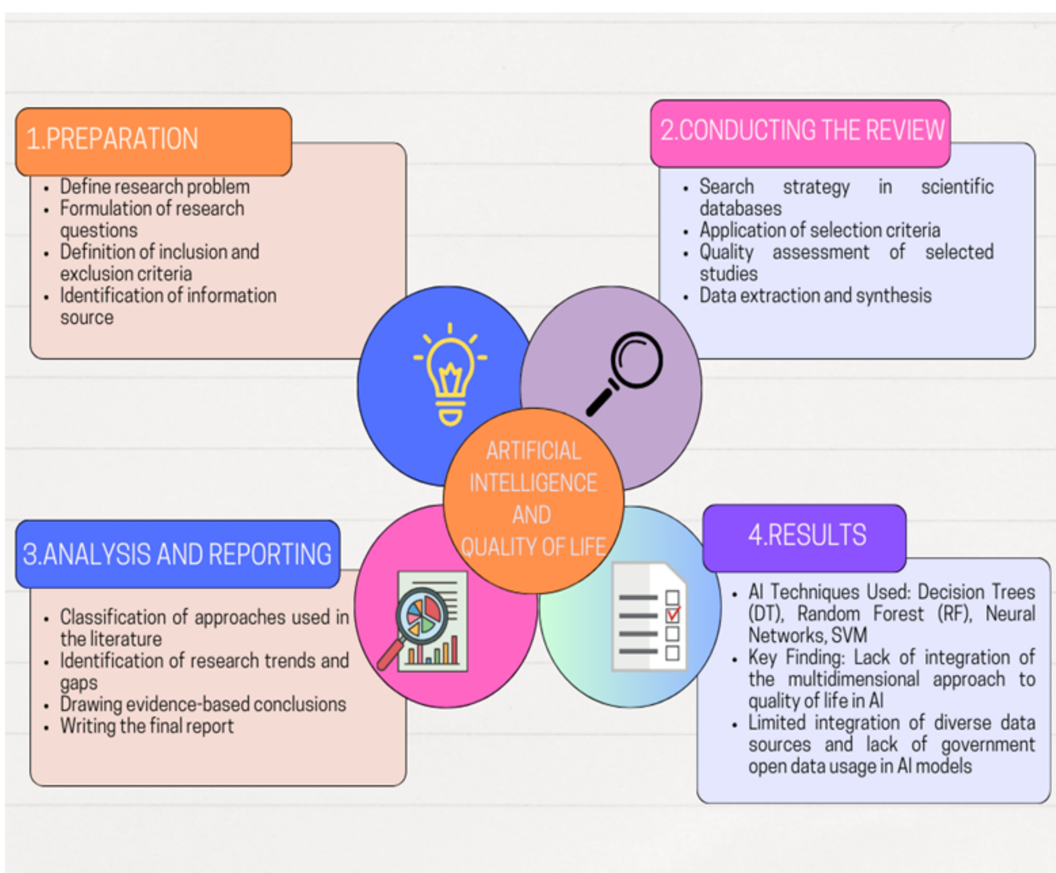
Palabras clave: CInteligencia Artificial, Calidad de vida, Machine Learning, Deep Learning, Mapeo sistemático

Contribution to the Literature

Why was it conducted?
The study was conducted to identify and analyze Artificial Intelligence techniques, especially Machine Learning, applied to the analysis of quality of life. The objective was to organize and synthesize the most relevant approaches used in recent research, evaluating their effectiveness, areas of application, and potential for addressing key dimensions of human well-being. Recognizing that quality of life is a multidimensional approach that encompasses health, education, subjective well-being, safety, the urban environment, and socioeconomic conditions, this research also lays the conceptual and methodological foundation for an undergraduate research project. The purpose of this research will be to apply these techniques to the analysis of data from DANE's National Quality of Life Survey (ECV), the official source that measures key indicators of well-being in Colombia.

What were the most significant results? What do these results contribute?

The results show that the most commonly used algorithms were Random Forests, Decision Trees, Support Vector Machines, and Neural Networks, applied primarily in areas such as health, education, the urban environment, and socioeconomic factors. It is confirmed that quality of life is addressed from multiple dimensions and that AI makes it possible to capture complex relationships between these variables. Furthermore, challenges were identified, such as the lack of integrative approaches and the poor representativeness of certain social contexts. These findings provide a solid foundation to guide future research, improve data-driven public decision-making, and promote the ethical and responsible use of AI in contexts of human well-being.



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Introduction

The growing interest in quality of life has led to the creation of associations that study its impact on social development and human well-being. The Organization for Economic Co-operation and Development (OECD), for instance, uses a multidimensional approach to assess 11 dimensions of well-being (income, employment, health, education, environment, safety, among others), measured through averages and inequalities, promoting resilience and sustainability (1).

In this regard (2) links societal change to quality of life through a four-level ecosystemic model: micro, meso, macro, and meta. The goal is to promote well-being for both the planet and people, benefiting as many stakeholders as possible. According to (3), what is to be measured, for whom, where, the reasons for the measurement, the rationale for the selected indicators, and the questions to be answered must be clearly defined. This entails delving into the statistical methods applicable to quality-of-life studies, emphasizing regulatory aspects, the challenges involved in retrospective or prospective estimations, the reliability, validity, and responsiveness of the instruments used, statistical models for data adjustment along with their respective quality metrics, as well as strategies to discard outliers or implement mixed methods (4).

This indicates that different techniques and methods from computer science, especially Artificial Intelligence (AI), should be used to measure quality of life, with the application of standard techniques, basic statistics, numerical analysis, of covariance estimates among others (5)(6). Given that quality of life is approached from an ecosystem perspective, in which social aspects are fundamental to understanding community well-being, and also considering the psychological approach that highlights individual and group happiness as a function of space, the place and subjective and objective aspects (7), in general terms, quality of life is associated with happiness, fulfilment and satisfaction as well as age-specific dimensions and values. This highlights the need for qualitative and quantitative indicators to assess fulfilment of the criteria for a full life (8).

The indicators are aligned with human needs as outlined in Maslow's hierarchy (9), and aim for development on a human scale, as proposed by Max-Neef (10). These concepts are further articulated through models such as Bronfenbrenner's biopsychosocial framework (11), with the aim of embracing the different dimensions of the concept of quality of life, which the United Nations in 1997 defined as the notion of human well-being measured by social indicators or other quantitative indicators, but which leads to different models, which emphasize on different aspects of human needs, on aspects of life satisfaction, on social welfare and the use of social networks, or psychological models that include aspects of personal growth, control over life, cognitive skills and adaptability (3).

The quality of life, in domains such as clinical, is considered a condition of complete physical, mental, and social well-being, not just the absence of disease, is emphasized in the evaluation of therapies. (12); in university settings, there is talk about corporate social responsibility (CSR), which focuses on training citizens to engage in active volunteering and community participation, creating networks that bring hope to others (13); It also involves the relationship between ecology, society, and the quality of social life, becoming ecological resilience and sustainable agriculture practices (14); Includes political aspects, environmental resources, and the relative material welfare of society

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in a neoliberal economic environment (15). Poverty is considered when considering inequitable social stratifications or the effects of lack of digital technology, which cause inequalities and negative effects on traditional forms of work (16).

In the Colombian context, addressing issues such as poverty and social inequality is essential to improving the quality of life of its inhabitants, and ML has been used in several studies for predictive purposes on aspects such as segregation and inequity in access to education services, cultural and recreational, trends in homicide and their relationship with the spatio-temporal risk of crime occurrence, the prediction of psychosocial risks in teachers, among others (17)(18)(19)(20).

In the last few years, there have been proposals for predictive models in the education sector, such as the model developed by (21) to assess digital teaching competence using machine learning (ML) techniques. These advances reinforce the potential of such techniques to improve key dimensions of quality of life.

From this interdisciplinary perspective and the growing availability of social data, it is necessary to examine how artificial intelligence, especially machine learning, can contribute to analysis, understanding, and improvement of quality of life. In this context, the following research questions arise:

¿What are the present and future challenges of artificial intelligence and big data for improving quality of life? ¿What are the algorithms most used in life quality prediction and how accurate have they been in previous studies? ¿What are the most commonly used algorithms and how accurate have they been in previous studies on this subject?

Through this article, we aim to organize a systematic mapping of the types of artificial intelligence techniques applied to quality-of-life analysis in five sections. The first section discusses the fundamental concepts needed for the application of AI and ML to predictive data analytics in the context of quality of life; the second section addresses the methodological aspects of mapping, describing the specific steps involved; the third section presents the results of the literature search; the fourth section analyses and discusses these results; and the fifth section sets out the conclusions of the study.

Basic Concepts

The analysis of large volumes of survey data requires the use of AI techniques, both supervised and unsupervised, within the domain of machine learning. These methods enable a prospective analysis of the dimensions of statistical instruments, facilitating informed decision-making. Additionally, information technologies (IT)—such as big data analytics, non-relational databases, and the Internet of Things (IoT)—foster innovation and contribute to improving quality of life (22)(23). This process involves cognitive models inspired by brain dynamics in the context of the industrial revolution, evolving into thinking machines, cybernetic systems, and the technogenesis of a networked society, while also exposing failures in anticipating the future of machine learning (24).

Thus entering the domain of ML as part of AI, a term coined in 1956 by McCarthy to refer to a system that expanded people's knowledge and understanding, which simulated the way humans do intelligent things (25); however the key word in artificial intelligence (AI) vision and evolution is

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"simulation" because the most advanced artificial neural networks such as GPT chat only base their actions on information collected by humans since they are based on a conception of intelligence as the ability to apply and acquire knowledge and skills (26).

According to (27), Analyzes the evolution, methods, and applications of ML, highlighting that learning involves changes and improvements in competences through the exploration of information, with the aim of making the machine autonomous in decision-making based on previous experience. AI has evolved in parallel with human knowledge about intelligence, defined by Joshi (28) as the ability to learn from experience, adapt to new situations and use knowledge to manipulate the environment. This connection has allowed the development of computer models inspired by the human brain, such as the control of devices through brain networks, prediction of depressive disorders and analysis of emotional states through brain activity (29) (30) (31).

To understand AI, it is essential to analyze the evolution and complexity of human beings. Living beings are distinguished from inanimate matter by characteristics such as reproduction, energy use, and adaptation. Oparin's theory explains the evolution from inanimate matter to beings with DNA. However, it does not specify how intelligence emerges in evolution (28).

Intelligence does not have a single definition, as it involves learning, adapting, and managing abstract concepts. Human beings, who possess the most advanced intelligence, create tools and study the brain to improve AI(31). Donald Hebb, connected psychology with neurobiology by explaining how neurons organize into networks to exchange information, leading to the development of neural networks and learning algorithms (32).

The study of the human brain has led to the conclusion that memory functions as an information processing system, language emerges from learning through neural networks, and consciousness acts as a user interface. This enables the analysis of mental processes from a computational perspective, applying the heuristic that the observer and the observed are part of the same system (32) (33).

AI focuses on developing models and techniques to simulate human abilities such as language processing, pattern recognition, and decision-making. Within AI, Machine Learning (ML) and its subfield Deep Learning (DL) have been key in predictive data analytics since the 1980s. Algorithms such as linear regression, decision trees (DT), and support vector machines (SVM) have been developed within supervised learning. In particular, classification algorithms like KNN are useful for predicting people's well-being and satisfaction based on health characteristics (34), (35), (36).

Materials and metods

This section describes the process followed to conduct the systematic mapping of artificial intelligence techniques applied to data analysis for decision-making and trend prediction in various sectors such as business, health, agriculture, logistics, and electricity generation—all related to human well-being and the improvement of quality of life.

Systematic mapping, used in evidence-based machine learning (ML) and artificial intelligence (AI) studies, enables the identification and classification of relevant publications on a specific topic. Its application facilitates the detection of knowledge gaps and helps minimize interpretation errors

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through information triangulation processes, thus ensuring the validity of the findings. It allows for the structured collection and analysis of relevant data sources, ensuring reliability through an objective and evidence-based approach.

In the field of software engineering (37) an adaptation of Kitchenham's original methodology is proposed, structuring the process into five key stages: formulation of research questions, design of the search protocol, quality assessment of the studies, data extraction, and synthesis of results. It emphasizes the importance of explicitly stating the primary studies included, the selection criteria, and the traceability of the analysis key elements for ensuring the reproducibility of findings.

In this study, this methodological structure is adopted to carry out a systematic mapping of artificial intelligence techniques applied to quality-of-life analysis.

Based on the methodology used in evidence-based software engineering, the methodological path shown in Figure 1 was followed. This approach can be applied to the analysis and development of studies in artificial intelligence and machine learning. It allows for a systematic structure in the collection and evaluation of literature, facilitating the identification of trends, challenges, and opportunities in the use of AI and ML for the improvement of quality of life.

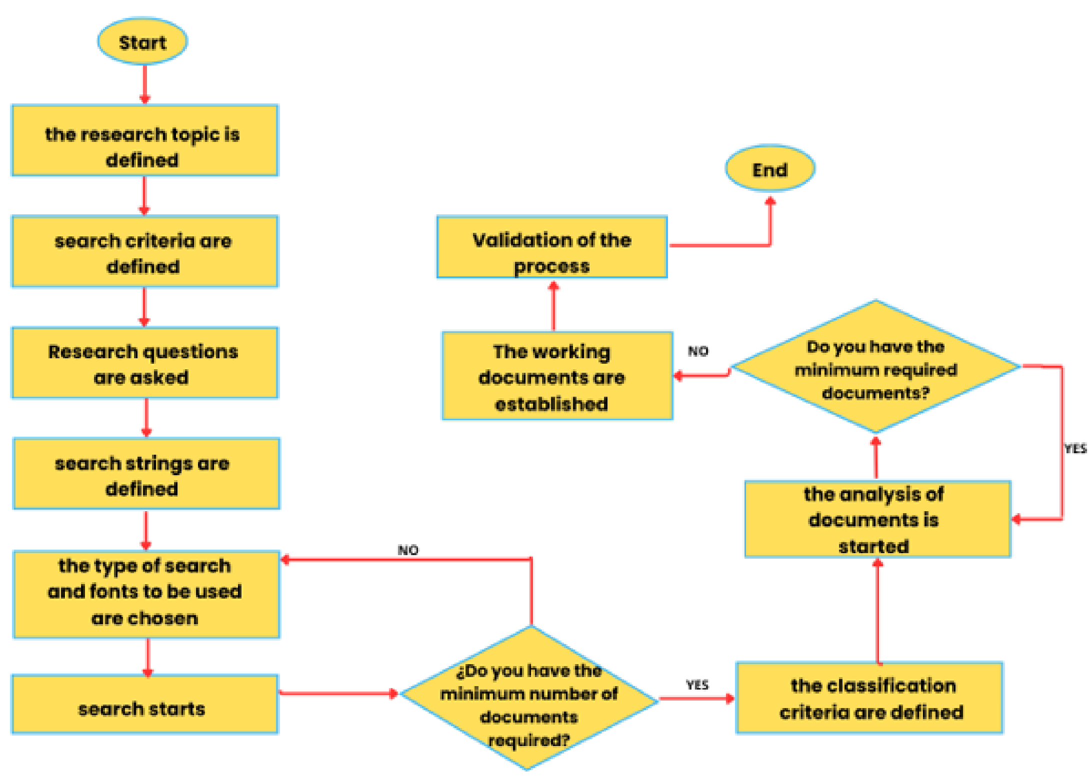

Figure 1. Methodological route for systematic mapping. Adapted from (37)

The Research Theme

This section defines the research theme: the analysis of machine learning (ML) techniques and tools applied to quality-of-life studies from a predictive perspective. It aims to identify how supervised approaches, probabilistic methods, and data science techniques can extract patterns, generate predictive models, and make projections across various dimensions of human well-

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being. To achieve this goal, the emphasis is placed on the use of reliable data and the rigorous implementation of processes for data collection, storage, cleaning, and analysis, along with the adoption of statistical and computational methodologies to ensure the quality and robustness of the results obtained (38).

Inclusion And Exclusion Criteria

To ensure consistency and validity in the selection of documents for this systematic mapping, inclusion and exclusion criteria were established and applied during the review phase. These criteria served to filter the most relevant and accessible studies, without limiting the analysis exclusively to those that directly addressed the research questions. This allowed for a broader and more contextual understanding of the topic. Table 1 summarizes the criteria used.

Table 1. Inclusion and Exclusion Criteria

Criterion Type	Criterion	Type
Time Period	Publications between 2017–2024	Inclusión
Source Type	Journal articles, specialized books, and theses from recognized institutions	Inclusión
Accessibility	Open access articles or those accessible through agreements with the University of Cauca.	Inclusión / exclusión
Source Quality	Articles in journals ranked Q3 or higher (quartiles)	Inclusión

Strategy and Search Equation

During the exploratory phase of the review process, key terms related to quality of life, artificial intelligence techniques and predictive analysis were identified in English and Spanish. These combinations provided a solid conceptual basis for the construction of the final search equation. Table 2 presents some of the exploratory terms used initially, before consolidating the formal equation.

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Table 2. Strategy and Search Equation

Number	Exploratory Combination	Language of search
1	Machine learning and quality of life	"machine learning" AND "quality of life"
2	Inteligencia artificial y bienestar social	"inteligencia artificial" AND "bienestar social"
3	Artificial Intelligence and Life Satisfaction	"Artificial Intelligence AND Life Satisfaction"
4	Deep learning and subjective well-being	"deep learning" AND "subjective well-being"
5	Predicción y determinantes sociales de la salud	"predicción" AND "determinantes sociales de la salud"

The Next Equation was used as a unified base for all searches in the databases consulted, with minimal adaptations in the syntax according to each platform.
("machine learning" AND "quality of life") OR ("inteligencia artificial" AND "bienestar social") OR ("Artificial Intelligence" AND "Life Satisfaction") OR ("deep learning" AND "subjective well-being") OR ("predicción" AND "determinantes sociales de la salud").

Type of Search and Sources to Use

An automated literature search was conducted in specialized databases such as IEEE Xplore, Scopus, and PubMed, as well as in open-access repositories including Google Scholar, ResearchGate, Springer, and ScienceDirect. Although these specialized sources were consulted, priority was given to selecting documents from databases with interdisciplinary coverage, reflecting the need to integrate approaches related to quality of life and artificial intelligence. The final selection of documents was based on predefined criteria, ensuring the relevance and quality of the studies included.

To ensure transparency and rigor in the review process, document selection was performed independently by two researchers. Any discrepancies were subsequently resolved through

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consensus. This procedure minimized bias and supported the validation of the relevance of the studies included in the systematic mapping.

Results

Start and Search

Once the criteria for inclusion and exclusion had been defined, a systematic search of documents was carried out. The total number of records found was 114, distributed according to the type of document as presented in Table 3.

Table 3. Frequency of documents by type

Document Type	Frequency
Journal Articles	52
Books	45
Thesis	17
Total	114

Documents are also classified according to the frequency found in each of the databases used. See table 4.

Table 4. Frequency of documents per database used

Databases	Frequency
Google Scholar	17
ResearchGate	29
Science Direct	6
Springer	50
Otras (IEEE,Scopus,PubMed,MDPI)	12

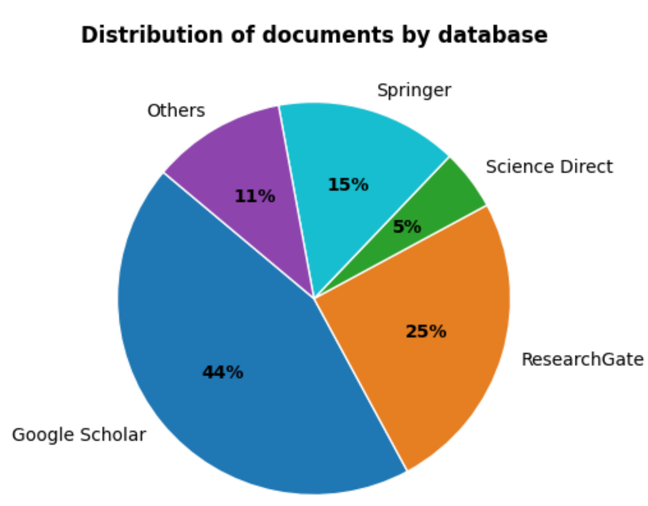

Figure 2. Percentage distribution of documents by database

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Regarding the distribution of documents according to the search criterion related to the time window, the information retrieved is presented by year of publication. See Figure 3.

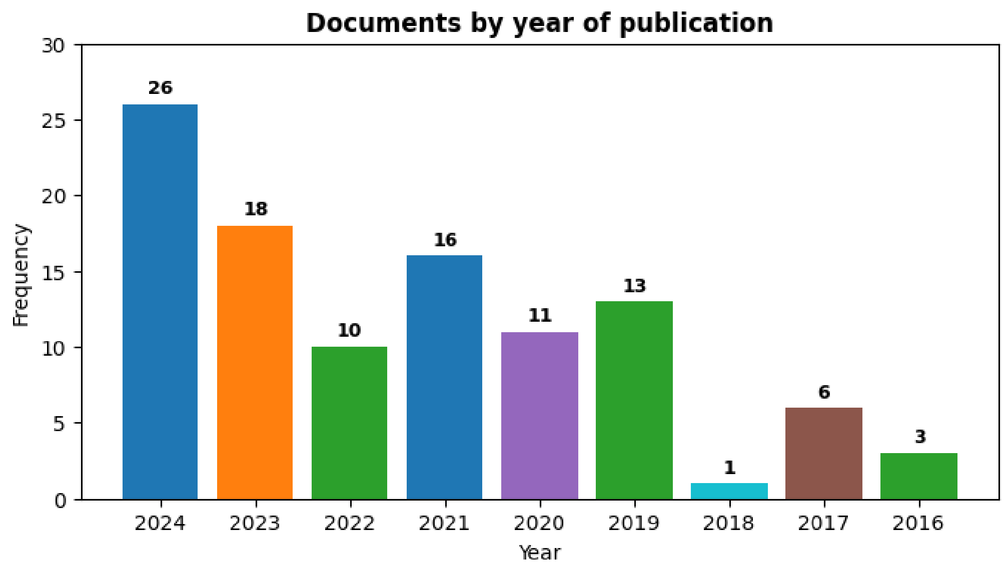

Figure 3. Distribution of documents by year of publication

The total number of documents found far exceeds the minimum of 30 studies suggested for systematic mapping studies, allowing progress to the selection and classification phase.

Definition of classification criteria

First, the documents found are grouped according to their type, that is, thesis, journal article or specialized book determining their frequency, as shown in figure 4.

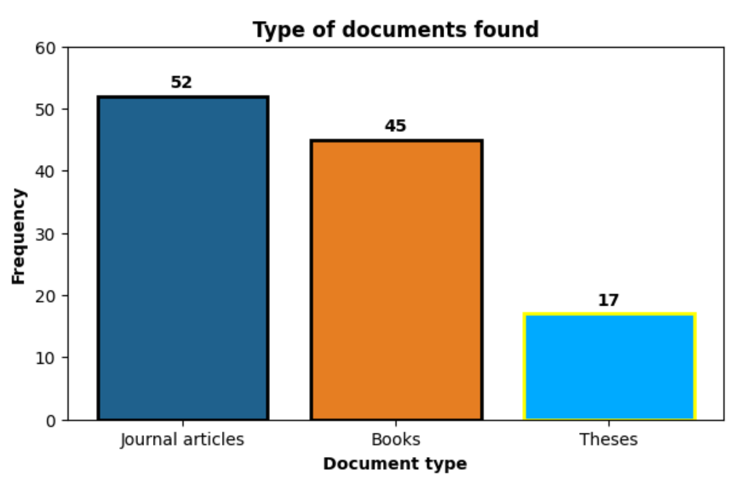

Figure 4. Type of document found by frequency

The most frequently found documents were journal articles, specialized books, and research theses related to artificial intelligence applications in quality-of-life issues.

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Based on a manual thematic analysis of the documents, common relationships were identified among the contents, such as the use of AI, ML, and DL techniques, neural networks, predictive models, generative models, prediction algorithms, and applications in software engineering.

Based on this classification, a grouping was performed to enable the final selection of relevant documents for the study. Figure 5 schematically illustrates these thematic relationships. The figure was manually constructed based on the systematic review of the documents, without the use of specialized text mining software.

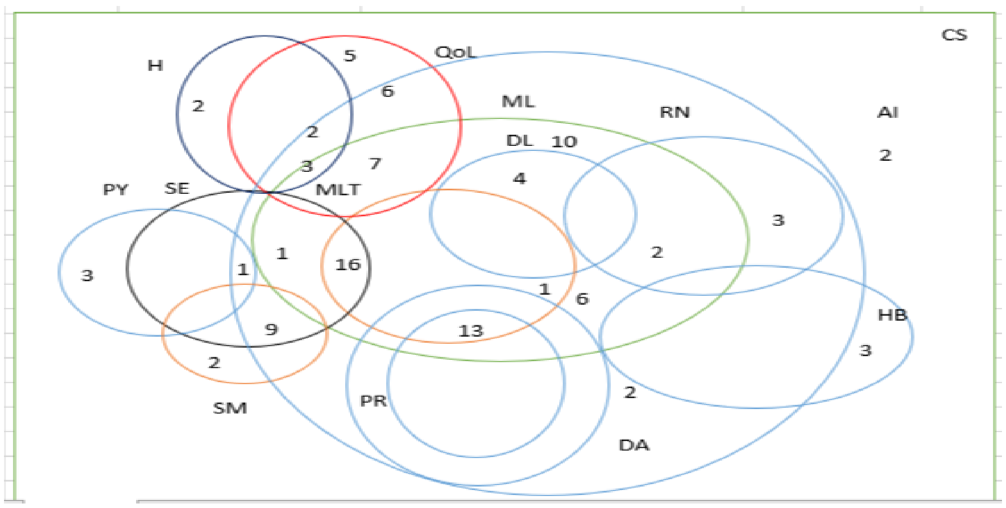

Figure 5. Relationships between found documents

Validation Process (Previous Systematic Reviews on AI and Quality of Life)

In addition to individual studies that apply artificial intelligence techniques to the analysis of data associated with quality of life, it is important to acknowledge that systematic reviews have also been conducted that address this intersection from a broader perspective. These reviews help to contextualize the present study and justify its necessity.

For example, one systematic review (39) examined the use of artificial intelligence in the healthcare sector, analyzing 180 articles from an initial pool of 1,988 publications. Their classification encompassed four key dimensions: benefits, challenges, methodologies, and functionalities. The authors highlighted that AI contributes to improving quality of life by enabling early diagnoses, personalized treatments, and continuous health monitoring, although it also faces challenges related to ethics, privacy, and integration into real clinical settings.

In the field of mental health—one of the core components of quality of life—another review (40) evaluated AI-based technologies aimed at enhancing psychological well-being. The review included systems such as therapeutic chatbots and interactive environments designed for the prevention and treatment of emotional disorders. It emphasized their potential to improve access to supportive interventions, while also underscoring the need for clinical oversight, regulatory standards, and ethical safeguards.

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Another study (41) analyzed 68 investigations focused on the application of AI across multiple dimensions of quality of life, such as health, work environment, and social environment. The review identified frequent use of techniques including machine learning, neural networks, and natural language processing. However, the authors noted a lack of methodological coherence and the absence of integrative frameworks to systematically assess the impact of these technologies.

In a complementary way (42) they conducted a systematic review of AI in special education, highlighting the use of ANN and SVM as predominant technical infrastructures in the development of cognitive and affective skills, Especially in students with autism spectrum disorders

Similarly, (43) explored AI applications in higher education in Latin America, identifying its contributions in areas such as dropout prediction, intelligent educational data analytics, and the optimization of administrative processes through ML, DL, and NLP techniques.

Finally, (44) addressed the role of AI in intelligent tutoring systems toward sustainable education, emphasizing the potential for personalized learning, emotion analytics, and the need to overcome challenges related to privacy, bias, and technological barriers.

While these studies provide an overview of the use of AI in health, social well-being, and education contexts, none specifically focus on the structured classification of AI techniques applied to different dimensions of quality of life from a systematic mapping perspective. This gap is precisely what the present study aims to address, by offering a rigorous and organized synthesis of the identified techniques, their field of application, and their reported performance.

Primary studies on AI techniques in quality of life

From the analysis of the abstracts of the articles in this category, fundamental ideas are gathered that help guide the research—from the perspective of quality of life through indexes that involve social variables. For example, the study conducted in Turkey (45) provides methodologies for estimating quality of life indices in large cities by incorporating geographic variables and subjective perceptions. These are estimated through data-dependent statistical methods such as principal component and entropy analysis, as well as multicriteria decision analysis techniques like the Analytic Hierarchy Process (AHP) and the Best-Worst Method to provide both objective and subjective evaluations of urban quality of life.

Study (46) Evaluates the detection of major depressive disorder using standardized quality of life scales such as the Patient Health Questionnaire-9 (PHQ-9) and the Short Form-20 Health Survey (SF-20), applying ML to improve diagnosis. Algorithms such as SVM, Naive Bayes, RF, ANNs, KNN, and DT were used, and performance was validated with k-fold cross-validation. The results showed that combining these methods outperforms traditional approaches, allowing for better identification of depression based on health data.

Study (47) Analyzes the factors influencing job satisfaction in the Netherlands through online longitudinal studies using ML techniques like RF and Gradient Boosting Machine (GBM) with XGBoost. These methods facilitated data parameterization, management of multicollinearity, and clustering. Results indicate that job satisfaction depends not only on salary but also on social relationships among colleagues, a sense of recognition, and perceived job stability.

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Study (48) Explores the application of ML and Extreme Machine Learning (EML) techniques for ecosystem conservation and quality of life improvement. A predictive model of living environment is proposed, based on data collected through a questionnaire considering economic capacities and individual desires. The quality-of-life index is calculated through a weighted arithmetic mean and classified by city categories. The model combines algorithms such as SVM, ANN, and EML techniques, including stacking and voting, to enhance classification accuracy.

Jananni, Sael & Bananbou (49) stress that the concept of quality of life encompasses economic, social, health and subjective perceptions. Note that although the use of AI techniques such as SVM and ANN has grown, methodological challenges for their effective application in complex quality of life issues remain, underlining the need for more research and standardization.

ML and DL techniques and time series models can be used to predict future environmental conditions that minimize the effects of COVID 19 using as inputs pandemic data recommended in 10 countries, including Brazil, Colombia, Argentina, France, Italy, Germany, Russia, India and the United States; a MiniMax technique was used to scale the data so that the characteristics of interest could be extracted and normalized to achieve an accurate level of prediction; a methodology was proposed that used RFR, Bayesian regression, DTR, KNR, the long and short-term random memory model (LSTM), the Facebook model , among others, revealing the results obtained that the best levels of prediction corresponded to RFR, the Facebook prophet and LSTM (50).

Study (51) discusses the importance of machine learning algorithms for data-based prediction and highlights that the choice of algorithm depends on the problem, the variables involved and the most suitable model. The most used algorithms are reviewed, including supervised ones such as SVM and DT, as well as mixed learning approaches such as boosting methods, which strengthen learning by combining weak models into a more robust one. Supervised and unsupervised neural networks are also described, highlighting their key role within AI.

Study (52) describe how ML techniques can be used to predict quality of life characteristics of cancer patients using the Better Life Index (BLI) predictor Measures different aspects of human life across the population such as environment, work, health, motivation in social life, governance, education, access to services, housing, community, and income. A predictive analytic model based on supervised tools is described that predicts the life satisfaction score using models such as decision trees, elastic networks, neural networks, RF, SVM, among others. It was found that centrally trained regression models, particularly SVM provides the best prediction values for both short-term and long-term life satisfaction indices.

Study (53) explore how the fourth industrial revolution has diversified data sources, driving the use of supervised, unsupervised, semi-supervised ML and enhanced learning for processing. It also emphasizes the challenges of training AI models in real-world contexts, such as overfitting and robustness to data variability.

Study (54) focuses on predicting vital satisfaction levels using machine learning. The study converts tabular biomedical data into natural language using advanced processing techniques, applying models such as Random Forest, Gradient Boosting and LightGBM. The importance of preselection

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of relevant characteristics to improve predictive effectiveness is emphasized, achieving high precision models after optimizations based on cross-validation and recursive selection.

Study (55) examines Individual and Social Welfare as key factors in the progress of nations, using the Better Life Index (BLI) to assess aspects such as health, education, employment, income and civic participation. To improve the accuracy in predicting quality of life, a metamodel of ML is used, combining DT, Neural Networks, RFo and Regresor with Vector Support (SVR). The results show that this integration of techniques optimizes the predictive capacity of the model.

Study (56) proposes a model for predicting quality of life for individuals in guardianship institutions, based on eight key factors and machine learning techniques. The model determines deficits and priorities of attention from the value of priority of care in each dimension, using various predictive models as RF , Tree of Regression, Gradient Extended, Linear Multiple, Multilayer Perceptron Regresor and an Adaptive Fuzzy Neuro Inference System. These models allow for the estimation of the support intensity scale (SIS) with high reliability in predicting quality of life.

Study (57) discusses the application of ML in education, highlighting its use in teaching-learning processes and the need to improve teachers' digital competencies. A systematic literature review was conducted in 38 countries following the PRISMA 2020 protocol, analyzing articles by title, abstract, and keywords. Various ML techniques were identified, including supervised, semi-supervised, unsupervised, and reinforcement learning, with an emphasis on RF, DT, and K-Nearest Neighbors. This review seeks to optimize the global implementation of these techniques in education.

Bheda (58) studied the predictive analytics of active learning-based education, taking into account that learning analytics (LA) is defined as the whole, measurement and analysis of data related to student performance in such a way that feedback from analytics can be used for learning optimization and improvement in student outcomes, particularly when used in collaboration with mixed learning models; the investigative approach of this thesis seeks to specify ML algorithms that allow the prediction of students' performance through specific measurements with adjustable parameters collecting information through activities designed for this purpose and articulated a course for students other than science; Similarly, the efficiency of teaching processes and methodological approaches of teachers using the virtual classroom can be measured; among the tools used are recurrent neural networks and short-term memory networks.

Johnston & Mathur (59)describe the application of supervised learning using scikit-learn to build predictive models from real data. Stress the importance of clear problem formulation, clean databases and adequate data structures. In addition, they explain that algorithms such as neural networks and Random Forest allow to map inputs and outputs, evaluating the performance of the model to ensure its correct operation.

In study (60) they investigate the prediction of academic performance of university students based on their Internet usage behavior, using ML algorithms. Factors such as online time, traffic volume and connection frequency were analyzed from standardized data of 4000 students. Techniques such as DT , neural networks and SVM were applied. The results indicate that the student's discipline is key to academic performance and that there is a possible positive correlation between

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connection frequency and performance, while traffic volume has a negative impact. It is concluded that Internet usage data can be used to predict university academic performance.

Study (61) presents the construction of ML systems with Python, addressing the history of ML, the classification of its techniques and the challenges in their practical application. Explains linear and polynomial regression techniques, descending gradient and classification by logistic regression. It also deals with overfitting and regularization in linear and logistic regressions. It focuses on the feasibility of learning from objective-unknown functions and error estimation. Additionally, delves into Vector Support Machines (SVM) with extended kernel and margin methods, neural networks and decision trees, along with unsupervised techniques within machine learning.

Study (62) analyzes the management of data analytics services, highlighting the challenges and future trends, especially in handling large volumes of information. It emphasizes how the nature of data and certain characteristics of machine learning (ML) generate conflicts in the management of these services. Additionally, it underscores the need for research in collaborative production between humans and machines, as well as the development of analytics services that consider ethical aspects. It is noted that, although these techniques impact various sectors, their most significant application is in healthcare, where massive digitalization significantly improves medical care.

The Article (63) presents that the exponential growth of social media within the services offered via the internet has led to a rapidly expanding range of applications that require data analysis. The main challenge lies in developing a system capable of learning from this data using various machine learning strategies, particularly algorithms such as SVM, decision trees, linear and logistic regression, neural networks, deep learning, and binary, multi-class, and multi-topic classification algorithms applied to big data. These are aimed at detecting behavioral anomalies, emotions, image analysis, event detection, relationships, reputations, opinions, business intelligence analytics, crime detection, and bioinformatics aspects.

This study (64) applies seven ML techniques to analyze data related to goal planning and customer base expansion in promotional campaigns. It uses two experimental datasets to validate results through standardization procedures. The conclusion is that, under ideal conditions, model-based methods outperform classification or distance-based methods. However, their advantage disappears when the quality of the training data is compromised. Classification methods showed poor performance, leading to suggestions for strategies to improve their effectiveness.

This article (65) analyzes the quality of work life among intensive care workers in Colombia using a mixed-method approach. Through the QWL questionnaire, narratives are examined to understand subjective perceptions and staff turnover intentions, while quantitative dimensions assess satisfaction, integration, and well-being in the work environment. It is identified that safety and well-being depend on technological updates, care protocols, experience, effort-salary balance, availability of staff and supplies, and the ability to disconnect from work.

This article (66) presents the development of a predictive model based on ML to investigate quality of life (QoL) scores in patients with alkaptonuria (AKU), a rare disease. The study uses clinical data from 129 patients stored in a specific database called Aprecise KUre. Using algorithms such as

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XGBoost and k-NN, key biomarkers were identified, including age, body mass index, and markers of oxidative stress and inflammation, which are correlated with physical but not mental QoL scores. This model demonstrates that machine learning can accurately predict the physical impact of AKU, highlighting the need for robust databases to improve the management of rare diseases and the design of personalized treatments.

This study (67) analyzes the use of Random Forest (RF) and Artificial Neural Networks (ANNs) to predict the impact of dengue in Colombia at both regional and national levels. Two RF models were developed, trained with historical dengue case data, satellite forecasts on vegetation, rainfall, air temperature, and population censuses, allowing for weekly case forecasts up to 12 weeks in advance. Additionally, a model based on ANNs was used to compare its performance with RF. The results showed that RF is a highly viable technique for predicting dengue cases in Colombia.

Answer to Research Questions

P1. What factors or aspects of quality of life can be predicted by artificial intelligence techniques?

AI techniques have been used in a number of studies to predict key factors that influence quality of life, including socio-economic aspects, health, well-being at work, education and the environment.

Socio-economic factors The Multidimensional Poverty Index (MPI) has been used to analyze poverty beyond income, considering variables such as education, health and access to technology (16). It has also made it possible to estimate satisfaction with life and general well-being using the Better Life Index (BLI), considering variables such as income, employment and access to services (55).

Health and Wellbeing ML models have been applied in the detection of mental illnesses such as depression, using quality of life scales and clinical data (46). They have also been used in the prediction of rare diseases, allowing the identification of relevant biomarkers to assess patients' quality of life (66). ML has also contributed to forecasting the spread patterns of infectious diseases like dengue, through the analysis of epidemiological and climatic data (67) .

Workplace Well-being AI has made it possible to study job satisfaction by identifying factors such as work environment, job stability, and interpersonal relationships as key determinants of well-being at work (47). It has also been used to evaluate the Quality-of-Life Index based on dimensions such as income, safety, and health (55).

Education and Academic Performance ML has been employed to predict academic performance by analyzing factors such as study habits, internet usage, and the level of interaction in virtual environments (60). También ha sido útil para identificar patrones de éxito educativo y riesgo de deserción, segmentando a los estudiantes en función de su desempeño (57) . More recently, ML has been applied to predict the level of digital teaching competence in Colombian institutions, identifying performance patterns and learning gaps as key aspects in the educational dimension of quality of life (21).

Security and Crime AI models have been applied in the prediction of criminal trends, allowing to identify spatial and temporal patterns of homicide in different cities (18),(19),(20).

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Urban Environment and Quality of Life Urban Environment and Quality of Life AI has been used to model the quality of the urban environment, considering variables such as infrastructure, pollution and access to basic services (48). It has also been applied to analyze the impact of climate change on public health, providing key information for environmental policy planning (50).

P2. ¿ What are the present and future challenges of artificial intelligence and big data for improving quality of life?

The use of AI and big data in improving quality of life faces technological, ethical and regulatory challenges that must be addressed to ensure its positive impact.

Technological and infrastructure challenges: One of the main challenges is lack of access to advanced technological infrastructure, especially in developing countries. The implementation of complex models such as deep neural networks and enhanced learning requires high computing capacity, which limits its applicability in regions with limited technological resources (23).

In addition, the management of large volumes of data and lack of interoperability between systems make it difficult to integrate AI in key sectors such as health and education (62).

Ethical and privacy challenges in predicting quality of life: The use of AI in quality-of-life decision making raises issues of transparency and interpretability. Algorithms such as DL and RF have shown high accuracy in predictions, but they present difficulties in their transparency, which can generate mistrust in their application in public policies (23). To address this problem, explanatory methods such as SHAP and LIME are being developed which make the models more interpretable and understandable for decision-makers (23).

In addition, the collection and use of personal data for quality-of-life prediction requires strict regulatory frameworks to avoid discrimination and algorithmic bias (62). Without proper controls, AI models can reinforce social inequalities, especially when training data reflects pre-existing biases in society (23).

Challenges in implementing AI in public policies and quality of life Despite the potential of AI, its adoption in governments and social sectors remains limited. Lack of data science and AI training hampers their application in decision-making, and the absence of clear regulatory frameworks prevents an ethical and equitable use of these technologies (5) (23). Table 5.

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Table 5. P3. ¿ What are the most widely used algorithms for predicting quality of life and how accurate have they been in previous studies?

Algorithm	Field of Application	Performance and Accuracy	Reference
Random Forest (RF)	Poverty, dengue, cancer, COVID-19, job satisfaction, crime, education	Best performance in dengue prediction; 85–90% accuracy in crime prediction; lower RMSE in COVID-19 predictions.	(18),(19),(47),(50)(52),(67),(21)
XGBoost	Poverty prediction, health, job satisfaction, COVID-19	Outperforms RF in poverty (F1=0.38 vs. 0.33); high accuracy in health and COVID-19	(47),(50),(66)
Artificial Neural Networks (ANNs)	Health, dengue prediction, living environment, education	Higher accuracy in QoL prediction for patients with rare diseases (RAE = 0.25)	(48),(20),(60) (66),(67),(21)
k-Nearest Neighbors (k-NN)	Health, crime, academic performance	Higher accuracy in health-related QoL prediction; better weekly crime prediction performance	(18),(19),(20),(66)
Support Vector Machines (SVM)	Education, crime	Higher accuracy in academic performance prediction (up to 72.75%)	(18) ,(20),(52) (57), (60),(21)
Decision Trees (DT)	Job satisfaction prediction, crime, education	62.30% accuracy in academic performance; lower than SVM and ANN	(19),(47), (50), (52) ,(60), (21)
Ensemble Models (Stacking, Voting)	QoL index, school dropout detection	Stacking (SMO + LMT) achieved 84.21% accuracy	(48),(57),
Naïve Bayes	Quality of life in cancer patients, education	Performance comparable to RF and SVM in certain tasks	(52), (21)
Deep Learning (Stacked LSTM, GRU,RNN +)	COVID-19 prediction (Colombia and other countries), education (MIT), learning analytics	Applied to COVID-19 prediction and educational analytics	(50)(58)

The most commonly used algorithms in quality-of-life prediction include Random Forest (RF), Decision Trees DT, XGBoost, Artificial Neural Networks (ANNs), k-NN and SVM. RF is the most recurrent model, excelling in predicting dengue, crime and COVID-19 with high precision. XGBoost has shown better performance in poverty and job satisfaction studies. ANNs and k-NN have been effective in health and academic performance, while the assembly models have shown good results in quality-of-life indices and detection of school dropout.

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Although less commonly used, deep learning models such as LSTM and GRU have excelled in complex time series tasks such as disease evolution prediction and personalized learning analytics. Its application is increasing as more data and computational resources become available.

Discussion

To gain a strategic perspective on the current state and future potential of AI in the analysis of quality of life, a SWOT analysis was conducted. Originally developed as a strategic planning tool in business settings, the SWOT matrix (Strengths, Weaknesses, Opportunities, and Threats) has been increasingly adopted in scientific research as a valuable framework for synthesizing complex information. In this context, it allows for a structured evaluation of the capabilities, limitations, prospects, and risks involved in the application of AI techniques to quality-of-life research.

The systematic mapping process enabled the collection and synthesis of relevant information through the analysis of abstracts, full-text documents, and specialized bibliographic sources. Based on the defined research questions and search categories, key elements were identified for the development of the SWOT matrix, facilitating the understanding of strengths, opportunities, and threats associated with the use of artificial intelligence techniques in the analysis of quality of life.

The SWOT matrix summarizes the main advantages, challenges, and gaps identified in the literature. See table 6. Among the strengths are big data analytics, the use of generative machine learning techniques, and intelligent decision-making. Weaknesses include persistent gaps in the application of modern AI to quality of life and a limited conceptualization of the term in several studies. Opportunities lie in the expansion of analysis across multiple dimensions of well-being, while threats are associated with the technical complexity of implementation and the lack of studies in local contexts.

Table 6. Matrix SWOT

Strengths
Big data analytics
Probabilistic and data mining tools
Generative machine learning techniques
Intelligent decision-making based on AI
Weaknesses
Limited concept of quality of life
Limited availability of predictive tools on quality of life
Gaps related to the application of modern AI in quality of life
Opportunities
Comprehensive analysis in different dimensions of quality of life
Application of AI techniques, models and tools to quality of life
Prediction of diagnoses and evolution of diseases affecting quality of life
Application of machine learning to subjective quality of life assessment
Threats

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Difficulty in technical implementation
Lack of studies on indicators of unmet basic needs for quality of life
Flaws in the planning of public policies

According to (1) the How Life Is campaign is part of the OECD's Better Life initiative, which aims to promote better policies for improving quality of life. This initiative evaluates well-being in 37 member countries through 11 dimensions and four types of resources that ensure its sustainability over time. The OECD provides a publicly accessible database to facilitate analysis. In the case of Colombia, the education dimension is particularly relevant due to its deficiencies in fundamental knowledge and skills, assessed through PISA tests on 15-year-old adolescents and the PIAAC study on adults. See Figure 6.

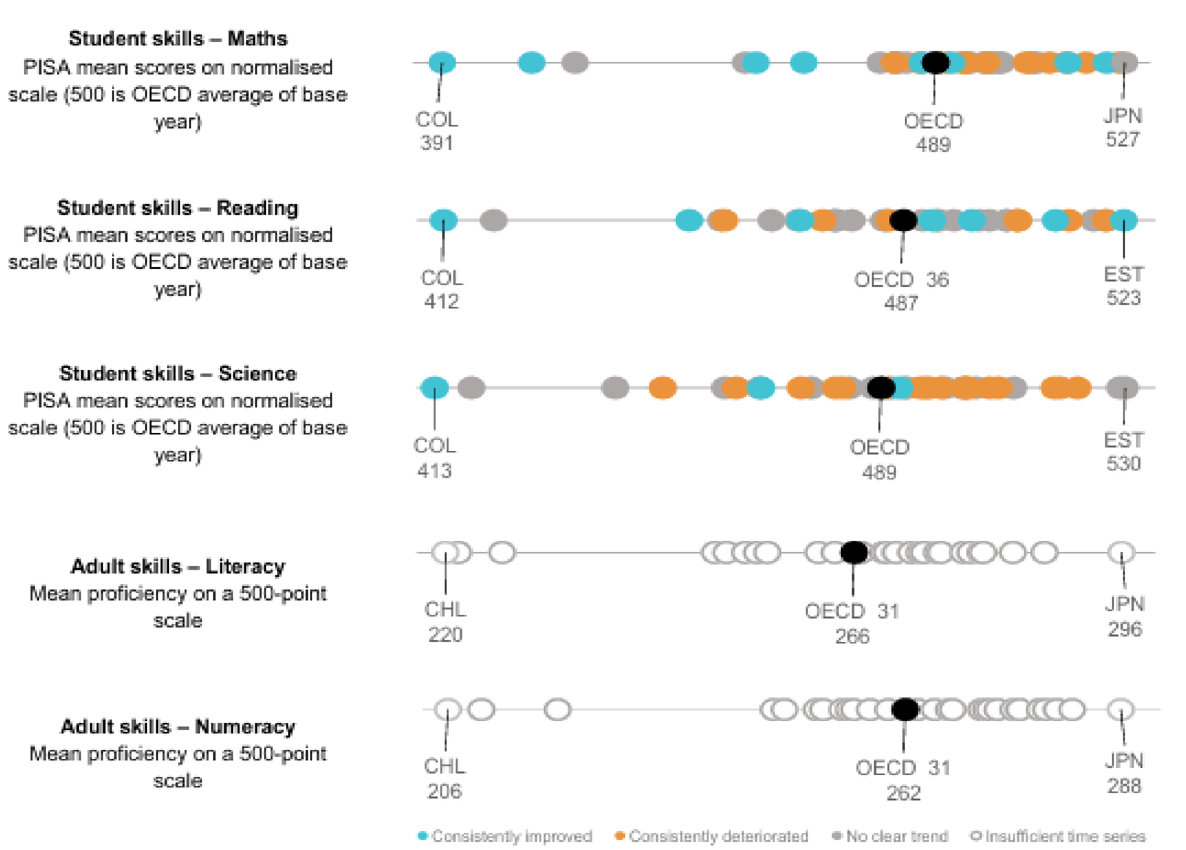

Figure 6. Colombia's position in the PISA 2020 tests according to OECD taken from(1)

In a complementary way, recent research such as (21), has reinforced the importance of using ML techniques to improve critical dimensions of educational quality of life in Colombia. His study designed and simulated a predictive model to assess digital teacher competence, achieving high levels of precision using algorithms such as Random Forest, Neural Networks and Gradient Boosting. These results not only highlight the positive impact of AI in strengthening human capital and digital inclusion, but also underline the potential of these techniques to be applied to other dimensions of social welfare in the country.

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In addition, recent systematic reviews such as (42)(43)(44) broaden the picture by analysing the incorporation of artificial intelligence into basic, higher and special education. These reviews highlight the ability of AI to personalize learning, detect students at risk of dropping out, and develop cognitive and affective skills in vulnerable populations such as students with autism spectrum disorders. Techniques such as neural networks, SVM and deep learning algorithms emerge as pillars of these applications, reinforcing the importance of strengthening technological infrastructure and digital skills to improve quality of life through education. Beyond local indicators, the term cooccurrence analysis performed with VOSviewer provides an overview of thematic trends in the use of AI for quality of life globally.

Figure 7 shows the keyword cooccurrence analysis generated with VOSviewer from selected articles. This analysis identified three main clusters: the first (in blue) groups terms associated with artificial intelligence techniques such as machine learning, deep learning, support vector machine and random forest; the second (in green) focuses on aspects of health and well-being, highlighting terms such as quality of life, depression and risk assessment; and the third (in red) relates demographic characteristics of the populations studied, such as adult, female and cohort analysis. The network shows a strong association between outcome prediction (forecasting) and quality of life assessment (outcome assessment), which reinforces the finding that AI use has been concentrated in clinical and epidemiological settings. It also highlights the prevalence of algorithms such as random forest and support vector machines, in line with the results of the P3 research question.

These results reflect a significant advance of AI in health and quality of life issues, although areas such as urban welfare, environmental impact and digital inclusion still present future research opportunities.

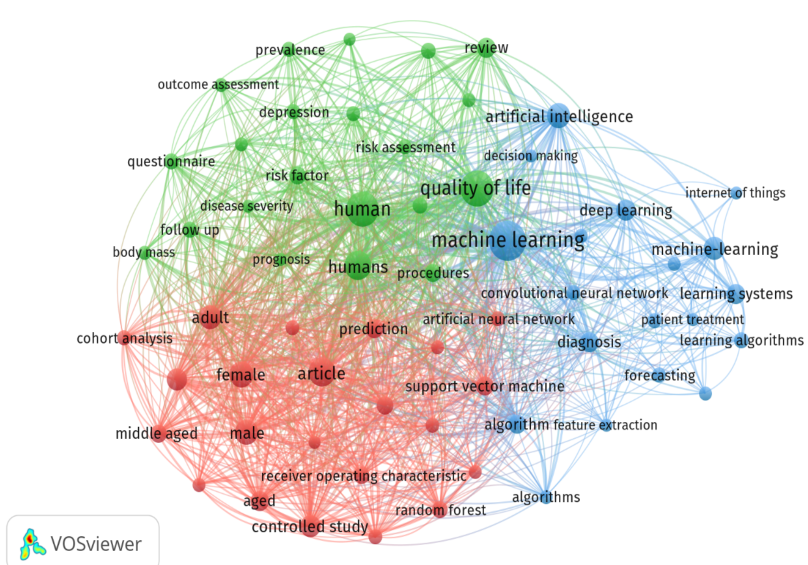

Figure 7. Word correlation analysis by clustering.

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Conclusions

This study aimed to identify and classify AI techniques applied to the analysis of quality of life, as well as to recognize the advancements, challenges, and opportunities in this emerging field. It also sought to answer three research questions related to the factors that can be predicted using AI, the main challenges in its application, and the predominant methodological approaches.

The systematic mapping revealed that the use of Machine Learning (ML) and Deep Learning (DL) techniques has been widely extended to predict key factors associated with different dimensions of well-being, including poverty, health, education, security, job satisfaction, and the environment. This thematic diversity confirms the cross-cutting impact of AI in quality-of-life analysis, enabling the exploration of social phenomena from multidimensional perspectives.

A key challenge identified is the availability and quality of data. Some studies rely on cross-sectional data, which can limit the ability of models to detect long-term trends. Having access to longitudinal data would allow for more accurate predictions regarding the evolution of quality of life. Moreover, it is necessary to strengthen the infrastructure for collecting and storing reliable and accessible information.

Regarding methodological approaches, the most commonly used algorithms include RF, XGBoost, DT, ANNs, SVM, and k-NN. These models have demonstrated high accuracy in predicting specific variables, such as poverty levels, job satisfaction, educational risks, and crime patterns. However, quality of life, as a complex phenomenon, still challenges the ability of current models to holistically integrate multiple factors.

In terms of challenges, the limited availability of longitudinal data, insufficient technological infrastructure, and biases present in training data represent significant barriers. Additionally, ethical risks were identified related to privacy, data protection, and the lack of transparency in algorithms—issues that require robust regulatory frameworks and specific mitigation strategies.

Finally, although the adoption of AI in public policy remains limited, there is growing interest in its integration to support evidence-based decision-making. Training in data science, strengthening technological infrastructure, and promoting partnerships between academia, government, and the private sector are essential to maximize the potential of AI in improving human well-being.

In conclusion, artificial intelligence offers a powerful and cross-disciplinary resource for analyzing and promoting quality of life. However, its effective implementation requires overcoming technological, ethical, and educational barriers. With a strategic, interdisciplinary, and ethically oriented approach, AI can become a key tool for driving more just, inclusive, and sustainable public policies

Limitations and future lines of research

Although this systematic mapping provides a comprehensive overview of the use of AI techniques in quality-of-life analysis, there are some limitations that must be considered. First, most of the studies included are based on cross-sectional data, which may restrict the ability to infer long term trends. Also, the selection of databases may have excluded relevant literature published in other specialized repositories.

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For future research, it is suggested to deepen the analysis of longitudinal data to improve the predictive capacity of quality-of-life models. It would also be relevant to conduct replication studies in local contexts, using explainable artificial intelligence (XAI) techniques that allow a more transparent interpretation of the results obtained. Finally, it is recommended to explore the impact of integrating heterogeneous data sources (health, education, environment) in order to capture more holistically the complexity of quality of life.

CrediT authorship contribution statement

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