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ARTIFICIAL INTELLIGENCE LARGE LANGUAGE MODEL INTERROGATION

REPRESENTATIONAL MEASUREMENT FAILURE IN HEALTH TECHNOLGY ASSESSMENT

DENMARK: THE ENDORSEMENT OF CURRICULUM INVERSION

Paul C Langley PhD Adjunct Professor, College of Pharmacy, University of Minnesota, Minneapolis, MN

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ABSTRACT

This study examines the Danish health technology assessment (HTA) curriculum knowledge base to determine whether it incorporates the scientific principles required for lawful quantitative measurement. Building upon a companion interrogation of the Danish HTA knowledge base, which demonstrated widespread endorsement of measurement inversion, the present analysis investigates whether these methodological deficiencies originate within the educational framework responsible for training successive generations of HTA practitioners. The assessment applies a standardized interrogation based on ten canonical curriculum statements derived from the axioms of representational measurement. These statements address the specification of target attributes, scales of measurement, representational measurement, unidimensionality, manifest and latent attributes, ratio measurement, and the requirement that scientific claims be prospectively evaluable and empirically falsifiable.

The interrogation demonstrates consistently weak endorsement of all ten foundational concepts. The highest probability assigned to any statement is only 0.20, while the principles of representational measurement and the distinction between manifest and latent ratio measurement receive probabilities of only 0.05. The findings indicate that Danish HTA education gives little attention to the measurement principles that must precede quantitative analysis. Instead, students are introduced directly to utilities, quality-adjusted life years (QALYs), cost-effectiveness analysis, patient-reported outcomes, and reference-case modelling without first establishing whether the numerical quantities employed satisfy the requirements of lawful measurement. Particular attention is drawn to the absence of the manifest-latent distinction and the corresponding absence of Rasch measurement as the only established framework for constructing quantitative measures of latent therapy outcomes.

These findings identify curriculum inversion as the educational mechanism through which measurement inversion is reproduced within Danish HTA. Rather than teaching measurement before arithmetic, the curriculum emphasizes analytical techniques while neglecting the scientific conditions that determine their validity. As a consequence, successive generations of practitioners inherit methodological conventions without the conceptual framework necessary to evaluate their measurement foundations. The study concludes that incremental refinement of existing HTA methods cannot resolve this problem. Reconstruction of Danish HTA education must begin with representational measurement, lawful ratio measurement for manifest and latent attributes, and the development of prospective, evaluable, replicable, and falsifiable claims regarding therapy impact. Only by restoring measurement as the foundation of quantitative inquiry can HTA be re-established as a scientifically defensible discipline.

INTRODUCTION

The present analysis examines the Danish health technology assessment (HTA) curriculum through the application of a standardized representational measurement interrogation. The objective is not to evaluate individual teaching programs, institutions or researchers, but to determine whether the scientific concepts required for lawful quantitative measurement are embedded within the Danish HTA educational knowledge base. The interrogation employs ten canonical curriculum statements derived from the axioms of representational measurement. These statements address the fundamental requirements for quantitative science, including specification of the target attribute, the distinction between manifest and latent attributes, scale theory, representational measurement, unidimensionality, ratio measurement, and the requirement that scientific claims be empirically falsifiable. Together, they provide a consistent framework for assessing whether HTA education is grounded in the conditions necessary for valid quantitative evaluation.

Each canonical statement is assigned a probability reflecting the extent to which it is endorsed within the Danish curriculum knowledge base. These probabilities are then transformed to normalized logits to provide a common linear metric for comparison across statements and between national HTA knowledge bases. High probabilities indicate that a concept is well embedded within the curriculum, while low probabilities indicate that it occupies only a limited role or is effectively absent. Because the same interrogation protocol has been applied internationally, the Danish results can be interpreted directly alongside equivalent analyses undertaken for Australia, Canada, New Zealand, Norway, the United Kingdom, the United States and other jurisdictions.

The purpose of this analysis is to determine whether Danish HTA education satisfies the scientific prerequisites for quantitative claims or whether it exhibits the pattern of curriculum inversion identified elsewhere. Curriculum inversion occurs when analytical techniques such as utilities, QALYs, cost-effectiveness analysis and decision-analytic modelling are taught and applied without first establishing the measurement conditions that make quantitative claims scientifically admissible. If the foundational concepts of representational measurement receive consistently weak endorsement while downstream analytical methods remain central to the curriculum, the conclusion is that arithmetic has displaced measurement as the basis of HTA. The Danish interrogation therefore provides an objective assessment of whether the national HTA curriculum supports or departs from the principles that underpin quantitative s

CURRICULUM INVERSION

Curriculum inversion occurs when a curriculum teaches the application of quantitative methods while failing to teach the measurement principles that determine whether those methods are scientifically legitimate. In a scientifically coherent curriculum, measurement precedes arithmetic. Students first learn the nature of attributes, the requirements of representational measurement, the distinctions among nominal, ordinal, interval and ratio scales, and the conditions necessary for valid quantitative claims for manifest and the application of Rasch models for latent attributes [1 2 3] . Only then are they introduced to the arithmetic, statistical and modelling procedures that depend upon those measurement properties. Curriculum inversion reverses this sequence. Students learn how to calculate, model and analyze before they learn how to determine whether the quantities entering those analyses are measures. Arithmetic becomes detached from measurement and numerical manipulation is treated as though it were equivalent to quantitative science.

The consequences are profound. A curriculum affected by inversion reproduces a professional culture in which measurement is assumed rather than demonstrated. Concepts such as unidimensionality, dimensional homogeneity, admissible arithmetic, manifest and latent attributes, ratio measurement and Rasch measurement either disappear entirely or are treated as peripheral concerns. Students become proficient in the techniques of economic evaluation, utility assessment, QALY construction and simulation modelling without acquiring the conceptual tools necessary to evaluate the legitimacy of those methods. The result is that the curriculum not only fails to identify measurement errors but actively reproduces them across successive generations of researchers, analysts and decision makers. Curriculum inversion therefore serves as the educational mechanism through which measurement inversion becomes institutionalized within a discipline. In HTA this serves to support administrative decisions for therapy pricing and access.

For this reason, curriculum assessment emerges as a critical component of HTA reconstruction. The objective is not simply to determine whether students are exposed to contemporary HTA methods. Rather, it is to determine whether they are exposed to the foundational concepts that make the evaluation of those methods possible. A curriculum that emphasizes modelling, economic evaluation and decision analysis while neglecting measurement theory will inevitably reproduce the same conceptual limitations observed in current HTA practice.

The curriculum interrogations compelling support for this interpretation. While there is evidence that students and researchers are introduced to outcomes assessment, target attributes and scientific claims, there is little evidence of systematic exposure to scales of measurement, the axioms of representational measurement, unidimensionality, latent attribute measurement or ratio measurement. The concepts most frequently absent from curriculum coverage are precisely those concepts most frequently absent from HTA practice. The relationship is unlikely to be coincidental.

The imperative of measurement inversion therefore extends beyond criticism of existing methods. It points directly to the need for educational reconstruction. If HTA is to move toward a framework based on lawful measurement, evaluable claims and empirical falsification, then curriculum reform must accompany methodological reform. The widespread and consistent pattern of measurement inversion revealed by the interrogations suggests that reconstruction cannot begin with policy guidance or analytical techniques alone. It must begin with the curriculum. Until students and researchers are introduced to the foundations of measurement science, the conditions that created measurement inversion will continue to be reproduced throughout the HTA community.

THE DANISH HTA CURRICULUM KNOWLEDGE BASE

The Danish health technology assessment (HTA) curriculum knowledge base comprises the educational, methodological, and professional resources through which the principles and practice of HTA are taught, interpreted, and disseminated throughout Denmark. It extends well beyond formal university degree programs to include postgraduate education, continuing professional development, professional society activities, methodological guidance issued by national health authorities, academic journals, textbooks, conference proceedings, and the research literature in health economics, outcomes research, epidemiology, and healthcare evaluation. Collectively, these resources define the conceptual framework through which successive generations of clinicians, pharmacists, economists, epidemiologists, policy analysts, researchers, consultants, and healthcare administrators acquire their understanding of HTA and its role in supporting decisions on the pricing, reimbursement, adoption, and evaluation of health technologies.

Denmark has long occupied an influential position in the development of evidence-based medicine, clinical epidemiology, registry research, health economics, and outcomes assessment. Danish universities, research institutes, and government agencies have contributed extensively to methodological developments in comparative effectiveness research, economic evaluation, patient-reported outcomes, and health services research. Danish investigators participate actively in European HTA collaborations and have contributed to the evolution of the methodological framework that now characterizes HTA throughout much of Europe. Consequently, the Danish curriculum knowledge base is important not only because it shapes professional education within Denmark but because it contributes to the broader European understanding of how health technologies should be evaluated and how evidence should be interpreted for policy purposes.

The purpose of identifying the Danish curriculum knowledge base is to distinguish the educational framework through which HTA concepts are transmitted from the broader Danish HTA knowledge base that encompasses reimbursement recommendations, technology assessment reports, clinical guidelines, methodological manuals, and health policy implementation. Nested within this broader knowledge base is an educational structure whose principal function is the transmission of accepted analytical methods and professional assumptions. It determines the concepts regarded as fundamental, the sequence in which they are introduced, the analytical techniques considered appropriate, and the standards by which future practitioners evaluate evidence and construct claims regarding therapy impact. The present interrogation is directed toward this educational framework rather than toward the conclusions reached in individual HTA reports or reimbursement decisions.

The central question addressed by this interrogation is whether the Danish curriculum introduces students and practitioners to the scientific principles of representational measurement before presenting the established analytical methods of contemporary HTA. These principles include specification of the target attribute, the principal scales of measurement, the axioms of representational measurement, admissible arithmetic, dimensional homogeneity, unidimensionality, the distinction between manifest and latent attributes, the corresponding requirements for linear ratio and Rasch logit ratio measurement, and the requirement that quantitative claims be prospectively evaluable, independently replicable, and capable of empirical falsification. These concepts are not optional methodological refinements but constitute the scientific foundations upon which every lawful quantitative claim ultimately depends.

The importance of examining the Danish curriculum knowledge base therefore extends well beyond national educational practice. If these scientific foundations are absent from the educational system responsible for preparing Danish HTA practitioners, researchers, and policy analysts, the implications extend directly to the future development of HTA itself. Curriculum inversion would indicate that students are introduced to utilities, quality-adjusted life years (QALYs), cost-effectiveness analysis, and decision-analytic modelling before they are taught the measurement principles required to determine whether those methods are scientifically legitimate. The interrogation therefore seeks to establish whether Danish HTA education is grounded in the accepted principles of representational measurement or whether it instead reproduces methodological convention without first establishing the conditions required for lawful quantitative measurement. The answer to this question provides an important indication of whether Denmark is preparing future HTA practitioners to undertake measurement-based scientific evaluation or to perpetuate the existing paradigm of measurement inversion.

INTERROGATING THE DANISH CURRICULUM KNOWLEDGE BASE

The objective of large language model (LLM) curriculum interrogation differs from that of previous HTA knowledge-based practice assessments. Earlier interrogations focused on whether institutions recognized the requirements of representational measurement and the standards necessary for quantitative claims. Curriculum interrogation asks a different question. Are faculty, students and researchers exposed to the concepts necessary to understand and apply those standards? The focus shifts from methodological outputs to educational inputs. Rather than examining what faculty, students and researchers do, attention is directed to what they are taught and what they know.

The importance of this distinction should not be underestimated. Educational programs do not merely transmit technical skills. They define the conceptual framework through which future practitioners understand evidence, measurement and scientific inquiry. Concepts that are absent from the curriculum are unlikely to emerge spontaneously in research practice. Equally, concepts that are emphasized repeatedly become part of the intellectual assumptions that shape subsequent analysis have never been systematically incorporated into HTA teaching and research training.

For this reason, the curriculum interrogation was designed around a series of canonical statements intended to identify the presence or absence of foundational measurement concepts. These statements were deliberately elementary. The purpose was not to assess advanced methodological knowledge but to determine whether faculty, students and researchers are likely to encounter the principles that underpin lawful quantitative claims. The resulting framework begins with the concept of an attribute as the object of measurement and proceeds through target attribute specification, scales of measurement, representational measurement, unidimensionality, manifest and latent attributes, ratio measurement and falsifiable claims. Together, these statements define the minimum intellectual foundations required for a measurement-based approach to therapy assessment in education.

These statements are:

- **An attribute is the specific outcome of interest in a therapy assessment.**
- **Every therapy assessment begins with specification of the target attribute.**
- **The principal scales of measurement (nominal, ordinal, interval and ratio) have different properties and support different forms of analysis.**
- **The measurement status of a target attribute must be established before quantitative claims can be advanced.**
- **The axioms of representational measurement underpin quantitative claims.**
- **Attributes must be demonstrated to be unidimensional before measurement is possible.**
- **A manifest attribute is directly observable and capable of supporting empirical observation.**

- **A latent attribute is not directly observable and requires a measurement model to estimate possession of the attribute.**
- **Manifest and latent attributes require different forms of ratio measurement.**
- **Therapy impact claims must be falsifiable.**

These ten statements form a logical sequence:

Attribute → Target Attribute → Scales of Measurement → Measurement Status → Representational Measurement → Unidimensionality → Manifest Attribute → Latent Attribute → Ratio Measurement → Falsifiable Claims

Together they define the minimum curriculum content required for a measurement-based approach to HTA and provide the framework for evaluating curriculum coverage in Canada HTA research centers.

The categorical probabilities reported in this assessment are intended as indicators of the extent to which a concept is represented within the curriculum knowledge base. They should not be interpreted as precise statistical estimates but as measures of the likelihood that a student, researcher or professional exposed to that knowledge base would encounter, recognize and subsequently endorse the canonical statement. In practical terms, the probability reflects the visibility and prominence of a concept within the educational environment associated with a research center or policy agency.

A high probability indicates that the concept is well represented within curriculum materials, research outputs and educational activities and is therefore likely to be familiar to students and researchers. Conversely, a low probability suggests that the concept is absent, only weakly represented, or occupies a peripheral position within the curriculum knowledge base. Students exposed to such an environment would therefore be unlikely to recognize the concept as an important component of HTA education and practice.

The probabilities should be viewed comparatively rather than in isolation. Their principal value lies in identifying patterns of curriculum coverage across institutions and concepts. In particular, low probabilities associated with scales of measurement, representational measurement, unidimensionality and ratio measurement indicate that these topics are unlikely to form a substantial part of the educational experience of the average student. The resulting profile provides an indication of curriculum strengths, deficiencies and potential areas for reconstruction.

DENMARK AND CURRICULUM INVERSION

The interrogation of the Danish health technology assessment (HTA) curriculum demonstrates a consistent failure to recognize the scientific foundations required for quantitative assessment of therapy impact. Across all ten canonical statements, endorsement probabilities remain low, ranging from 0.05 to 0.20. No statement achieves even a moderate level of endorsement. This pattern is significant because the statements do not represent controversial methodological preferences or alternative schools of thought. They express the universally accepted principles that underpin quantitative inquiry in the physical and social sciences.

TABLE 1: CURRICULUM CONTENT ENDORSEMENT: DANISH KNOWLEDGE BASE

CANONICAL STATEMENT	CATEGORICAL PROBABILITY	NORMALIZED LOGIT
An attribute is the specific outcome of interest in a therapy assessment	0.20	-1.40
Every therapy assessment begins with specification of the target attribute	0.15	-1.75
The principal scales of measurement (nominal, ordinal, interval and ratio) have different properties and support different forms of analysis	0.20	-1.40
The measurement status of a target attribute must be established before quantitative claims can be advanced	0.10	-2.20
The axioms of representational measurement underpin quantitative claims	0.05	-2.50
Attributes must be demonstrated to be unidimensional before measurement is possible	0.10	-2.20
A manifest attribute is directly observable and capable of supporting empirical observation	0.20	-1.40
A latent attribute is not directly observable and requires a measurement model to estimate possession of the attribute	0.10	-2.20
Manifest and latent attributes require different forms of ratio measurement	0.05	-2.50
Therapy impact claims must be falsifiable	0.15	-1.75

The highest probability assigned to any statement is only 0.20, indicating that even elementary concepts such as defining the attribute of interest, recognizing the principal scales of measurement, and distinguishing manifest attributes receive only weak recognition within the Danish curriculum knowledge base. More advanced requirement including representational measurement, unidimensionality, latent measurement models, and the distinction between manifest and latent ratio measurement receive even lower endorsement, with probabilities between 0.05 and 0.10. These results indicate that the concepts necessary for establishing lawful quantitative claims occupy little or no central role in Danish HTA education.

Particularly striking is the lack of recognition given to representational measurement. Scientific measurement is not an optional methodological refinement but the prerequisite for every quantitative claim. Before arithmetic operations can be undertaken, it must first be demonstrated that the attribute possesses the mathematical properties required for those operations. Without this demonstration, numerical manipulation becomes descriptive arithmetic rather than scientific measurement. The interrogation indicates that this distinction is largely absent from the Danish HTA curriculum.

The absence of a clear distinction between manifest and latent attributes is equally important. Manifest attributes are directly observable and can often support conventional ratio measurement. Latent attributes, by contrast, cannot be observed directly and require explicit measurement models capable of demonstrating possession of the attribute. Failure to distinguish these fundamentally different forms of measurement encourages the routine treatment of ordinal scores, preference values and utility indices as though they were quantitative measures of therapy impact.

Similarly, the limited recognition afforded to unidimensionality indicates that Danish HTA teaching does not consistently establish whether an attribute exists as a single measurable construct before attempting its quantitative evaluation. Without demonstrating unidimensionality, no claim can legitimately be made that a numerical score represents a single underlying attribute. This omission undermines the scientific status of subsequent arithmetic operations, including averaging, multiplication and cost-effectiveness calculations.

The weak endorsement of falsifiability reinforces this conclusion. Scientific claims must be capable of empirical failure. Therapy impact claims should therefore be specified in advance, measured using appropriate instruments, and subjected to protocols capable of confirming or refuting the claim. Where quantitative claims depend instead upon assumptions embedded within simulation models or preference algorithms, opportunities for empirical refutation are substantially diminished.

Taken together, these findings indicate that the Danish HTA curriculum exhibits the defining characteristics of curriculum inversion. Rather than teaching the conditions that must be satisfied before quantitative analysis is possible, the curriculum proceeds directly to the application of established HTA techniques. Utilities, QALYs, cost-effectiveness analysis and decision modelling consequently become accepted practice without prior demonstration that the underlying numerical inputs satisfy the requirements of representational measurement. Denmark therefore reflects the same pattern observed across numerous HTA knowledge bases internationally, where arithmetic has displaced measurement as the foundation of quantitative evaluation.

Statement-by-Statement Review

Statement 1: An attribute is the specific outcome of interest in a therapy assessment (Probability 0.20; Logit –1.39)

The concept of an attribute receives only limited recognition. Although Danish HTA routinely evaluates therapies, the curriculum places relatively little emphasis on identifying the attribute that is to be measured before selecting instruments or analytical methods. Consequently, discussion frequently moves directly to outcomes, utilities or economic models without establishing precisely what characteristic of the patient or intervention is being measured.

Statement 2: Every therapy assessment begins with specification of the target attribute (Probability 0.15; Logit –1.73)

Endorsement is lower still for the principle that all therapy assessments should begin by specifying the target attribute. This suggests that the curriculum emphasizes established methodological procedures rather than constructing evaluation around a clearly defined measurable attribute. The result is that measurement becomes secondary to modelling and economic analysis.

Statement 3: The principal scales of measurement have different properties and support different forms of analysis (Probability 0.20; Logit –1.39)

Recognition of the distinction between nominal, ordinal, interval and ratio scales is limited. While these scales may occasionally be described in general methodological teaching, their implications for admissible arithmetic operations are not consistently incorporated into HTA methodology. As a consequence, inappropriate numerical operations on ordinal data remain largely unchallenged.

Statement 4: The measurement status of a target attribute must be established before quantitative claims can be advanced (Probability 0.10; Logit –2.20)

This statement receives very weak endorsement. Establishing measurement status is fundamental to scientific inquiry because arithmetic cannot legitimately precede measurement. The Danish curriculum appears instead to assume that existing outcome measures or preference scores already possess appropriate measurement properties without requiring independent demonstration.

Statement 5: The axioms of representational measurement underpin quantitative claims (Probability 0.05; Logit –2.50)

This is one of the weakest endorsed statements in the interrogation. The principles of representational measurement—including admissible transformations, homomorphism and the mathematical structure required for quantitative measurement—are largely absent from the curriculum. Their omission removes the scientific foundation upon which quantitative HTA claims should rest.

Statement 6: Attributes must be demonstrated to be unidimensional before measurement is possible (Probability 0.10; Logit –2.20)

Limited recognition of unidimensionality indicates that Danish HTA education rarely requires demonstration that an attribute represents a single measurable construct. Without this requirement, composite indices and multidimensional instruments are readily accepted despite lacking the characteristics necessary for lawful quantitative measurement.

Statement 7: A manifest attribute is directly observable and capable of supporting empirical observation (Probability 0.20; Logit –1.39)

The distinction between directly observable attributes and other forms of evidence receives only modest recognition. Although manifest variables are widely used in clinical research, their unique measurement properties are not systematically differentiated from those of latent constructs within the curriculum.

Statement 8: A latent attribute is not directly observable and requires a measurement model to estimate possession of the attribute (Probability 0.10; Logit –2.20)

Recognition of latent measurement is weak. Patient-reported outcomes and quality-of-life constructs are commonly employed within Danish HTA, yet the curriculum provides little indication that these require explicit measurement models capable of establishing possession of the latent attribute rather than relying upon simple score aggregation.

Statement 9: Manifest and latent attributes require different forms of ratio measurement (Probability 0.05; Logit –2.50)

This statement receives the lowest level of endorsement. The curriculum shows little appreciation that observable variables and latent constructs require fundamentally different measurement frameworks. The absence of this distinction contributes directly to the routine acceptance of utility scores and other composite indices as though they possessed ratio-scale properties.

Statement 10: Therapy impact claims must be falsifiable (Probability 0.15; Logit –1.73)

Although falsifiability is a defining characteristic of scientific inquiry, it receives only limited recognition. The Danish HTA curriculum emphasizes evidence synthesis and modelling but gives comparatively little attention to the design of empirically testable claims capable of prospective confirmation or refutation. Consequently, quantitative conclusions often depend more upon accepted modelling conventions than upon directly evaluable scientific measurement.

MANIFEST AND LATENT ATTRIBUTES: THE MISSING FOUNDATION OF DANISH HTA

A central finding of the Danish curriculum interrogation is the absence of any explicit framework distinguishing manifest from latent attributes and the corresponding measurement requirements that follow from this distinction. This omission is particularly significant because the Netherlands has been one of the principal architects of the contemporary European reference-case tradition. The manifest-latent distinction is not a methodological refinement but one of the foundational concepts of representational measurement. Without it there is no coherent basis for determining how therapy outcomes should be measured, what constitutes a lawful quantitative claim, or whether the arithmetic applied within HTA is scientifically admissible.

Manifest attributes are directly observable. Their existence and magnitude can be established through empirical observation without the need for an intervening measurement model. Examples include survival time, hospital admissions, emergency department visits, medication adherence, treatment discontinuation, adverse events, laboratory values, and healthcare resource utilization. These attributes are observable phenomena that can be counted, timed, or otherwise recorded directly. When properly specified, they support linear ratio measures with a meaningful zero and lawful arithmetic operations. The scientific task is straightforward: define the attribute, establish the unit of observation, specify the observation period, and subject the resulting claim to empirical evaluation and independent replication.

Latent attributes present a fundamentally different measurement problem. Pain, fatigue, depression, anxiety, physical functioning, treatment satisfaction, health confidence, and need fulfilment cannot be observed directly. Their existence must be inferred from observable indicators, typically responses to structured questionnaire items. Consequently, latent attributes require a measurement model capable of estimating possession of the attribute while satisfying the axioms of representational measurement. Within HTA this requirement is met through Rasch measurement, which provides a logit ratio measure possessing the properties required for lawful quantitative inference.

The importance of this distinction cannot be overstated. Manifest and latent attributes require fundamentally different forms of ratio measurement. Manifest attributes require linear ratio measures; latent attributes require Rasch logit ratio measures. These are the only two measurement frameworks capable of supporting lawful quantitative claims regarding therapy impact. The distinction therefore determines the entire measurement strategy adopted within HTA.

The interrogation suggests that the Danish curriculum knowledge base does not recognize this distinction as an organizing principle for HTA education. Instead, outcomes are grouped within broad categories such as patient-reported outcomes, quality of life, utility measurement, clinical effectiveness, and value assessment. These categories are descriptively useful but scientifically inadequate because they fail to distinguish between directly observable attributes and attributes requiring a measurement model. The measurement requirements governing each type of outcome consequently remain obscured.

Once this distinction disappears, virtually any numerical output can be treated as though it possesses equivalent measurement status. Utility scores, preference weights, composite indices, symptom scales, observational counts, and resource-use measures are brought together within the same analytical framework despite possessing fundamentally different measurement properties. The consequence is a loss of measurement discipline in which numerical construction is mistaken for quantitative measurement.

For Denmark this finding carries significance. Danish researchers and institutions have played a leading role in developing and disseminating the European reference-case tradition. Yet the interrogation indicates that the educational framework underpinning that tradition does not begin with the most fundamental distinction required by representational measurement. The result is that successive generations of practitioners become highly proficient in economic evaluation, cost-utility analysis, and decision modelling without first asking the elementary scientific question: what type of attribute is being measured, and what form of measurement is required?

THE ABSENCE OF RASCH

The absence of the manifest-latent distinction also explains the near absence of Rasch measurement within the Danish curriculum knowledge base. If latent attributes are not explicitly recognized as requiring a measurement model, there is no perceived need to introduce the one measurement framework capable of constructing lawful quantitative measures of latent attribute possession. Instead, ordinal questionnaire responses are transformed into utility scores, indices, and QALYs and subsequently treated as though measurement has already been achieved. The measurement problem is therefore bypassed rather than solved.

From the perspective of curriculum design, this represents a classic example of curriculum inversion. Students are introduced to utilities, QALYs, patient-reported outcomes, and reference-case modelling before they are taught to distinguish between manifest and latent attributes. Consequently, they are never encouraged to ask the critical scientific question that should precede every HTA submission: What is the target attribute, is it manifest or latent, and which lawful form of ratio measurement is required?

For a country that has exercised such influence over the development of European HTA, this omission is particularly consequential. The interrogation suggests that the Danish curriculum knowledge base has helped disseminate methodological sophistication without first establishing the scientific foundations of measurement. Until the distinction between manifest and latent attributes becomes the organizing principle of HTA education, curriculum inversion will continue to reproduce measurement inversion, not only within Denmark Netherlands but throughout the broader European HTA tradition that Danish methodology has helped shape.

One of the most striking findings from the interrogation of the Danish HTA curriculum knowledge base is not simply the absence of representational measurement but the near-complete absence of Rasch measurement and its role in the assessment of latent attributes. This omission is particularly significant because Denmark has been one of the principal contributors to the development of modern European HTA. Danish researchers and institutions have played a leading role in advancing cost-utility analysis, reference-case methodology, and economic evaluation. Yet the educational framework underpinning this tradition gives little recognition to the one measurement framework capable of constructing lawful quantitative measures of latent attributes. The issue is not whether the term *Rasch* occasionally appears in specialist publications or psychometric research. The issue is whether Rasch measurement is recognized as the scientific foundation for measuring latent therapy outcomes. The interrogation indicates that it is not.

This places Rasch in a unique position. Rasch is not simply another psychometric technique competing with item response theory, PROMIS, utility instruments, or preference-based scoring systems. It addresses an entirely different scientific problem. Its purpose is to determine whether ordinal observations can be transformed into a quantitative measure of possession of a latent attribute. In doing so, it provides the only established framework capable of demonstrating whether the conditions required for measurement have been satisfied.

The distinction is fundamental. Patient-reported outcomes begin with ordinal responses to questionnaire items describing pain, fatigue, anxiety, physical functioning, treatment satisfaction, need fulfilment, or other latent attributes. These responses provide information about order but not quantity. Arithmetic performed directly on ordinal observations cannot create measurement. Summed scores, averages, weighted algorithms, utility values, and preference functions remain numerical constructions unless it has first been demonstrated that the underlying latent attribute has been measured. Numerical manipulation is not measurement.

Rasch measurement was developed precisely to solve this problem. Through the conjoint calibration of persons and items, the Rasch model estimates the location of individuals on a latent continuum while simultaneously testing whether the observations satisfy the conditions required for lawful measurement. Unidimensionality, specific objectivity, invariance, item fit, response-category functioning, local independence, and differential item functioning are not optional methodological refinements. They are the empirical conditions that must be satisfied before a claim regarding possession of a latent attribute can be advanced. Rasch therefore provides both the measurement model and the empirical tests necessary to determine whether measurement has actually been achieved.

The interrogation indicates that this perspective is largely absent from the Danish curriculum knowledge base. Students and practitioners are introduced to patient-reported outcomes, utilities, quality-of-life instruments, preference weights, QALYs, and economic evaluation without first confronting the measurement problem these constructs are intended to solve. The educational sequence moves directly from ordinal responses to scoring systems and economic models. The essential intermediate step demonstrating that a latent attribute has been measured is effectively bypassed.

This omission has profound implications. Without Rasch measurement, latent attributes remain unmeasured. Utility scores, composite indices, and preference algorithms may generate numerical outputs, but they do not establish that the underlying construct has been measured. The existence of a number should never be confused with the existence of a measure. Nevertheless, much of contemporary Danish HTA proceeds as though this distinction does not exist. Students consequently learn how utilities are generated, how QALYs are constructed, and how reference-case models are populated, yet they are not taught how latent attributes themselves can be measured. The curriculum therefore introduces numerical representations of patient benefit before introducing the scientific framework required to justify those representations. This is curriculum inversion in its clearest form.

For Denmark this conclusion carries particular weight. One of the countries that helped shape the European reference-case tradition has not incorporated into its educational framework the only established measurement theory capable of supporting quantitative claims for latent therapy outcomes. Until Rasch measurement assumes its proper place within Danish HTA education, latent attributes will continue to be represented through scores, utilities, and indices rather than lawful measures, and the distinction between scoring and measurement will remain obscured. The consequence is that curriculum inversion continues to reinforce the broader pattern of measurement inversion that characterizes contemporary European HTA.

CONCLUSION: CURRICULUM INVERSION AND THE FUTURE OF HTA IN DENMARK

The companion interrogation of the Danish HTA knowledge base demonstrated that contemporary health technology assessment in the Netherlands is characterized by measurement inversion. The accepted principles of representational measurement receive little recognition, while utilities, QALYs, cost-effectiveness analysis, and reference-case modelling continue to be treated as though they provide scientifically valid quantitative measures of therapy impact. The present study has addressed the complementary question of how such a framework has been created, sustained, and transmitted across successive generations of practitioners. The answer is curriculum inversion.

The interrogation demonstrates that the Danish HTA curriculum knowledge base introduces students and practitioners to the methods of contemporary HTA before introducing them to the scientific principles required to evaluate those methods. Educational emphasis is placed upon comparative effectiveness, economic evaluation, utilities, QALYs, decision modelling, evidence synthesis, and reimbursement methodology rather than upon specification of the target attribute, representational measurement, admissible arithmetic, unidimensionality, manifest and latent attributes, Rasch measurement, dimensional homogeneity, and the requirement that therapy-impact claims be prospectively evaluable, independently replicable, and capable of falsification. Graduates therefore acquire technical competence in constructing the reference-case framework without first acquiring the scientific framework necessary to determine whether that framework supports lawful quantitative claims.

For the Netherlands this conclusion carries particular significance. Danish universities, researchers, and policy organizations have been among the principal architects of the European reference-case tradition. They have helped shape the methodological framework subsequently adopted across much of Europe. The interrogation therefore indicates that curriculum inversion is not simply a feature of Danish HTA; it is one of the mechanisms through which measurement inversion has been disseminated internationally. The European reference-case paradigm was not built upon the foundations of representational measurement. It was built upon administrative necessity. Every major component of that framework—utilities, QALYs, cost-effectiveness ratios, and reference-case simulation modelling—depends upon quantities that fail the accepted requirements for lawful measurement. The result is methodological sophistication applied to measurement impossibilities.

This conclusion leaves no room for incremental reform. A framework whose constituent quantities fail the axioms of representational measurement cannot be rescued through improved modelling, better utility instruments, more sophisticated statistics, expanded real-world evidence, or increasingly elaborate simulations. None of these activities can create measurement where measurement does not exist. Arithmetic cannot rescue quantities that are not measures. Forty years of methodological refinement have not resolved this problem because the problem lies beneath the methodology itself.

The implications for Danish universities are therefore direct. Continuing to educate students in the construction and application of reference-case models without first teaching the scientific principles governing lawful measurement is incompatible with the central purpose of higher education. Universities exist to advance objective knowledge, not to perpetuate analytical traditions whose measurement foundations have collapsed. Students should certainly understand the historical importance of utilities, QALYs, and reference-case modelling, but they should understand them as examples of a paradigm that failed to satisfy the accepted standards governing quantitative science. They should not be taught that these constructs provide valid measures of therapy impact because they do not.

The only scientifically defensible path forward is reconstruction. Every HTA submission should begin with explicit specification of the target attribute. Manifest attributes should be evaluated through lawful linear ratio measures. Latent attributes should be evaluated through Rasch logit ratio measures that satisfy the axioms of representational measurement. Every quantitative claim should be accompanied by a prospective protocol specifying the attribute, measurement method, comparator, evaluation period, replication strategy, and conditions for empirical falsification. Measurement must precede arithmetic in every assessment without exception.

Taken together, the companion interrogations of measurement inversion and curriculum inversion demonstrate that the Dutch reference-case tradition has reached its intellectual limit. It has succeeded in standardizing administrative decision making while failing to establish the scientific legitimacy of the quantities upon which those decisions depend. That paradigm has no scientific future because it rests upon measurement impossibilities. Its place is no longer at the center of HTA education but in the history of the discipline as an instructive example of how methodological sophistication can evolve independently of measurement science.

To facilitate this transition, Maimon Research LLC has developed a comprehensive nine-unit HTA Reconstruction Program [4]. The program provides a systematic introduction to representational measurement, the theory of attributes, the principal scales of measurement, admissible arithmetic, dimensional homogeneity, manifest and latent attributes, Rasch logit ratio measurement, protocol development, and the construction of evaluable, replicable, and falsifiable claims regarding therapy impact. Its purpose is not to modify the existing reference-case paradigm but to replace it with a scientific framework in which measurement once again precedes arithmetic.

The program has been designed for universities, HTA agencies, reimbursement organizations, research centers, professional societies, pharmaceutical companies, and health economists seeking a transition from assumption-driven modelling to scientifically defensible measurement. It provides a structured pathway for professional development while establishing the competencies required for the next generation of HTA practitioners. In this way, it offers not simply a critique of the existing paradigm but a practical route toward the reconstruction of HTA as a measurement-based scientific discipline.

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