Original Article

TEXTO & CONTEXTO ENFERMAGEM
TEXT & CONTEXT NURSING TEXTO & CONTEXTO ENFERMERÍA

VALIDATION OF A METHODOLOGICAL RESEARCH MODEL FOR THE DEVELOPMENT OF NURSING TECHNOLOGIES

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ABSTRACT

Objective: to verify validity evidence for the Praxis Model for Technology Development® in nursing.
Method: a methodological study, guided by the human praxis framework. The operational model content was built by a documentary study of theses and dissertations available in the Catalog of Theses and Dissertations of the Coordination for the Improvement of Higher Education Personnel, and theoretical/epistemological content derived from the philosophical framework of Adolfo Sanchez Vázquez. The content and appearance were validated using the Instrument for Evaluating Methodological Models for Technology Development. Content analysis and the Content Validity Index with binomial test were used to analyze the data, while Cronbach's alpha was used for reliability.
Results: the model was structured into four phases (pragmatic, creative/artistic, experimental and revolutionary). Validation was carried out by 26 nurse judges, selected according to the established criteria. The model was assessed as relevant by the judges, obtaining a mean index of 0.950 for the content domain and 0.825 for the appearance domain, with an overall Cronbach's alpha of 0.941. Changes were suggested to the model's figures/diagrams regarding color, the model's sequential numbering and the representation of collective participation.
Conclusion: the model was found to be clear and applicable for developing technological products and processes through a creative and participatory process, which will enable resolving problems in professional practice. It allows you to identify, plan, execute, test, report and synthesize solutions for nursing practice.

DESCRIPTORS: Research in Nursing. Methods. Technological Development. Inventions. Nursing. Validation Study.

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VALIDAÇÃO DE MODELO METODOLÓGICO DE PESQUISA PARA O DESENVOLVIMENTO DE TECNOLOGIAS EM ENFERMAGEM

RESUMO

Objetivo: verificar evidências de validade do Modelo Práxico para Desenvolvimento de Tecnologias® em enfermagem.
Método: estudo metodológico, norteado pelo referencial de práxis humana. A construção do conteúdo operacional do modelo ocorreu por meio de estudo documental, realizado em teses e dissertações disponíveis no Catálogo de Teses e Dissertações da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, e conteúdo teórico/epistemológico, por derivação do referencial filosófico de Adolfo Sanchez Vázquez. A validação de conteúdo e aparência foi realizada por meio do Instrumento de Avaliação de Modelos Metodológicos voltados ao Desenvolvimento de Tecnologias. Para a análise dos dados, utilizaram-se a análise de conteúdo e o Índice de Validade de Conteúdo com teste binomial, e para a confiabilidade, o alfa de *Cronbach*.
Resultados: o modelo foi estruturado em quatro fases (pragmática, criativa/artística, experimental e revolucionária). A validação foi realizada por 26 juízes enfermeiros, selecionados de acordo com os critérios estabelecidos. O modelo foi avaliado como pertinente pelos juízes, obtendo média do referido índice de 0,950 para o domínio conteúdo e 0,825 para o domínio aparência, com alfa de *Cronbach* geral de 0,941. Foram sugeridas alterações nas figuras/diagramas do modelo referentes à cor, numeração sequencial do modelo e representação da participação coletiva.
Conclusão: o modelo foi considerado claro e aplicável ao desenvolvimento de produtos e processos tecnológicos por meio de um processo criativo e participativo, o qual permitirá a resolução de problemas na prática dos profissionais. Ele permite identificar, planejar, executar, testar, relatar e sintetizar soluções para a prática da enfermagem.

DESCRITORES: Pesquisa em Enfermagem. Métodos. Desenvolvimento Tecnológico. Invenções. Enfermagem. Estudo de Validação.

VALIDACIÓN DE MODELO METODOLÓGICO DE INVESTIGACIÓN PARA EL DESARROLLO TECNOLÓGICO EN ENFERMERÍA

RESUMEN

Objetivo: verificar evidencias de validez del Modelo Práctico para el Desarrollo Tecnológico® en enfermería.
Método: estudio metodológico, guiado por el marco de la praxis humana. La construcción del contenido operativo del modelo se produjo a través del estudio documental, realizado sobre tesis y disertaciones disponibles en el Catálogo de Tesis y Disertaciones de la Coordinación de Perfeccionamiento del Personal de Educación Superior, y del contenido teórico/epistemológico, por derivación del marco filosófico de Marco de Adolfo Sánchez Vázquez. La validación de contenido y apariencia se realizó mediante el Instrumento de Evaluación del Modelo Metodológico orientado al Desarrollo Tecnológico. Para el análisis de los datos se utilizó el análisis de contenido y el Índice de Validez de Contenido con prueba binomial y para la confiabilidad el alfa de Cronbach.
Resultados: el modelo se estructuró en cuatro etapas (pragmática, creativa/artística, experimental y revolucionaria). La validación se llevó a cabo por 26 jueces enfermeros, seleccionados según los criterios establecidos. El modelo fue evaluado como relevante por los jueces, y obtuvo un índice promedio de 0,950 para el dominio de contenido y de 0,825 para el dominio de apariencia, con un alfa de Cronbach global de 0,941. Se sugirieron cambios en las figuras/diagramas del modelo en cuanto a color, numeración secuencial del modelo y representación de la participación colectiva.
Conclusión: el modelo se consideró claro y aplicable al desarrollo de productos y procesos tecnológicos a través de un proceso creativo y participativo, que permitirá la resolución de problemas en la práctica profesional. Permite identificar, planificar, ejecutar, probar, informar y sintetizar soluciones para la práctica de enfermería.

DESCRIPTORES: Investigación en Enfermería. Métodos. Desarrollo Tecnológico. Invenciones. Enfermería. Estudio de Validación.

INTRODUCTION

Methodological research models represent ways of achieving a specific goal. They comprise a set of phases/steps and techniques used by researchers to structure, group and analyze data relevant to achieving the research objectives[1–2]. A model presents a systematic, dynamic and sophisticated format for obtaining knowledge about a given research object.

In nursing research, methodological models include ways of observing realities, facts and phenomena, as well as analyzing experiences, observing logical deductions and scientifically proving results. The model is the logic applied to science, combining reasoning (deductive or inductive), experience, knowledge and formal systems of thought with a view to investigating and proving a given phenomenon.

Methodological development in nursing has kept pace with scientific trends, allowing it to consolidate as a structured and legitimized science[2–3]. It has sought theoretical, practical, methodological and clinical evolution in research. In this scenario, the construction, validation and evaluation of theories, methods, theoretical-conceptual and methodological models have enabled resolving different problems faced by the profession[2,4].

In the context of technological development, nursing develops products and processes[5–7] using models proposed by different areas to understand specific phenomena in depth, prioritizing systematic and participatory approaches to interpret emerging demands in praxis and collectively create solutions. Within this creative context, praxis seeks to intertwine theory and practice, and centered on philosophical elements, it seeks to interpret the universe around it with a view to social transformation. Looking at the world from these elements means using practical consciousness (human action) and praxis (reflection and criticism of action)[8–9].

Producing technologies has been an emerging focus in the scientific production of Brazilian nursing. Using tools applied to the being and doing of this science has led to discussions and reflections on paradigm shifts, agility, and practicality in solving problems arising from practice, and has helped with decision-making in health. In general terms, the development of technologies has made significant contributions to nursing management, teaching, and care[10].

For these reasons, thinking about new ways of doing research has become a potential driving force behind the evolution of nursing knowledge, making it possible to integrate new and innovative methodological approaches, such as the Praxis Model for Technology Development® (PMTD®). The PMTD® aims to guide technological development (construction, validation, and evaluation) from a participatory and praxeological perspective[9]. The model is inserted into the nursing research scenario with a systematic structure, theoretical/conceptual, visual, and operational elements to support the exploration, description, analysis, explanation, simulation and dissemination of different phenomena emerging from human activity in multiple social and health scenarios[11].

In view of the above, this study evaluated the validity aspects of a methodological, participatory and praxeological model created in/for nursing to identify, plan, execute, test, report and synthesize real solutions in their professional context. The PMTD®[11] combines human (empirical) knowledge, science, theory, and practice with the aim of achieving individual (professional) and/or collective (target population) praxis. The aim of this study was to verify evidence of the PMTD®'s validity in nursing.

METHOD

This is a methodological study[12] based on the theoretical-philosophical framework of human praxis[8], and was conducted in two stages: construction of the model; and content and appearance validation.

The PMTD® was built through a documentary study of the theses and dissertations database of the Coordination for the Improvement of Higher Education Personnel (CAPES), guided by the question: what methodological system is used in the participatory development of nursing technologies?

A total of 1,729 studies published up to April 2020 were identified using the terms “technology” and “nursing”. This stage was independently conducted by two researchers with the aim of guaranteeing the method rigor and reliability of the results in order to reduce possible biases in measuring studies due to errors in data collection, interpretation of results or design.

Next, dissertations and theses produced by nurses were selected with no time limit, which addressed the construction, validation, application, implementation, and evaluation of a technology relating to the praxis of the target audience. Thus, studies were included in which the technologies produced were based on the practical process for which they were intended to be applied. Some studies that showed inconsistency and/or clarity in detailing the praxis involved in technological production were excluded.

As a result, 73 studies which fulfilled the study objective were considered. Then, the theoretical and operational structure of the model was outlined considering the findings, and derived from the theoretical framework of praxis. The PMTD® content was written to meet the needs of the academic population; therefore, it presents technical, scientific, and philosophical language, with characteristics that are genuine to the framework chosen to help understand the content and operationalize the methodological model. Illustrative diagrams were subsequently created to represent the phases and operations of the proposal in order to facilitate interpretation and reproducibility of the tool, making it clearer, more dynamic and more accessible to read.

It should be noted that content analysis was used to process the data from the documentary study[13]. In the pre-analysis stage, the dissertation and thesis reports were stored in the Atlas.ti® software version 9.014 in PDF format in a folder created for storage [documentary study]. Each study [document] was assigned a unique alphanumeric sequence. The material exploration stage was carried out by identifying the units of record and/or context [quotations], as well as drawing up codes that converge with the framework adopted[8] [codes]. This was done based on the criteria of completeness, representativeness, homogeneity, relevance, and exclusivity. They were then grouped and categorized [families].

Next, the quotations, codes, and families were cross-referenced in the final stage of the results interpretation to create analytical networks. Finally, these networks were downloaded in illustration format to present the results and analyze them in the light of the theoretical framework[8].

For the model validation stage, data was collected from experts in a virtual environment from December 2020 to September 2022, covering Brazil’s five regions (North, Northeast, Midwest, Southeast and South).

The study sample was non-probabilistic and intentional[13]. The experts were selected through the Lattes Platform, by accessing the “Curriculum Lattes” page. The “Search curriculum” option in the quick access column was subsequently applied to “Professional activity” (“Health Sciences” major area and “nursing” area). Then, in the main bar, the “Subject” search mode was selected, and the descriptors ‘nursing research’, ‘methods’ and ‘technological development’ were applied.

Potential judges were contacted by e-mail after analyzing their Curriculum Lattes, according to the following pre-established inclusion criteria: being a doctor; being a nurse; having a link with an academic and/or professional Postgraduate Program; having supervised dissertations and/or theses on the development/validation of technologies; having experience with the theme of analysis and/or theoretical/epistemological development; having experience with the theoretical-philosophical

framework of praxis; having scientific production related to the development of technologies; and having scientific production related to analysis and/or theoretical/epistemological development.

Thus, emails were sent to 189 researchers, 52 of whom confirmed their interest in taking part in the study. Those interested were sent a link giving them access to the questionnaire, which had been built, validated and hosted on Google Forms®. Potential participants were required to sign an Informed Consent Form in order to answer the questions on the instrument. In addition to the validation tool, questions were asked to find out the judges' profiles. A total of 26 judges took part in the evaluation process and the PMTD® was validated on the basis of those completed up to September 2022, when access to the link by the researchers expired.

The theoretical aspects and illustrative diagrams of the PMTD® were evaluated using the Instrument for the Assessment of Methodological Models for Technology Development (*Avaliação de Modelos Metodológicos voltados ao Desenvolvimento de Tecnologias – IAMDT*)[15]. The instrument contains 26 items in domain 1 – content validation, and four items in domain 2 – appearance validation, with a Likert scale assigned with four judgment levels: (1) totally disagree; (2) disagree; (3) neither agree nor disagree; (4) agree; and (5) totally agree[15].

The validation data was generated on the Google Docs® form, exported to a Microsoft Excel® spreadsheet, version 2013, and then analyzed using the Statistical Package for the Social Sciences (SPSS)® for Windows, version 22.0.

Data analysis used the Content Validity Index (CVI), which assesses the proportion or percentage of judges in agreement on certain aspects of the instrument and its items. The score is calculated using the sum of agreement with the items marked "4" (agree) or "5" (totally agree), with these scores being considered +1 (positive evaluations), being relevant and very relevant. For the other evaluations, the score "3" (neither agree nor disagree) was considered as zero, and "1" and "2" as -1 (negative evaluations).

The Level Content Validity Index (I-CVI) was used to assess the agreement level between the experts for each item. The I-CVI was calculated based on the number of judges evaluating the item as relevant and very relevant. The Scale-Level Content Validity Index/Average Calculation Method (S-CVI/AVE) was calculated using the proportion of scale items rated as relevant and very relevant by each expert. An item with an index equal to or greater than 0.80 was considered validated[16]. A binomial test was performed with a 5% significance level, i.e. 95% Confidence Interval (95%CI)[17], in order to analyze whether the proportion of agreement regarding the suitability and relevance of the PMTD® was statistically equal to or greater than 0.8.Cronbach's alpha coefficient was calculated to check the internal consistency of the instrument[18].

The study followed the ethical principles governed by Resolution No. 466/2012 and Resolution No. 520/2016 of the National Health Council (CNS), so that it was operationalized after the project was assessed by the Research Ethics Committee. In addition, the principles set out in Circular Letter No. 02/2021 of the National Research Ethics Commission were taken into account, which provides guidelines for procedures in research with any stage in a virtual environment.

RESULTS

Methodological model construction

The data related to the praxis involved in technological development in nursing was analyzed according to the theoretical-philosophical framework of human praxis[8]. According to Vázquez[8], praxis can be creative and reiterative, linked to the degree of creation manifested by man in/for the act of

creating. It can also be reflective and spontaneous to understand the degree of awareness, practice or praxis involved from the design process to its use in the practical context (Figure 1).

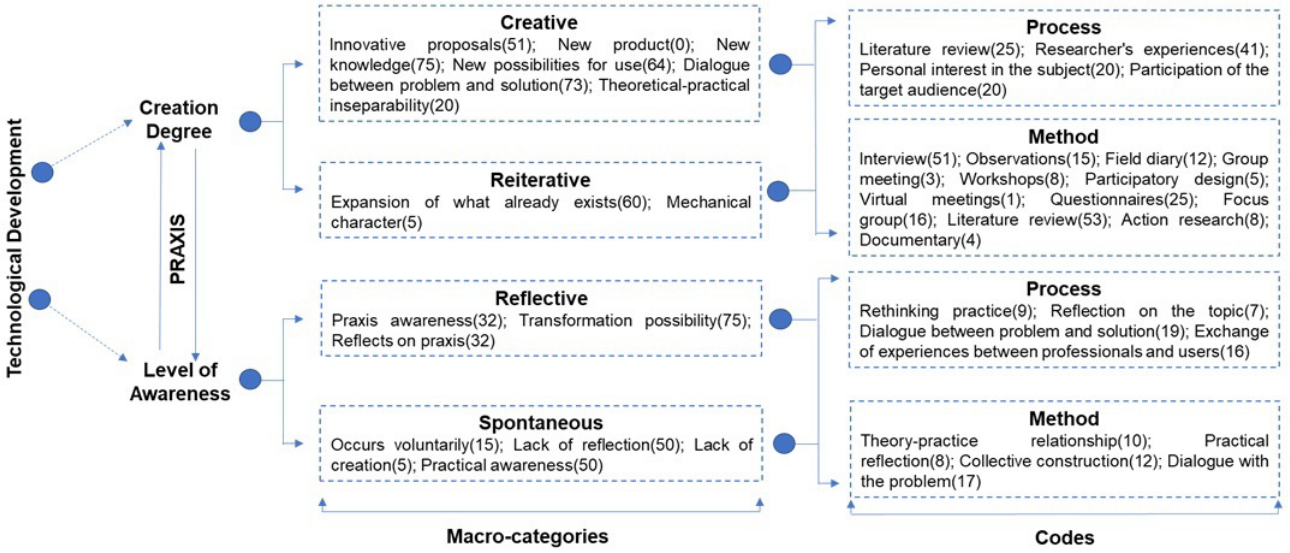

Figure 1 – Representation of the praxis involved in technological development in Brazilian theses and dissertations. Santa Maria, RS, Brazil, 2024.

The motivation or problem presented in the studies that justified the interest in technological development and the researchers' starting point for the creation process were coded as "process" (Figure 1). The "method" code describes the data collection techniques and strategies adopted to understand the realities of the study in terms of scenarios and social actors (Figure 1). Based on this data, and by theoretical-philosophical, conceptual and epistemological derivation of human praxis[8], the PMTD®[11] was structured into four phases: pragmatic; productive/artistic; experimental; and revolutionary.

The pragmatic phase[11] consists of immersing the researcher in the study context. The productive/artistic phase[11] consists of organizing, agreeing and adjusting the ideas that emerged in the pragmatic phase, and is permeated by the practical process. The experimental phase[11] consists of carrying out tests, validating processes, protocols and instruments and evaluating the product. Then in the revolutionary phase[11], the creation is evaluated by the implementation scenario. Thus, the PMTD® underwent a content and appearance validation process after the initial version was built.

Content validation and appearance of the methodological model

A total of 26 expert judges took part in the content and appearance validation of the PMTD®, all of whom were doctors, 69% (n=18) of whom taught at a public university, and 88.5% (n=23) of whom were women. The mean time since graduation was 11.4±6.7 years, and the mean age was 50.0±10.1 years. Researchers were represented in all regions of the country, except for the Midwest.

Table 1 shows the items in the instrument and the distribution of responses that scored 4 or 5 in the PMTD® validation analyses, divided between the content (items 1 to 26) and appearance (items 27 to 30) domains. Cronbach's alpha, calculated based on standardized items, showed an overall value of 0.941, characterizing the instrument's internal consistency as almost perfect. Seven of the items in domain 1 (items 2,4,12,18,19, 22 and 24) had 100% "agree" or "totally agree" responses. The I-CVI for each item evaluated separately was only lower than 0.8 in domain 2, item 27. Thus, the I-CVI of each item was calculated, obtaining a mean of 0.950 for the content domain and 0.825 for the appearance domain (Table 1).

Table 1 – Judges' agreement with the evaluation items of the Praxis Model for Technology Development®. Santa Maria, RS, Brazil, 2024. (n=26)

Domains/Items	C* and CT† (%)	I-CVI‡	Cronbach's Alpha
Domain 1 – Content validation			
1. Does the title represent your goals?	88.5	0.9	0.936
2. Is the theoretical framework used relevant and applicable to the proposal?	100	1.0	0.930
3. Do the concepts express and represent the assumptions of the model/method?	88.5	0.9	0.930
4. Does it systematically present its stages/phases?	100	1.0	0.931
5. Is the description of the stages/phases clear?	96.2	1.0	0.932
6. Does the name of each stage/phase match the content presented?	96.2	1.0	0.929
7. Does it present well-described operational steps for the execution of its stages/phases?	92.3	0.9	0.930
8. Are the phases/stages (inter)related in the search for a representation of the phenomenon?	92.3	0.9	0.928
9. Is the model/method suitable for interpreting practical reality?	96.2	1.0	0.930
10. Does it contribute to building knowledge in the area?	96.2	1.0	0.928
11. Does it encourage the active participation of the researcher(s) in the research context?	96.2	1.0	0.932
12. Does it allow for an (inter)researcher-researched-context relationship?	100	1.0	0.931
13. Does it help the researcher to build hypotheses?	92.3	0.9	0.929
14. Does it provide methodological and representational support for technological development?	96.2	1.0	0.928
15. Do you suggest techniques for establishing communication and cooperation to interpret reality, raise and prioritize problems and formulate hypotheses?	88.5	0.9	0.930
16. Does it encourage collective participation in the search for solutions?	96.2	1.0	0.931
17. Does the technique(s) of approaching the research scenario encourage participatory action among those involved?	96.2	1.0	0.930
18. Do you establish partners for technological creation in terms of your area of activity and objectives?	100	1.0	0.931
19. Does it represent the way to produce technical-scientific knowledge?	100	1.0	0.930
20. Does it present a logical sequence of ideas and their stages/phases?	92.3	0.9	0.928
21. Is the information clear, objective and representative of the proposal?	88.5	0.9	0.926
22. Does it encourage an understanding of reality in order to contribute to its transformation?	100	1.0	0.929
23. Does its interactive language allow for participatory involvement between researcher(s) and researched?	96.2	1.0	0.928
24. Is the language of the model/method suitable for researchers?	100	1.0	0.931
25. Does it provide elements for the researcher to carry out analysis and synthesis on the object?	96.2	1.0	0.928
26. Does it allow the discovery, description, explanation, reproduction and control of phenomena for the development of new products and processes?	96.2	1.0	0.927
Means	–	0.950	0.930

Table 1 – Cont.

Domains/Items	C* and CT† (%)	I-CVI‡	Cronbach's Alpha
Domain 2 – Appearance validation			
27. Are the illustrations clear and understandable (if there are any)?	73.1	0.7	0.935
28. Do the illustrations (if any) represent the content and operation of the phases/stages?	80.8	0.8	0.934
29. Are the shapes of the illustrations (if any) appropriate to the proposal?	88.5	0.9	0.930
30. Are the pictures consistent with the text?	92.3	0.9	0.929
Means	–	0.825	0.932

*Agree; †Totally agree; ‡Content Validity Index at the item level.

The S-CVI/AVE was calculated for each expert, and the S-CVI was then calculated from the mean, as shown in Table 2.

The proportion of relevance (S-CVI/AVE) of the two domains of the instrument was 100% for 57.7% (n=15) of the 26 judges. Only 7.7% (n=2) of the judges had an S-CVI/AVE value of less than 0.80. The agreement between the judges was highly significant, with p≤0.001 using the binomial test, and given the mean S-CVI of 0.9, it was decided to consider all the items in the domains as validated by the judges (Table 2).

The judges' agreement on the suitability and relevance of the PMTD® was significant, except for expert 3, who most often marked "partially agree" (Table 2).

Table 2 – Assessment of agreement between judges regarding the proportion of relevance, adequacy and pertinence of the Praxis Model for Technology Development®. Santa Maria, RS, Brazil, 2024 (n=26)

Judge	DT§	D‖	C*	CT†	Estimate	P-value‡‡	95%CI¶	S-CVI/AVE**
1	0	0	2	22	0.9	0.001	0.83	0.8
2	0	0	2	27	1.0	0.001	1.00	1.0
3	0	4	17	2	0.9	0.001	0.63	0.6
4	0	0	9	20	1.0	0.001	1.00	1.0
5	0	0	7	22	1.0	0.001	1.00	1.0
6	0	0	12	15	1.0	0.001	0.93	0.9
7	0	0	0	29	0.9	0.001	1.00	1.0
8	0	0	14	11	0.9	0.001	1.00	0.8
9	0	0	8	20	1.0	0.001	0.87	0.9
10	0	1	16	6	1.0	0.001	0.97	0.7
11	0	0	12	17	1.0	0.001	0.77	1.0
12	0	0	6	20	1.0	0.001	0.97	0.9
13	0	0	28	2	0.9	0.001	0.90	1.0
14	0	0	10	19	1.0	0.001	1.00	1.0
15	0	0	0	29	0.9	0.001	1.00	1.0
16	0	0	0	29	1.0	0.001	1.00	1.0
17	0	0	19	10	1.0	0.001	1.00	1.0
18	0	0	21	8	1.0	0.001	1.00	1.0
19	0	0	0	29	1.0	0.001	1.00	1.0
20	0	0	4	25	0.9	0.001	1.00	1.0

Table 2 – Cont.

Judge	DT§	D‖	C*	CT†	Estimate	P-value‡‡	95%CI¶	S-CVI/AVE**
21	0	0	13	10	0.9	0.001	0.80	0.8
22	0	0	0	29	1.0	0.001	1.00	1.0
23	1	1	2	24	1.0	0.001	0.87	0.9
24	0	0	6	22	1.0	0.001	0.97	0.9
25	0	0	9	20	1.0	0.001	1.00	1.0
26	0	1	19	7	1.0	0.001	0.90	0.9
S-CVI††	**0.9**							

§Totally disagree; ‖Disagree; *Agree; *Totally agree; ¶Confidence interval; **Relevance proportion; ††Relevance proportion mean; ‡‡Binomial test.

It is important to note that the judges' suggestions were accepted in their entirety, despite the satisfactory S-CVI results for the content and appearance domains being higher than 0.8.

Some of the PMTD® illustrations were removed because they were not in line with the text and others were adjusted as requested by the experts (Figure 2).

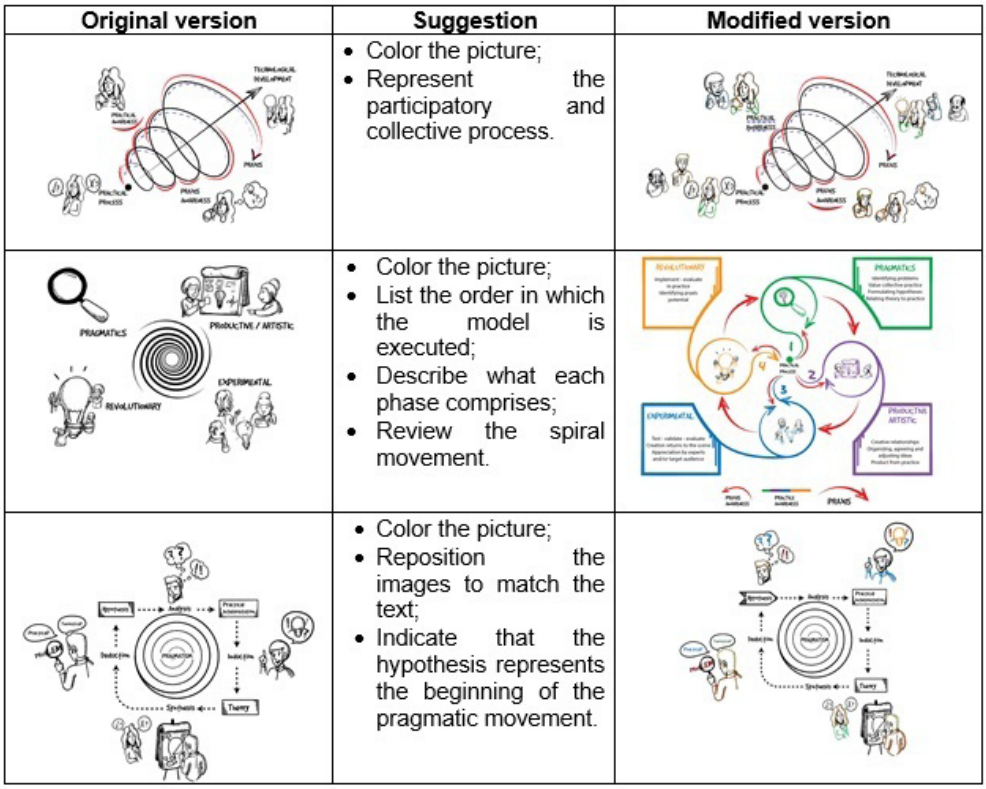

Figure 2 – Representation of the original and modified versions of the diagrams illustrating the Praxis Model for Technology Development® based on the judges' evaluation. Santa Maria, RS, Brazil, 2024

Adjustments were subsequently made to the PMTD® based on the suggestions. Its final version, after validation, was submitted to the Copyright Registry by the Brazilian Book Chamber, receiving ISBN 978-65-00-99385-1. This version is available at the link: https://drive.google.com/file/d/1r8E1DLyRTtM5yWSdG-Un8cLUWil0rx7t/view?usp=sharing

DISCUSSION

Nursing has advanced its body of knowledge, especially in the development of technologies applied to the multiple scenarios in which it operates[10,19]. Nursing has used a variety of methodological

references from other knowledge areas to support research in order to make scientific advancementsand develop technologies, which is then capable of providing higher quality production and internal coherence[1–2,10]. However, it is necessary to reflect on the fact that expanded technological production in nursing has introduced various tools into academic circles, especially those with questionable origins, usability and permanence.

It is understood that the creation of tools must have its meaning(s) well defined, with a clear and (inter)related theoretical and practical basis(s). This thinking leads to a discussion about praxis in the context of technological production, as well as the weakness of praxis methodological references capable of interpreting realities, identifying problems and proposing solutions considering participatory precepts (population-researcher-context).

In this study, technological production in nursing was analyzed through the human, ethical and political relationships existing in praxis, conceiving it as a central category of philosophy, with a complex, mobile and changeable content, understood as the fruit of man's consciousness[8,20]. In order to understand its complexity, it was necessary to capture its dimensions through macro-categories and codes that represented the dialectical movement proposed by praxis in technological development.

In this context, it is clear that the praxis that exists in technological development emerges on the basis of four macro-categories of the philosophy of praxis, such as the creative and the reiterative (aimed at the process of technological creation), and the reflexive and the spontaneous (linked to the consciousness of man in the context of the conception and use of creations)[8] (Figure 1).

It is understood that technological development under the influence of praxis requires research approaches that enable horizontal relationships between researcher-context-population. Thus, praxis adopts human, practical, artistic, ethical, aesthetic and political behavior[8,11]. Therefore, nursing is a form of praxis in itself, because epistemological issues in praxis are among the foundations of the nursing discipline.

The data show that the gaps instigated in/by the authors' praxis stem from processes (motivation or study problem) identified from theoretical-practical gaps highlighted by scientific literature, the researchers' experiences, personal interest, or through participatory movements between the researcher and the target audience (Figure 1). In relation to the awareness involved in the creative process[8], this can be seen as reflexive and spontaneous, relating to the critical potential of theoretical appropriation and its intertwining with the practice experienced[21–22].

Based on the above, the production and validation of the PMTD® represents a scientific evolution for nursing as a methodical, theoretical, epistemological and praxeological strategy. It sets out to explore, describe, analyze, explain, simulate and disseminate phenomena emerging from the practical activity of man in multiple social scenarios under the principles of human praxis[8]. In this logic, PMTD® makes it possible to promote and incorporate research results into everyday practice in health services, enabling the health of individuals, families and/or communities to be improved.

The experts rated the theoretical framework[8] used to build the model as pertinent and relevant to the results of the I-CVI, as well as the S-CVI. Human praxis is perceived as "the transformation of a reality that is considered unjust, a transformation based on a critique that is supported by scientific knowledge of this reality"[8].:14 According to the authors[9,22], when the relationship between theory and practice is revealed as praxis, it equips nurses to intervene in emerging situations in society. Faced with the production of technologies[8–10], nurses can engage in deliberative, dialogic and creative praxis during their daily practice. From praxis, nurses can identify the socio-political, environmental, ethical and aesthetic aspects latent in the practical process.

The PMTD® was evaluated as relevant and applicable to nursing research. The pragmatic phase comprises the interpretation of the reality observed/experienced with the aim of (re)getting to know society, its knowledge and its practices in order to establish relationships to identify demands and plan interventions[11]. Getting closer to the public was considered an effective strategy for identifying their needs and building coherent and implementable possibilities together[20–23]. In this analytical way, a practical problem emerges and becomes eligible as a research problem. By inserting nurses into the practical context, they are able to carefully and accurately assess the phenomenon identified and combine it with the relevant theoretical framework.

Theory and its application in nursing research and practice is conceived[24] as a guiding instrument for knowing, being and doing in order to build the body of knowledge of science. It comprises a dialectical process originating in the practical context and gaining strength through research. Based on the PMTD®, nursing meets praxis in technology production[8,25] when it uses theories to produce explanations, descriptions and prescriptions of the practical process in different scenarios.

The ideal model for technological development is to value the practical process as the starting point and outcome of the product created. Thus, by committing itself to care, nursing qualifies its practice by proposing technologies to solve everyday problems[18]. A study[26] proposing a model for product design corroborates this, since the problem to be studied must be clearly presented from the outset of the research project, and it must arise from nurses' care practices[26].

The pragmatic phase represents the researcher's interaction with society and the scenario in which they are inserted. Oriented by praxis, PMTD® seeks the praxical revolution[8] of human behavior (artistic, ethical or political). This revolution will take place through a participatory and dialectical movement between subjects-researcher-context[9,22]. This interaction was particularly evident in the evaluation of items 12,15, 16 and 17.

High practical and praxis awareness levels can be perceived in the productive/artistic phase. The reflections emerging in this phase from pragmatism transcend the abstraction of theoretical praxis in order to objectify practical praxis[11]. This pragmatic movement encourages man to reach the peak of his praxis potential, "that of creator", in order to propose a potentially transformative solution to the practical process[8–9].

In the PMTD®, an artistic production is created when a human's consciousness rises in the dialectical movement of praxis. Producing involves combining theory and practice in systematizing a new creation that is representative of the practical process. The PMTD® proposes production relations between participants-researcher-context in order to objectify human consciousness, strengthening the participatory movement. Theorizing must remain active during artistic production in order to maintain scientificity and avoid structural weaknesses in creation[11].

Production relationships involve the stages of ideation (collective planning for creation), feasibility (execution of creation), partners (working group for creation), goals / deadlines (activity – deadline – delivery of creation) and resources (forecasting materials, people and funding for creation)[11]. Establishing an organization and planning makes the path of technological construction safer, with fewer methodological biases, allowing the researcher greater control over the creative process. Similarly for the artistic production phase, items 18, 19 and 20 (which most strongly represent it) showed high agreement rates among the judges.

Producing tools based on the target audience's interfaces has been suggested as a potential way of overcoming problems with usability and/or user acceptability. This shows that taking an active part in the creative process can have important repercussions for the permanence of the product in the practical field[24–27].

After creation, the artistic production will be evaluated in the experimental phase by specialists or the target audience, constituting an action aimed at proving the hypotheses of the product created. Experimentation seeks to affirm the basic technology characteristics or reformulate them according to the phenomenon[8,11]. In the PMTD®, experimentation involves drawing up a panel of experts based on criteria that converge with the phenomenon of interest[27]. Experimental activity must be methodical, using scientifically valid measuring instruments for the intended purpose[28]. In this way, the *IAMDT* was used as a tool to support the judges in evaluating the production, which was well accepted and generally obtained a good evaluation from the judges, with an adequate I-CVI and Cronbach's alpha.

Some authors[25,27–28] mention the importance of using validated instruments for the experimental activity, as they denote reliability and trustworthiness to measure the phenomenon, reducing subjective interpretation biases. This points out that it is important to consider the quality of the instruments in order to guarantee the legitimacy and credibility of the experimentation results.

After experimentation, the artistic production must be applied in the setting where it was forged; in other words, in the practical process. This action makes it possible to evaluate the revolutionary potential (revolutionary phase) of the technology through its use by the target audience.

Usability is defined as the extent to which a system, product or service can be used to achieve its own objectives effectively, efficiently and to the satisfaction of its target audience and application context[29]. It plays an important role in the transfer and acceptance of artistic production by the practical technological context.

The evaluation of technological usability consists of applying tests in order to give the public the opportunity to try out the product and then evaluate its usability[30–31]. An important factor to be considered by the PMTD®, based on international evidence, is applying and evaluating products for a longer period than usual[31]. This practice can generate a broader view of use, which is rarely explored in evaluation studies.

Based on its usability, artistic production must manifest praxical potentials in the search for praxeological revolution (of the knowledge and doing of man and their practical context). These potentials arise from the degree of awareness[8–9,22] shown by individuals in the practical process, and can be "creative and reiterative" (referring to the degree of creation) and "reflective and spontaneous" (referring to the degree of awareness – use).

From this perspective, the PMTD® has proven to be an efficient and promising model from conception to technological evaluation in a practical context. However, a limitation is the impossibility of comparisons with other studies, given that it is an innovative model, as well as the instrument used to evaluate the model. In order to improve the method, further studies are suggested on its use for the development of nursing technologies, which will consequently consolidate it, as well as generating new validity evidence.

It has been pointed out that developing technologies requires collaborative action involving researchers and professionals from different knowledge areas to corroborate the PMTD®. This practice can have a positive impact on the translation quality of technological knowledge for the target population[32]. In this context, the expected revolution for praxeological technology will be in its implementation in the practical process. Continuing studies are therefore being developed with a view to producing pragmatic determinants, strategies, mechanisms of action and results for implementing technological knowledge in practice.

CONCLUSION

This model was developed out of the concerns of the researchers and the theoretical and methodological gaps identified in the scientific production of Brazilian nursing on the subject.

Through the validation of the PMTD®, it was possible to see that the experts agreed on understanding the content and the relevance of the proposal to meet research needs centered on technological development. Thus, it was clear that researchers in the area considered the model to be clear and applicable to nursing studies, making it an important tool for solving problems emerging from the practice of these professionals. The model has a structure to help researchers identify, plan, execute, test, report and synthesize solutions for nursing practice.

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NOTES

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