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Recognition of predictable variables in the early stages of learning: training experience with kinesiology/physiotherapy students.

Reconocimiento de variables pronosticables en etapas iniciales del aprendizaje: experiencia formativa en estudiantes de kinesiología/fisioterapia.

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Summary: Background: Understanding rationalities is fundamental in the training of kinesiologists. However, semantic and syntactic ambiguities persist in theoretical approaches to learning. **Objective**: To explore students' ability to recognize variables susceptible to prognosis. **Methodology:** Educational research with a cross-sectional observational approach through a training workshop held in 2023 with 76 students from the cohort applying descriptive statistics techniques. **Results**: A greater understanding of the domains related to the Function-Dysfunction, Movement and Health axis is evident, compared to the corresponding dimensions. The interpretation of graphs in various combinations reflects an adequate use of this skill for decision-making. **Conclusion**: Understanding on the part of the students, especially in the identification of key variables, is efficient. Areas of confusion and errors in interpretation indicate the need to address conceptual gaps. The training workshop proved to be a valuable tool for this improvement.

Keywords: Prognosis, learning, rationality, kinesiology/Physiotherapy,

Resumen: Antecedentes: La comprensión de las racionalidades es fundamental en la formación de kinesiólogos. Sin embargo, en las aproximaciones teóricas para el aprendizaje persisten ambigüedades semánticas y sintácticas. **Objetivo**: Explorar la capacidad del estudiantado para reconocer variables susceptibles de pronóstico. **Metodología:** Investigación educativa con enfoque observacional transversal mediante un taller formativo realizado en el año 2023 con 76 estudiantes de la cohorte aplicando técnicas de estadística descriptiva. **Resultados**: Se evidencia una mayor comprensión de los dominios relacionados con el eje Función–Disfunción, Movimiento y Salud, en comparación con las dimensiones correspondientes. La interpretación de gráficos en diversas combinaciones, se refleja un uso adecuado de esta habilidad para la toma de decisiones. **Conclusión**: La comprensión parte de los estudiantes, especialmente en la identificación de variables clave es eficiente. Las áreas de confusión y errores en la interpretación indican la necesidad de abordar las lagunas conceptuales. El taller formativo demostró ser una herramienta valiosa para esta mejora.

Palabras clave: Pronóstico, aprendizaje, racionalidad, kinesiología/Fisioterápia.

1. Introduction

In kinesiology, prognostication is understood as a professional rationale that articulates principles and procedures designed to anticipate the functional evolution of individuals in different clinical and educational contexts. Traditionally, this process has been conditioned by epidemiological models focused on disease and morbidity and mortality, in which statistical rates have guided clinical decision-making (1-2). However, such approaches have shown limitations by focusing on large populations and biomedical variables, neglecting the functional uniqueness of each individual.

From the perspective of the Human Movement Function-Dysfunction Model (HMDM), prognosis is conceived as the ability to project function and movement in relation to health, guiding professional practice in a situated manner. This model organizes kinesthetic practice around domains (function, movement, and health) and their dimensions, allowing for a comprehensive assessment and projection of the functional trajectory beyond traditional biomedical diagnosis (3-4). The integration of these approaches has consolidated prognosis as a distinctive rationale, oriented not only to the monitoring of clinical variables, but also to reflective and pedagogical decision-making in university education (5).

In the educational setting, the early introduction of this rationale into kinesiology programs is key, as it allows students to understand that prognosis is not limited to statistical data, but rather involves the contextual interpretation of functional indicators. International literature highlights that physiotherapy students tend to first consolidate general categories—such as movement or health—before being able to discriminate more specific dimensions, reflecting a progression in the development of clinical reasoning (6-7). Similarly, recent studies have shown that clinical simulation and situated experiences promote confidence in decision-making, reducing hesitation in the face of complex scenarios (8).

Within this framework, this training experience seeks to explore how novice kinesiology students recognize and interpret variables linked to prognosis, using situated activities supported by MFDMH resources. This approach allows for an investigation of learning progression, identifying strengths in the recognition of general domains and difficulties in discriminating specific dimensions.

Therefore, the objective of this study was to explore the ability of first-year kinesiology students to recognize and interpret variables related to prognostic rationality within the framework of the MFDMH, through a situated training workshop.

2. Methods

Design

A cross-sectional observational study, selected for its relevance in describing the recognition and prognostic projection skills of novice students at a specific point in time. This design is suitable for training experiences, as it allows students' understanding to be captured in the immediate context of the workshop without the need for longitudinal follow-up. However, it is recognized as a limitation of this approach that it is not possible to establish changes over time or infer causal relationships, and is limited to a descriptive characterization of the group analyzed.

Participants

A total of 76 students decided to participate after giving their informed consent for the use of the results obtained from a training workshop called Prognosis in Kinesiology: Determinants and Sense of Opportunity. The students were selected based on their membership in the 2023 first-year cohort of the Kinesiology program at the Catholic University of Maule. Those enrolled in their second semester and who agreed to participate through informed consent were included. No additional exclusion criteria were applied, given the formative and exploratory nature of the experience. To ensure the validity of the activity, the assessment instruments (theoretical case, graphs, and integration questionnaire) were reviewed by a panel of three faculty experts in the

Function-Dysfunction Model of Human Movement and kinesiology teaching. This procedure ensured content validity. A pilot test was also conducted with a small group of 10 first-year students (previous cohort 2022), which allowed for item clarity and improved understanding of the graphs before their final application.

Study variables

Primary outcome: Recognition of prognosis type (natural, with follow-up, with intervention). Secondary outcomes: Identification of domains (function, movement, health) and specific dimensions of the MFDMH; perception of the prognosis's usefulness for decision-making.

Instruments and measurement

Standardized theoretical case with anthropometric and performance data. Four charts (route to school, 6-minute walk, health perception, oxygen saturation). Integration questionnaire with four questions (including perception of the usefulness of the prognosis). Student responses were recorded on individual record sheets and compiled at the end of the workshop.

Strategy

A two-module workshop divided into four sections, with their respective tutors, focused on the learning outcome (LE): "Prioritize functional, movement, and health problems according to their magnitude and relevance to the functional context of first-quadrant individuals living in the community." This previously developed activity, based on the program's topics and content, is also designed to address the learning strategies, assessment criteria, and tools. This curricular activity is expected to achieve the achievement levels.

Assessment

A formative assessment will be presented based on a hypothetical case. The requirements involved are used to obtain recognition of the behavior of the variables involved, as well as the integration exercises required to achieve the theoretical prognostic qualifications of RDA.

Support Resources

a) Theoretical Case: A 6-year-old DCT boy weighing 25.5 kilos and measuring 1.27 meters tall is in second grade at an urban school in the city of Talca. He stands out among his classmates due to his academic performance in most subjects and has been on sick leave at home for a week due to the common cold. DCT is a child who prefers to use technology with little parental guidance and remains sedentary for most of the day during the week.

b) Materials: All anthropometric tables published by MINSAL, Chapter 6 of the Teaching Support Text "Professional Reasoning in Kinesiology: Function-Dysfunction at the beginning of the life cycle", and a PowerPoint presentation with reference tables to characterize epidemiological contexts in the Maule region are provided in the classroom.

c) Training Workshop (Annex 1): It consists of 4 graphs that provide information related to the performance of the case over a period of time involving 8 months of evolution during the year 2022 and that contains the following graphic background where domains and dimensions must be recognized:

Chart 1. Number of stops from home to get to school (500 meters).

Chart 2. 6-minute Walk Test Performance (mts.)

Chart 3. Physical Health Perception (%).

Chart 4. O2 saturation (%).

The section with the indicated graphics is added, seeking the integration of the results based on the following questions of the Theoretical Case:

- What type of forecast could you make with the measurements you had up to May 2022?
- From July 2022, what would be your forecast?
- Between September and October 2022 What is the condition?
- What is the usefulness of a reliable and valid forecast? (This question was intended to explore students' perceptions of the importance of forecasting in professional decision-making.)

Data analysis

Student responses were processed using descriptive statistics. Absolute and relative frequencies (%) were calculated for each variable analyzed and organized into contingency tables according to the domains and dimensions of the MFDMH. Likewise, measures of central tendency (mean and median) were estimated when applicable to numerical variables. The results were represented graphically using histograms and bar charts to facilitate interpretation of the proportions of correct answers, errors, and omissions in the responses. The analysis was performed using Microsoft Excel (version 2023) to support tabulation and graphical representation. In addition to measures of central tendency, measures of dispersion (standard deviation for continuous variables and interquartile range for ordinal variables) were calculated to characterize the variability of responses. Exploratory comparisons were also made between student sections and between domains, using chi-square tests for proportions and Student's t test for differences in means, as appropriate. These analyses were descriptive in nature and conducted using Microsoft Excel and SPSS (version 21).

3. Results

68.4% of students (SD = 0.47) correctly identified the Function–Dysfunction domain, indicating that more than two-thirds of students were able to grasp this fundamental concept. In contrast, only 48.4% (37; SD = 0.50) recognized the Person dimension, reflecting greater difficulty in transferring knowledge to more specific levels of analysis. This difference demonstrates that, in terms of learning, domains are more accessible to students at earlier stages than the corresponding dimensions.

100% of students correctly identified the Movement domain, demonstrating a solid and consistent understanding of this category, even in the early stages of training. However, only 3.9% (3; SD = 0.19) recognized the distance traveled dimension, reflecting students' difficulty in shifting their analysis from a general concept (the domain) to a specific dimension. In terms of learning, this indicates that teaching needs to strengthen the ability to disaggregate information into finer levels of analysis.

85.5% (65; SD = 0.35) correctly identified the Health domain, demonstrating a good level of understanding in a broader category closer to the students' everyday experience. In contrast, only 53.9% (41; SD = 0.50) recognized the musculoskeletal dimension, indicating a partial difficulty in conceptual discrimination. These results suggest that students internalize global domains more easily before moving on to differentiate specific dimensions.

100% (76; SD = 0) correctly identified the domain, while 97.4% (74; SD = 0.16) recognized the cardiopulmonary dimension. This high level of accuracy indicates that, in this case, students not only managed to appropriate the general concept, but also the specific dimension linked to it, which may be related to the familiarity with the concept of oxygen saturation in their initial training. From a pedagogical perspective, it suggests that some content, due to its proximity to clinical practice, is consolidated more quickly.

12% (9; SD = 0.33) correctly identified the prognosis with follow-up by natural evolution, while 78% (59; SD = 0.42) selected only “natural evolution” without follow-up and 10% (8) opted for intervention. In terms of learning, these results show that most students recognize natural evolution as a prognostic element, but still have difficulties integrating the idea of follow-up as part of rationality. This reveals a transition in learning from basic understanding to more complex reasoning.

71% (54; SD = 0.45) indicated the Favorable condition since July 2022, while 26% (20) did not answer and 3% (2) responded "Unfavorable." The high percentage of correct responses reflects that the majority manage to adequately project the evolution of the case; however, the proportion of students who did not respond indicates insecurity or lack of confidence in making prognostic decisions. This suggests the need to reinforce pedagogical strategies that strengthen security and argumentation in clinical reasoning.

Sixty-one percent (47; SD = 0.49) responded that their condition continued to improve between September and October 2022, while 29% (22) did not answer and 10% (7) chose "stable" or "deteriorating." The predominance of correct answers indicates that students are able to understand the continuity of the positive trend. However, the significant number of students who chose not to answer shows hesitations in their reasoning. In terms of learning, this reflects that longitudinal data interpretation requires additional training to be consolidated at early stages.

Regarding the usefulness of a reliable and valid forecast, 44% (33; SD = 0.50) highlighted decision-making, 25% (19) the observation of variables, 17% (13) professional rigor, and 14% (11) did not answer. These results suggest that the majority recognize the practical function of the forecast as a decision-making tool, although a significant portion of the group does not yet fully associate this process with methodological rigor or the continuous evaluation of variables. In terms of learning, this indicates the need to emphasize the relationship between forecasting, decision-making, and scientific foundation.

4. Discussion

Our results, which show a greater understanding of general domains (movement, health, and function–dysfunction) compared to difficulties in discriminating specific dimensions, are consistent with research indicating that initial learning in kinesiology tends to consolidate first in broad categories before advancing to finer levels of analysis. This pattern has been reported in recent studies on clinical reasoning in physical therapy students, where the importance of progressing from general schemes to contextualized differentiation is highlighted (9)–11). Likewise, the insecurity reflected in the proportion of students who did not respond to certain items is consistent with the findings of Sousa et al. (15), who identified that confidence in prognostic decision-making develops gradually with clinical experience and teacher feedback. Along these lines, the literature on learning in health sciences emphasizes that the early incorporation of rationalities such as prognosis in initial training allows not only to develop clinical judgment skills, but also to strengthen students' reflective capacity (12–13).

The exploration of the reflective capacities that interact to recognize and interpret the variables that contribute to the prognostic rationality can be installed prematurely in the initial stages of training (5), especially when students approach it through contexts situated in relation to their training that are relevant to their routine experiences and also through the use of theoretical resources related to the topics covered during their first year of training in kinesiology (13).

Recognition of the movement and health domains was 100%, while the least identified was function at 57.6%. Regarding the totality of the dimensions that make up the data, the identity of the CP dimension stands out first (94.6%), followed by ME (44%), and Person (42.4%), with the TF dimension being the least known (13.5%) . In the context of interpreting the analysis for a time unit (until May 2022), although the discrimination of the exercise requires visualizing the type of prognosis, such an interpretation requires high accuracy. It can be observed that 12% of the students can accurately specify when they are dealing with a Natural Evolution follow-up prognosis. However, if we accept the similarity of the confusing response, this is complemented by the 78% who recognize a Natural Evolution status. In this way, it can be argued in a training context that 90% of the students are able to adequately place the prognosis in its typology. Considering that this decision had to integrate the information from 4 graphs of the same case, we are in the presence of a first-level student who can early recognize significant aspects of what represents the rationality of the forecast, considering a transversal variable that is time.

There are no publications in the literature that show the teaching of this rationality, since the forecasts mostly correspond to extensive studies where the morbidity and mortality rates are those that lead the projections almost always associated with the behavior of the diseases and in terms of Bayesian reasoning, whose main purpose is the sensitivity and specificity of the tests that are applied mainly for diagnostic hypothesis purposes rather than prognoses (9).

When students are asked to respond based on the same theoretical case but modifying the temporal unit of analysis (from July 2022), with their respective cross-sectional monitoring so that

they not only identify the type of forecast but also establish a projection, it can be observed that 71% manage to interpret the case condition from a perspective that is verbalized as a Favorable prediction. It is striking that 26% of students did not answer and that 3% contradicts the data trend. Given the regularity of students who did not answer, as they did not exceed 30% for each of the forecasting challenges, such responses may be indicating certain characteristics that at least reflect insecurity regarding decision-making and that it is well worth approaching these experiences qualitatively to see where the procedural or cognitive weaknesses that influence such a decision lie.

When comparing our results with recent literature in physiotherapy education, a similar pattern in the progression of clinical reasoning is observed. For example, Monteiro et al. (6) report that physiotherapy students tend to first recognize general categories of functional performance before being able to discriminate more specific dimensions, which coincides with the greater understanding observed in domains versus dimensions in our study. Complementarily, Wainwright et al. (7) point out that insecurity in prognostic decision-making during the early years of training is related to the lack of situated experiences, which is reflected in the 26–29% of students who chose not to respond to our more complex items. In contrast, recent research in European settings (8) has shown that the early incorporation of clinical simulation reduces these hesitations, suggesting that pedagogical strategies based on scenarios closer to real practice could strengthen students' confidence and reasoning in local contexts.

Studies that regularly address prognostic factors tend to focus on these epidemiological and clinical projections, using longitudinal designs and large cohorts to establish prognostic factors and validate predictive models (1-2, 14). There is no exact number that is universally applicable, as it depends on many factors. However, in most cases, we aim to keep the prognostic error rate as low as possible, preferably close to 0%. In our study, the margin of error in prediction was 3%, corresponding to the proportion of responses that contradicted the information presented. This finding should be understood in the specific context of a workshop with novice students and not as a universal reference value. The literature has indicated that margins of error in prognostic studies depend on the design, the clinical context, and the characteristics of the sample, and vary widely according to the condition and the methods used (1-2). Students may become more reserved and avoid commenting when faced with a verbalization that compromises their clinical judgment. While a percentage of errors that definitely contradict the interpretation of information requires further explanation, the need to investigate through a qualitative study is confirmed.

Now, when the possibility of comparatively and evolutionarily characterizing the condition based on another time unit (September 2022 condition) is incorporated, 61% of students correctly visualize the data analysis, expressing the following verbalization: Maintenance of an improving trend, which some students prefer to understand as stability (5%). This shows a 66% accuracy in prognostic judgments. Again, 29% of students prefer not to make a judgment, while another 5% see a deterioration. Regardless of whether these same students are unable to adequately materialize a decision, the consequences, severity, fear, and awareness of the risk-benefit are scenarios that any responsible actor considers when making a judgment, and therefore their abstention is understandable.

These correct responses are based on the prognostic rationale inherent to MFDMH, in which the student must identify not only the affected domain (function, movement, or health) but also project its evolution using the logic of function and dysfunction. Thus, choosing a prognosis with monitoring based on natural evolution, favorable condition, or maintenance of improvement reflects the application of reasoning based on the relationship between time, variation in observed variables, and their functional impact. This approach allows us to understand that prognostic decisions are not isolated responses, but rather integrated processes that articulate clinical data and functional context. This speculation is confirmed by the responses to the question about the usefulness of this rationale. We can see that those who do not participate are significantly reduced to 14% (No Answer), while 86% emphasize the importance of constructing a reliable and valid prognosis. 17% emphasize the responsibility required to work rigorously to determine a decision, 25% value the ability to observe the evolution of the case, and 44% believe it is a rationale that allows for sound decision-making.

This study provides empirical evidence on the feasibility of introducing prognostic rationality early in novice kinesiology students, showing that general domains are understood before specific dimensions. This finding confirms that prognostic learning follows a progression from broad categories to levels of greater conceptual discrimination. Furthermore, identifying hesitations and omissions in responses allows for the identification of areas of uncertainty that require specific pedagogical strategies to strengthen confidence in clinical decision-making. Together, these results contribute to the didactics of kinesiology training by proposing a teaching model that articulates theory, practice, and critical reflection from the early stages.

5. Conclusions.

- The early incorporation of prognostic rationality in entry-level kinesiology students showed positive acceptance in the learning process, evidenced by a greater understanding of general domains versus specific dimensions.
- This finding suggests that it is possible to progressively introduce this rationality from the initial stages, although the results should be interpreted with caution, given that they come from a single workshop applied to a single cohort.
- Future studies with comparative designs and larger samples will confirm and expand these observations.

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WORKSHOP ANNEX

EXPLORACIÓN DEL MOVIMIENTO Y LA FUNCIÓN
LÍNEA DE RAZONAMIENTO PROFESIONAL

Agosto 2023

TALLER FORMATIVO

Pronóstico en Kinesiología: Determinantes y Sentido de Oportunidad

Nombre: _____

A continuación, analice las siguientes gráficas suponga niño ♂ 6 años, 1,27 mts y 25,5 kg.

Gráfico 1 :

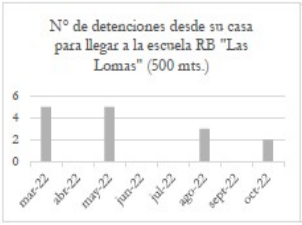
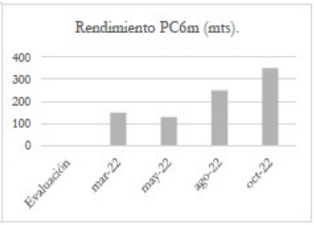


Gráfico 2:



A qué dominio/dimensión tributan los gráficos:

G1	**G2**

Gráfico 3:

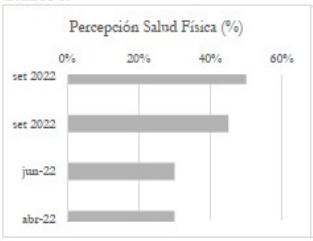
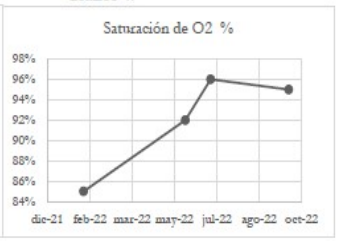


Gráfico 4:



A qué dominio/dimensión tributan los gráficos

G3	**G4**

EXPLORACIÓN DEL MOVIMIENTO Y LA FUNCIÓN
LÍNEA DE RAZONAMIENTO PROFESIONAL

Agosto 2023

Considerando la información de manera integral, incluyendo todos los gráficos (G1, G2, G3 y G4):

1. ¿Qué tipo de pronóstico podría realizar con las mediciones que poseía hasta mayo 2022?

2. De acuerdo a la información que dispone, proyectando desde Julio 2022 ¿Cuál sería su pronóstico?

3. Con alta probabilidad ¿Qué ocurre entre setiembre y octubre 2022? Y que permitiría que usted realizara un pronóstico.

4. Cuál es la utilidad de tener mediciones confiables y válidas en el tiempo.