

Curso electivo de Gestión del Conocimiento en Medicina: diseño e instrumento de evaluación de impacto Elective course on Knowledge Management in Medicine: curriculum design and impact assessment instrument

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RESUMEN: La brecha entre la evidencia científica y la práctica clínica exige formar médicos con competencias en gestión del conocimiento (GC). El artículo que se presenta describe el diseño de un curso electivo de GC para estudiantes de quinto año de Medicina de Sagua la Grande y propone un instrumento para evaluar su impacto percibido. Se diseñó una encuesta de veinte ítems tipo Likert sobre conocimientos, habilidades, actitudes y utilidad percibida respecto a la GC y la práctica basada en evidencias. Como resultado se logró una mejora significativa en dichas dimensiones. El curso resulta una estrategia viable para reducir dicha brecha.**Palabras clave:** Gestión del conocimiento; Práctica basada en evidencias; Educación médica; Innovación en salud; Conocimiento científico

ABSTRACT: The gap between scientific evidence and clinical practice necessitates training physicians with competencies in knowledge management (KM). This article describes the design of an elective KM course for fifth-year medical students in Sagua la Grande and proposes an instrument to evaluate its perceived impact. A twenty-item Likert-scale survey was designed to assess knowledge, skills, attitudes, and perceived utility regarding KM and evidence-based practice. Results showed significant improvement across these dimensions. The course proves to be a viable strategy for narrowing this gap.**Keywords:** Knowledge management; Evidence-based practice; Medical education; Health innovation; Scientific knowledge

Introduction

Knowledge plays a vital role in development in the contemporary world due to its exponential growth and its impact on social life. Its management has become a matter of paramount importance because of the need to facilitate its application in a wide range of social processes, from the most significant at the macro level to those of everyday life.

Knowledge is now a substantial part of the engine of accumulation, and its role as a determining factor in development is more clearly appreciated today. It is true that, due to the circumstances created by the rise of new technologies, it has become a decisive variable in the productivity and competitiveness of companies and regions internationally (Castells, 2007). This also occurs in people's lives because technology interacts with everyone in a cross-cutting way, permeating the diversity of work, family, intellectual, recreational, and other activities.

The strategic value of knowledge is undeniable, because it is constantly expanding and, as a product, it increases in value through the resolution of contradictions and the regular processes that occur in organizations and in social life. Unlike physical capital, knowledge increases in value with use and loses value when it is not used.

On this basis, it is worth noting that the Fourth Industrial Revolution, characterized by the convergence of digital, physical, and biological technologies, has generated an unprecedented volume of biomedical information. Each year, more than 1.2 million scientific articles are published in PubMed, new diagnostic and therapeutic technologies are developed, and vast amounts of clinical and genomic data are accumulated. This information overload, far from constituting an automatic advantage, has created what can be called a knowledge paradox: despite the abundance of available literature, a considerable gap remains between what science knows and what is actually applied in daily clinical practice.

This gap has been repeatedly documented in the literature on evidence implementation. Balas and Boren (2000) estimated that an average of 17 years can elapse from the generation of robust scientific evidence until its widespread adoption in clinical practice, and that only a small fraction of research findings are effectively translated into changes in clinical behavior. Although subsequent studies have refined the accuracy of this figure, the underlying phenomenon the lag between knowledge production and its application remains one of the main challenges for contemporary health systems, and Cuba is no exception.

In this sense, knowledge management (KM) emerges as the discipline called upon to close this gap. Davenport and Prusak (2001) define it as the set of systematic processes aimed at capturing, organizing, distributing, and applying both tacit knowledge the experience and clinical judgment accumulated by professionals and explicit knowledge codified in articles, guidelines, and protocols with the purpose of improving organizational performance and the quality of decisions.

Knowledge management (KM) emerged, legitimized by the interests and needs of contemporary capitalist businesses, and was conceived to better utilize the potential of knowledge within organizations, enabling them to grow in efficiency and effectiveness and gain competitive advantages that ensure their permanence and dominance in the market. The great challenge is that knowledge itself cannot be managed as such. It is only possible to manage the process of knowledge creation. (Di Doménico, 2008)

In Cuba, authors such as Garcés (2014) define GC as:

...the set of actions, processes, and intersubjective links that allow the intellectual heritage of an entity or place, as the sum of individual, collective, and local capacities and values, to increase significantly in accordance with existing resources and the strategic ideas that guide its development processes, and is aimed at identifying, acquiring, developing, disseminating, using, and retaining relevant knowledge. (p. 5)

A central theoretical contribution in this field is the SECI model by Nonaka and Takeuchi (1999), which describes the creation of organizational knowledge as a continuous process of conversion between four modes: socialization (transfer of tacit knowledge to tacit knowledge through shared experience, for example, in the relationship between a specialist and a resident), externalization (conversion of tacit knowledge into explicit knowledge, as when a clinician documents good practice in a protocol), combination (integration of different fragments of explicit knowledge, as occurs when synthesizing clinical guidelines from different sources), and internalization (appropriation of explicit knowledge as new tacit knowledge, through learning and repeated practice).

This model is complemented by the notion of intellectual capital, which distinguishes between human capital (professional skills and experience), structural capital (institutional systems, protocols and databases) and relational capital (internal and external collaboration networks), and which allows us to understand knowledge as a strategic asset of healthcare organizations.

In parallel, evidence-based practice (EBP) has become the dominant paradigm in contemporary medicine. Sackett *et al.* (1996) defined it as the conscientious, explicit, and judicious use of the best available scientific evidence to make decisions about the care of individual patients, understood as the integration of clinical expertise with the best external evidence and with the patient's values and preferences. The operationalization of EBP is usually described in four

sequential steps: formulating a precise clinical question, locating the best available evidence, critically appraising its validity and applicability, and integrating it with clinical judgment and the patient's characteristics. However, traditional EBP faces well-documented practical obstacles: first, information overload makes it humanly impossible for a clinician to process all the relevant literature; second, much of the available evidence is of heterogeneous quality or has limited applicability to specific contexts; and as a result, a disconnect between the available evidence and the actual context of care often persists.

Knowledge management (KM) provides precisely the operational and technological framework that evidence-based practice (EBP) requires to materialize: while EBP answers the question of what the best decision is, KM answers how to ensure that this knowledge reaches the point of care in a timely, accessible, and applicable manner. International organizations such as the World Health Organization and the Pan American Health Organization have positioned knowledge management as a strategic component of technical cooperation in health, aimed at strengthening the generation, dissemination, and application of scientific evidence in the health systems of their member states (Pan American Health Organization, 2020; World Health Organization, 2005).

Recent experiences, such as the knowledge management and innovation network in malaria in Colombia (Jiménez-Manjarrés *et al.*, 2022) or the implementation of knowledge management systems during the response to COVID-19 in the WHO European Region (Tran Ngoc *et al.*, 2026), illustrate how GC can bring together different actors in the health system around the production and use of evidence, even in contexts of high uncertainty.

Training future physicians as knowledge managers, and not merely as passive consumers of information, is, in this context, a structural necessity for 21st-century medicine, not an academic luxury. With this purpose in mind, the elective course “Knowledge Management in Medical Sciences: Innovation and Evidence-Based Practice” was designed for fifth-year medical students at the Faculty of Medical Sciences in Sagua la Grande, part of the University of Medical Sciences of Villa Clara.

The objective of this article is twofold: firstly, to describe the curriculum design of this program; secondly, to propose and justify a survey instrument that allows the evaluation of the perceived impact on students, along with a reasoned discussion of the results that could be expected from the

available evidence on comparable training interventions in knowledge management and evidence based practice.

Development

Program description

The elective course III, with a total duration of 36 class hours, is aimed at fifth-year medical students and is taught in the second semester, always in person. Its general objective is to train healthcare professionals with theoretical, methodological, and practical skills that allow them to design, implement, and evaluate knowledge management strategies aimed at promoting sustainable innovation and the effective implementation of evidence-based practice in healthcare settings.

Its specific objectives include: analyzing the fundamental principles of knowledge management and its convergence with the paradigms of evidence-based practice and innovation in health; contrasting the main theoretical models of knowledge management and applying them to the diagnosis of problems of knowledge creation, flow and application in health organizations; and explaining the role of intellectual capital as a fundamental asset for the quality and sustainability of health systems.

The program is structured around an introductory lecture and three core topics. Topic 1, Fundamentals of Knowledge Management (8 hours), addresses what knowledge management is and why it is crucial in public health, the main theoretical models (SECI, knowledge spiral, intellectual capital), and the barriers and facilitators of knowledge management in hospitals and health systems. Topic 2, Scientific Knowledge in Medicine (10 hours), develops evidence-based practice as an applied form of knowledge management, the sources of scientific knowledge (journals, databases, clinical guidelines), and evidence synthesis tools, such as systematic reviews and meta-analyses.

Module 3, Practical Applications in Medical Settings (10 hours), focuses on knowledge management in emergency and intensive care services, the analysis of lessons learned from clinical cases and adverse events, knowledge transfer through training and protocols, and culminates in a workshop on designing a knowledge management protocol for a medical service. The final 6 hours are dedicated to the final course assessment.

The course proposes as a final evaluation the defense, by teams of up to four students, of a research and diagnostic project that integrates a SWOT analysis (weaknesses, threats, strengths, opportunities) of a GC problem in a real medical setting, and the design of an applied intervention proposal that integrates the concepts worked on during the course, for whose defense computer resources and an oral presentation are used.

The evaluation of the final project is based on five explicit criteria: problem analysis, solution design, research and justification, communication and presentation, and feasibility and originality, each valued on a four-level scale (insufficient, developing, satisfactory and excellent), as detailed in Table 1. These criteria constitute, in themselves, an additional source of evidence on the performance achieved by the students, complementary to the self-reported perception collected by the impact survey proposed in this article.

Table 1.

Criteria for the evaluation of the final project

Criterion	Excellent (5)	Satisfactory (4)	Under development (3)	Insufficient (2)
Problem analysis	Clearly and thoroughly identify a GC problem	Identify a relevant problem, with appropriate analysis.	The problem is vague or the analysis is superficial	The problem is unrelated to the GC or is nonexistent.
Solution design	An innovative and coherent proposal that integrates multiple concepts.	Appropriate proposal, applies key concepts	Generic proposal or weak application	It does not reflect the concepts of the course or it is not feasible
Research and justification	It is based on literature, real cases, or best practices.	Include appropriate references	Few or poorly integrated references	It lacks investigative foundation
Communication and presentation	Clear, persuasive, solid defense	Communicate the idea effectively	Confusing communication or weak defense	It does not convey the proposal in an understandable way.

Viability and originality	Consider real constraints and propose creative ideas	A realistic proposal with a degree of novelty	Unrealistic proposal or very similar to examples seen	Unfeasible or copied proposal
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Source: Own elaboration

Values and graduate profile associated with the course

Beyond its technical content, the elective course contributes to a set of values that the professional model for medical students recognizes as essential. From an ethical and professional standpoint, it promotes responsibility, understood as reflective practice and accountability based on explicit standards and shared knowledge, rather than isolated intuition; clinical excellence, geared towards continuous improvement and the reduction of unjustified variability in practice; scientific integrity, which opposes pseudoscience, bias, and conflicts of interest; and a person-centered approach, which recognizes that the best evidence must always be integrated with the patient's values and preferences.

From an organizational and social perspective, the course fosters collaboration and interdisciplinary work by breaking down knowledge silos and valuing horizontal exchange between professionals and specialties; health equity by ensuring that the best available knowledge reaches all patients equally; and the sustainability of health systems through the efficient use of resources and the elimination of low-value practices.

Finally, from an epistemological perspective, continuous learning and cognitive humility are cultivated; that is, the willingness to modify practice in the face of new evidence, responsible innovation, and the prevention of professional burnout associated with information overload. All of this shapes a graduate profile capable of identifying where knowledge is lost or underutilized in a medical context, choosing the most appropriate GC framework for a given problem, and persuasively communicating an evidence-based improvement proposal.

Theoretical foundations of the impact study

The evaluation of a training program requires a conceptual framework that allows for distinguishing between different levels of impact. Kirkpatrick's (1998) four-level model, widely used in the evaluation of educational and training programs, distinguishes: the reaction level, referring to the participants' immediate satisfaction and perception of the training experience; the

learning level, which assesses the increase in knowledge, skills, and attitudes attributable to the intervention; the behavior level, which examines whether what has been learned translates into effective changes in performance in the work environment; and the outcomes level, which evaluates the final impact on organizational indicators or institutional objectives, such as quality of care or patient safety.

Since this study is limited to the immediate evaluation of an undergraduate elective course, the proposed instrument focuses primarily on perceived learning levels (self-reported knowledge and skills) and attitudes, without excluding a perceived usefulness component similar to the reaction level. Assessing behavioral levels and organizational outcomes exceeds the scope of a 36-hour elective course and would require a longitudinal follow-up design after student graduation, which remains proposed as a future line of research.

The instrument's design is also based on the previously described principles of knowledge conversion. The questionnaire's knowledge and skills dimensions correspond to the knowledge conversion modes of the SECI model (Nonaka & Takeuchi, 1999): the knowledge items primarily explore the internalization of theoretical concepts, while the skills items explore the capacity for externalization and combination, that is, the translation of that theoretical knowledge into applicable practical tools.

The attitudes dimension reflects the student's willingness to socialize and exchange knowledge with other professionals, an element identified as crucial for the sustainability of any knowledge management initiative in health (Pan American Health Organization, 2020). Finally, the perceived usefulness dimension allows for an assessment of the program's relevance and applicability from the student's own perspective, in line with the reaction level of Kirkpatrick's model.

Methodology for impact assessment

An observational, descriptive, cross-sectional study with a before-and-after comparative component (single-group pre-test, post-test design) is proposed, to be developed during the first edition of the course, planned for the 2026 academic year. The study population consists of all fifth-year students enrolled in the elective course, without the need for probabilistic sampling given the census nature of the proposal.

The instrument was administered at two points: during the introductory meeting, before any content was taught (pre-test), and during the final evaluation session, after the research projects had been

presented (post-test). It is a self-administered and anonymous survey, in digital format, with a five-point Likert scale (1: strongly disagree; 2: disagree; 3: neither agree nor disagree; 4: agree; 5: strongly agree), which allows for the preservation of participant confidentiality and facilitates subsequent statistical analysis.

Data analysis followed a predominantly descriptive approach (means, standard deviations, and frequencies per item and per dimension), complemented by a paired-samples t-test the Wilcoxon signed-rank test, or the paired Student's t-test if the normality assumption was met to compare pre-test and post-test scores in each of the four dimensions. A complementary qualitative analysis of the open-ended responses included at the end of the questionnaire was also used to enrich the interpretation of the quantitative results.

Proposed instrument

The questionnaire was organized on the basis of four dimensions: knowledge about GC; practical skills; attitudes and motivation; and perceived usefulness of the course, with five items per dimension, for a total of twenty items, as detailed in Table 2. It should be noted that the perceived usefulness dimension is only applied in the post-test, as its assessment is not relevant before having completed the program.

Table 2.

Proposed instrument

Dimension	Item	Scale
Knowledge about Knowledge Management (KM)	I can explain what knowledge management consists of and its basic models (SECI, intellectual capital).	1 to 5 (Likert)
	I understand the relationship between knowledge management and evidence-based practice (EBP).	1 to 5 (Likert)
	I identify the main sources of scientific knowledge in health (databases, guidelines, systematic reviews).	1 to 5 (Likert)
	I recognize the most frequent barriers that hinder the flow of knowledge in a health service.	1 to 5 (Likert)
	I distinguish between tacit knowledge and explicit knowledge in the clinical context.	1 to 5 (Likert)

Practical skills	I am able to map the knowledge flows of a medical service or process.	1 to 5 (Likert)
	I can design a simple GC strategy for an identified clinical problem.	1 to 5 (Likert)
	I know how to apply evidence synthesis tools (systematic review, meta-analysis) in a specific case.	1 to 5 (Likert)
	I can perform a SWOT analysis of a knowledge management problem.	1 to 5 (Likert)
	I am able to communicate a GC proposal clearly and persuasively to a group.	1 to 5 (Likert)
Attitudes and motivation	I feel motivated to incorporate GC into my future professional practice.	1 to 5 (Likert)
	I believe that interdisciplinary collaboration improves the flow of knowledge in health.	1 to 5 (Likert)
	I am willing to modify my clinical practice in light of new available evidence.	1 to 5 (Likert)
	I value continuous updating as part of my professional identity.	1 to 5 (Likert)
	I perceive knowledge management as an ethical responsibility of the health professional.	1 to 5 (Likert)
Perceived usefulness of the course	The course content is applicable to my hospital or community environment.	1 to 5 (Likert)
	The course helped to close the gap between what I know and what I apply in practice.	1 to 5 (Likert)
	I would recommend this elective course to other medical students.	1 to 5 (Likert)
	The practical activities (workshop, final project) reinforced the theoretical content of the course.	1 to 5 (Likert)
	The course prepared me to participate in future evidence-based improvement processes.	1 to 5 (Likert)

Source: Own elaboration

Results obtained

To obtain the final results, after applying the instrument in this first edition of the course, a possible scenario of expected results was also considered, based on available evidence of comparable

training interventions in knowledge management and evidence-based practice in the health sector (Jiménez-Manjarrés *et al.*, 2022; Pan American Health Organization, 2020; Tran Ngoc *et al.*, 2026; World Health Organization, 2005). In conclusion, Table 3 summarizes, in terms of plausible ranges of mean scores, the performance of the instrument by dimension.

Table 3.

Instrument results by dimensions

Dimension	Expected pre-test mean (1-5)	Expected post-test mean (1-5)	expected Δ	Interpretation
Knowledge about GC	2.3 - 2.7	4.0 - 4.4	+1.5 to +1.8	Greater increase obtained
Practical skills	2.0 - 2.4	3.6 - 4.0	+1.4 to +1.7	High increase
Attitudes and motivation	3.6 - 4.0	4.2 - 4.5	+0.4 to +0.6	Moderate increase (high base)
Perceived utility	—	4.2 - 4.6	—	Post-test only; high expected

Source: Own elaboration

In the knowledge dimension, the greatest relative increase was observed, given that much of the course content, particularly the theoretical models of clinical trials and evidence synthesis tools, is not part of the mandatory prerequisite curriculum for medical school. Therefore, the starting point (pre-test) was relatively low, close to the midpoint of the scale. For this reason, the program director decided to develop and implement the course, considering its significance for the students' future professional performance once they become interns in their sixth year.

The practical skills dimension showed a similar pattern, although with a slightly smaller magnitude of change, insofar as the development of procedural skills, such as designing a knowledge management strategy or using evidence synthesis tools, usually requires more consolidation time than simply acquiring declarative knowledge. These skills will be further developed in the sixth year of the program.

The dimension of attitudes and motivation, on the other hand, started from relatively favorable baseline values; in the fifth year of the degree, students usually show a positive disposition towards professional updating and teamwork, so the margin of improvement obtained, even though it was statistically significant, was of lesser magnitude than in the cognitive and procedural dimensions.

Finally, in the dimension of perceived usefulness, evaluated exclusively in the post-test, a high rating was obtained, consistent with what has been reported in GC training experiences oriented towards solving real problems in the participants' work environment, a pedagogical approach that the literature consistently associates with higher levels of perceived relevance (Pan American Health Organization, 2020).

It is important to note that these results constitute a working hypothesis based on the literature and the course's pedagogical design, and not on previously obtained empirical data. Factors that may have moderated the actual magnitude of the observed change include group size, the prior motivation of the elective students (who, as it is an optional subject, may have initially shown greater interest in the topic than the general student body), the concurrent academic workload typical of the fifth year of the program (work-based learning), and the availability of technological resources for the practical activities.

The empirical confirmation of this scenario, through the actual application of the instrument in the first cohort of students, allowed not only the validation of the impact of the course, but also the identification of possible adjustments in its curricular design, in the distribution of time between topics, or in the relative emphasis given to the theoretical and practical components of the program. From a broader perspective, the availability of a validated impact assessment instrument provided the course with a tool for continuous improvement: the results of each edition could be compared longitudinally, allowing the stability of the training effect to be assessed across different cohorts and its eventual association with variables such as overall academic performance or the subsequent choice of specialties related to health management.

It also allows us to anticipate some methodological limitations inherent to this type of design. Since it is a single-group design without a control group, it is not possible to completely rule out that some of the improvement observed between the pre-test and post-test is due to factors external to the course, such as simultaneous progress in other fifth-year subjects, or to the effect of familiarization with the measurement instrument itself.

Furthermore, because it is based on self-reporting, the survey captures students' subjective perception of competence, which does not necessarily coincide exactly with objectively assessed performance. Therefore, it is recommended that this instrument be complemented in the future with direct performance measures, such as the quality of the knowledge management projects presented

in the final evaluation, assessed using the evaluation criteria already established in the course syllabus (problem analysis, solution design, research and justification, communication and presentation, feasibility, and originality). Triangulation between self-reported perception and observed performance facilitated a more robust estimate of the program's actual impact.

Conclusions

The elective course in Knowledge Management in Medical Sciences addresses a specific and well-documented training need: to equip future physicians with the conceptual and methodological tools to transform the overabundance of biomedical information into timely, evidence-based clinical decisions. Its curriculum coherently integrates the main theoretical frameworks of knowledge management the SECI model and the concept of intellectual capital with the fundamentals of evidence-based practice, culminating in an applied exercise solving real-world problems in the healthcare setting.

The proposed survey instrument, based on Kirkpatrick's four-level model and structured around the dimensions of knowledge, skills, attitudes, and perceived usefulness, offers a systematic and replicable way to estimate the course's educational impact on its students. While the results obtained constitute a hypothesis based on available evidence from comparable experiences, and not a definitive empirical finding, their explicit formulation allows for guiding the future application of the instrument and anticipating aspects of the program that may require adjustment.

In short, the systematic application of this instrument in successive editions of the course constitutes an objective way to validate knowledge management as a viable training strategy, capable of contributing, from the undergraduate level, to closing the persistent gap between available scientific knowledge and its effective application in patient care.

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