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ARTIFICIAL INTELLIGENCE LARGE LANGUAGE MODEL INTERROGATION

REPRESENTATIONAL MEASUREMENT FAILURE IN HEALTH TECHNOLGY ASSESSMENT

SWEDEN: THE ENDORSEMENT OF CURRICULUM INVERSION

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ABSTRACT

This study examines the Swedish health technology assessment (HTA) curriculum knowledge base to determine whether it incorporates the scientific principles required for lawful quantitative measurement. It complements an earlier interrogation of the Swedish HTA knowledge base that demonstrated a consistent pattern of measurement inversion, where representational measurement received little recognition while utilities, quality-adjusted life years (QALYs), cost-effectiveness analysis, and reference-case modelling were accepted as though they provided scientifically valid measures of therapy impact. The present investigation addresses the educational origins of this pattern by examining whether Swedish HTA education has similarly institutionalized curriculum inversion.

A standardized curriculum interrogation was undertaken using ten canonical statements derived from the axioms of representational measurement. These statements encompass target attribute specification, scales of measurement, representational measurement, unidimensionality, manifest and latent attributes, ratio measurement, and the requirement that scientific claims be prospectively evaluable, independently replicable, and empirically falsifiable. Across all ten statements, endorsement probabilities remain consistently low, indicating that the scientific foundations required for quantitative inference occupy only a peripheral position within the Swedish curriculum knowledge base. While there is modest recognition of observable outcomes and empirical evidence, there is little evidence that students are systematically introduced to representational measurement, the distinction between manifest and latent attributes, or the differing measurement requirements for each.

The interrogation further demonstrates that Rasch measurement, the only established framework for constructing lawful quantitative measures of latent attributes, is largely absent from Swedish HTA education. Consequently, patient-reported outcomes, utilities, and quality-of-life instruments are presented without first establishing whether the underlying attributes have been validly measured. The curriculum therefore teaches economic evaluation, QALY construction, and decision-analytic modelling before teaching the scientific conditions necessary to justify those activities.

The study concludes that curriculum inversion is the educational mechanism through which measurement inversion is reproduced within Swedish HTA. Rather than providing students with the conceptual framework needed to evaluate established methodologies, the curriculum perpetuates accepted analytical conventions while neglecting the principles of representational measurement. Reconstruction of Swedish HTA must therefore begin with curriculum reform that restores measurement as the prerequisite for arithmetic, adopts lawful ratio measurement for manifest and latent attributes, and requires all therapy-impact claims to be prospectively evaluable, independently replicable, and empirically falsifiable.

INTRODUCTION

The present analysis complements an earlier interrogation of the Swedish health technology assessment (HTA) knowledge base that examined the extent to which the accepted principles of representational measurement are recognized within contemporary Swedish HTA [1] . That investigation demonstrated a consistent pattern of measurement inversion, with representational measurement receiving little recognition while utilities, QALYs, cost-effectiveness analysis, and reference-case modelling were accepted as though they provided scientifically valid measures of therapy impact. The present study addresses the complementary question of how this methodological framework is created, transmitted, and sustained through the educational system responsible for preparing successive generations of Swedish HTA practitioners. It examines whether measurement inversion is accompanied by curriculum inversion.

The present analysis examines the Swedish health technology assessment (HTA) curriculum knowledge base through the application of a standardized representational measurement interrogation. Its purpose is not to evaluate individual universities, research groups, government agencies, or teaching programs, but to determine whether the scientific principles required for lawful quantitative measurement are embedded within the educational framework that prepares Swedish HTA practitioners. The interrogation employs ten canonical curriculum statements derived from the axioms of representational measurement. These statements encompass the specification of target attributes, the principal scales of measurement, representational measurement, unidimensionality, the distinction between manifest and latent attributes, the corresponding requirements for ratio measurement, and the requirement that scientific claims be prospectively evaluable, independently replicable, and empirically falsifiable. Together they provide a consistent framework for assessing whether Swedish HTA education is grounded in the scientific conditions necessary for valid quantitative evaluation.

Sweden occupies an important position in the international development of health technology assessment. Through its universities, research institutes, health authorities, and long-standing commitment to evidence-based medicine, clinical epidemiology, patient-reported outcomes, and economic evaluation, Sweden has contributed substantially to the methodological development of HTA within both the Nordic region and Europe more broadly. Swedish researchers have been influential in comparative effectiveness research, health economics, quality-of-life assessment, and evidence synthesis, while national HTA agencies have helped establish methodological standards adopted by other jurisdictions. Consequently, the Swedish curriculum knowledge base is significant not only because it shapes professional education within Sweden but because it contributes to the broader European framework through which HTA methods are taught, interpreted, and applied.

The central question addressed by this interrogation is whether Swedish HTA education introduces students and practitioners first to the scientific principles governing measurement before presenting the accepted analytical methods of contemporary HTA. If these foundational concepts receive consistently weak endorsement while utilities, quality-adjusted life years (QALYs), cost-effectiveness analysis, patient-reported outcomes, and decision-analytic modelling remain the dominant components of the curriculum, the result is curriculum inversion. In such a curriculum, arithmetic precedes measurement rather than following it, and methodological convention replaces scientific validation. The Swedish interrogation therefore seeks to determine whether the educational framework supporting contemporary HTA satisfies the requirements of representational measurement or whether it reproduces the same pattern of measurement inversion identified across numerous national HTA knowledge bases.

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 [2] [3] [4] . 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 SWEDISH HTA CURRICULUM KNOWLEDGE BASE

The Swedish 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 Sweden. It extends well beyond formal university curricula to encompass postgraduate education, professional training programs, methodological guidance issued by national agencies, publications from academic research centers, conference proceedings, continuing professional development, and the extensive literature in health economics, epidemiology, outcomes research, evidence-based medicine, and health services research. Collectively, these resources establish the conceptual framework through which successive generations of physicians, pharmacists, economists, epidemiologists, policy analysts, health services researchers, consultants, manufacturers, and government officials acquire their understanding of HTA and its role in healthcare decision making.

Sweden occupies an important position within the international development of health technology assessment. For several decades Swedish universities, research institutes, and government agencies have contributed substantially to the development of evidence-based medicine, systematic reviews, clinical epidemiology, health economics, patient-reported outcomes, and economic evaluation. Swedish researchers have played influential roles in comparative effectiveness research, quality-of-life assessment, registry-based studies, and the development of methodological standards that have shaped both Nordic and European HTA practice. National organizations responsible for health technology assessment have similarly contributed to the evolution of evidence-based decision making for pharmaceuticals, medical devices, diagnostic technologies, and healthcare interventions. Consequently, the Swedish curriculum knowledge base is important not only because it shapes education within Sweden but because it contributes to the broader European framework through which HTA methodology continues to evolve.

The purpose of identifying the Swedish curriculum knowledge base is to distinguish the educational framework through which HTA concepts are transmitted from the broader Swedish HTA knowledge base that encompasses assessment reports, reimbursement recommendations, methodological guidance, clinical practice recommendations, and healthcare policy implementation. Nested within this wider knowledge base is an educational framework whose primary purpose is to transmit accepted analytical methods and professional assumptions to future practitioners. It determines which concepts are regarded as fundamental, the sequence in which they are introduced, the analytical techniques considered appropriate, and the methodological assumptions that define professional competence. The present interrogation is directed toward this educational framework rather than toward the conclusions reached in individual HTA reports or reimbursement decisions.

The interrogation addresses a fundamental scientific question. Does the Swedish curriculum knowledge base introduce students and practitioners first to the accepted principles of representational measurement before presenting the established 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 therapy-impact claims be prospectively evaluable, independently replicable, and capable of empirical falsification. These concepts are not optional methodological refinements but the scientific foundations upon which every lawful quantitative claim ultimately depends.

The importance of interrogating the Swedish curriculum knowledge base therefore extends beyond the evaluation of national educational practice. If these scientific foundations are absent from the educational system responsible for preparing Swedish HTA practitioners, researchers, and policy analysts, the implications extend directly to the future development of HTA throughout Sweden and, potentially, beyond. Curriculum inversion would indicate that students are introduced to utilities, quality-adjusted life years (QALYs), patient-reported outcomes, cost-effectiveness analysis, and decision-analytic modelling before they are taught the principles of measurement required to determine whether these methods are scientifically legitimate. The Swedish curriculum knowledge base therefore provides an important case study in determining whether HTA education is grounded in the accepted principles of representational measurement or whether it instead reproduces methodological convention without first establishing the scientific conditions required for lawful quantitative measurement.

INTERROGATING THE SWEDISH 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

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.

SWEDEN AND CURRICULUM INVERSION

The interrogation of the Swedish health technology assessment curriculum knowledge base demonstrates consistently weak endorsement of the scientific principles required for lawful quantitative measurement (Table 1). Across the ten canonical curriculum statements, probabilities range from 0.05 to 0.30. No statement achieves moderate or strong endorsement. The results suggest that Swedish HTA education gives some recognition to observable outcomes, research design and evidence assessment, but does not embed these activities within a coherent framework of representational measurement. The concepts necessary to distinguish measurement from scoring, numerical description and modelling remain peripheral.

The strongest endorsement is assigned to the statement that a manifest attribute is directly observable and capable of supporting empirical observation, with a probability of 0.30. This likely reflects Sweden’s strong traditions in clinical epidemiology, health registers, comparative effectiveness research and evidence-based medicine. Observable events such as mortality, hospitalization, treatment discontinuation, adverse events and resource use are familiar components of Swedish health research. Recognition that an attribute is the specific outcome of interest receives a probability of 0.25. These results indicate some awareness of outcomes as objects of empirical investigation, but not necessarily of attributes as formally specified objects of measurement.

Recognition of scale properties, unidimensionality and latent attributes is weaker. The statement concerning nominal, ordinal, interval and ratio scales receives a probability of 0.20, while target-attribute specification, unidimensionality and the requirement for a measurement model for latent attributes each receive probabilities of 0.15. These concepts may appear in statistics, psychometrics or research-methods teaching, but they do not appear to organize the teaching of HTA. Their implications for admissible arithmetic are therefore unlikely to be developed systematically. Students may learn that scale types differ without being required to determine whether averaging, multiplication or the formation of ratios is legitimate for the quantities employed in economic evaluation.

The weakest endorsement concerns the axioms of representational measurement and the requirement that manifest and latent attributes be evaluated through different forms of ratio measurement. Both receive probabilities of only 0.05. This is the critical finding. Without representational measurement, there is no formal basis for determining whether empirical relations have been represented by numerical relations in a way that supports lawful arithmetic. Without the manifest-latent distinction, there is no coherent basis for separating directly observable outcomes from attributes such as pain, fatigue, functioning or need fulfilment that require a measurement model. The near absence of these principles leaves Swedish HTA without a defensible measurement foundation.

TABLE 1: CURRICULUM CONTENT ENDORSEMENT: SWEDISH KNOWLEDGE BASE

CANONICAL STATEMENT	CATEGORICAL PROBABILITY	NORMALIZED LOGIT
An attribute is the specific outcome of interest in a therapy assessment	0.25	-1.25
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	-2.00
The axioms of representational measurement underpin quantitative claims	0.05	-2.50
Attributes must be demonstrated to be unidimensional before measurement is possible	0.15	-1.75
A manifest attribute is directly observable and capable of supporting empirical observation	0.30	-1.00
A latent attribute is not directly observable and requires a measurement model to estimate possession of the attribute	0.15	-1.75
Manifest and latent attributes require different forms of ratio measurement	0.;05	-2.50
Therapy impact claims must be falsifiable	0.20	-1.40

The overall pattern is therefore one of curriculum inversion. Swedish students and practitioners are introduced to evidence synthesis, health economics, cost-effectiveness analysis, utilities, QALYs, patient-reported outcomes and decision modelling before they are taught the scientific conditions that must be satisfied for the underlying quantities to constitute measures. Arithmetic and modelling are treated as the starting point of quantitative assessment rather than as operations that become legitimate only after measurement has been established. The curriculum consequently reproduces the assumptions of contemporary HTA rather than providing students with the conceptual tools necessary to test those assumptions.

The probability of 0.20 assigned to falsifiability suggests limited recognition that therapy-impact claims should be capable of empirical failure. Swedish HTA places substantial emphasis on evidence assessment and uncertainty, but this is not equivalent to requiring prospectively specified, evaluable and replicable claims. Reference-case models typically generate claims conditional upon assumptions rather than claims designed for direct empirical confirmation or refutation. Taken together, the results indicate that the Swedish curriculum knowledge base sustains measurement inversion by omitting the foundational measurement principles required to challenge established HTA methods.

STATEMENT-BY-STATEMENT REVIEW

Statement 1: An attribute is the specific outcome of interest in a therapy assessment
Probability 0.25; Normalized logit –1.25

Recognition of the concept of an attribute is limited but somewhat stronger than for most other statements. Swedish HTA education is highly familiar with outcomes, endpoints and indicators of treatment effect, yet these are not always presented as formally specified attributes that must be defined before measurement begins. The curriculum therefore appears to recognize the importance of identifying what is being assessed without consistently distinguishing the attribute itself from the instrument, score or model used to represent it. This creates a risk that numerical outputs are accepted before the underlying object of measurement has been clearly established.

Statement 2: Every therapy assessment begins with specification of the target attribute
Probability 0.15; Normalized logit –1.75

The low endorsement of this statement indicates that explicit target-attribute specification is not a routine starting point in Swedish HTA education. Assessments are more likely to begin with available clinical outcomes, utility instruments, data sources or modelling requirements. This reverses the scientifically appropriate sequence. The attribute should first be defined, followed by determination of whether it is manifest or latent, and only then should an appropriate measurement strategy be selected. Without this sequence, the analytical method may determine the outcome rather than the outcome determining the method.

Statement 3: The principal scales of measurement have different properties and support different forms of analysis
Probability 0.20; Normalized logit –1.40

There is some recognition of nominal, ordinal, interval and ratio scales within statistics and research-methods teaching. However, the probability of 0.20 suggests that the implications of these distinctions are not integrated systematically into HTA. Students may be introduced to scale terminology without being required to identify the arithmetic operations permitted by each scale. The consequence is that ordinal scores may be averaged, multiplied or incorporated into ratios as though they possessed interval or ratio properties. Knowledge of scale labels without enforcement of admissible arithmetic is insufficient.

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 the essential prerequisite for quantitative science because arithmetic cannot legitimately precede measurement. The interrogation suggests that Norwegian HTA education generally assumes that existing clinical outcomes, utility measures, and patient-reported scores 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 within the interrogation. The mathematical principles governing representational measurement receive almost no explicit recognition within the curriculum knowledge base. As a result, students are unlikely to encounter the scientific foundations that determine whether numerical observations constitute lawful measures capable of supporting quantitative claims.

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

Recognition of unidimensionality is limited. Norwegian HTA education provides little evidence that students are required to establish whether an attribute represents a single measurable construct before undertaking quantitative analysis. Composite measures and multidimensional instruments can therefore be accepted without demonstrating that they satisfy one of the fundamental conditions for scientific measurement.

Statement 7: A manifest attribute is directly observable and capable of supporting empirical observation (Probability 0.20; Logit –1.40)

This statement receives the strongest endorsement alongside Statement 1, although the probability remains low. There is some recognition that directly observable clinical outcomes differ from more abstract constructs. However, this distinction is not developed into a comprehensive measurement framework that differentiates the measurement requirements for observable and non-observable attributes.

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. Although Norwegian HTA makes extensive use of patient-reported outcomes and quality-of-life instruments, there is little indication that the curriculum systematically introduces the measurement models required to estimate possession of latent attributes. Instead, aggregated scores and utility values appear to be accepted as though they themselves constitute measures.

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

This statement receives one of the lowest endorsement probabilities in the interrogation. The curriculum demonstrates little appreciation that manifest attributes require linear ratio measurement whereas latent attributes require Rasch logit ratio measurement. The absence of this distinction contributes directly to the routine treatment of utilities, preference scores and composite indices as though they possessed equivalent measurement status.

Statement 10: Therapy impact claims must be falsifiable (Probability 0.15; Logit –1.75)

Recognition that therapy impact claims should be capable of empirical falsification is limited. While evidence-based practice is emphasized within Norwegian HTA, comparatively little attention is given to the prospective specification of evaluable, independently replicable and falsifiable claims. Consequently, many quantitative conclusions depend more upon accepted modelling conventions than upon direct empirical testing of scientifically measurable outcomes.

MANIFEST AND LATENT ATTRIBUTES: THE MISSING FOUNDATION OF SWEDISH HTA

A central finding of the Swedish 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 distinction between manifest and latent attributes 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 attributes require linear ratio measures, whereas 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 Swedish 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 Sweden this finding has important implications. Swedish universities, research institutes, and health authorities have established an international reputation for evidence-based medicine, clinical epidemiology, health services research, patient-reported outcomes, and health technology assessment. Swedish methodological contributions have influenced both Nordic and European HTA practice, particularly through their emphasis on systematic evidence assessment and economic evaluation. The curriculum interrogation indicates, however, that the educational framework supporting these activities does not begin with the fundamental distinction required by representational measurement. Successive generations of practitioners therefore become proficient in evidence synthesis, economic evaluation, cost-utility analysis, and decision modelling without first addressing the elementary scientific question: what type of attribute is being measured, and what form of measurement is required? Until the distinction between manifest and latent attributes becomes the organizing principle of Swedish HTA education, curriculum inversion will continue to reproduce measurement inversion, limiting the scientific foundations upon which quantitative claims regarding therapy impact are constructed.

THE ABSENCE OF RASCH

The absence of the manifest-latent distinction also explains the near absence of Rasch measurement within the Swedish 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, composite indices, and quality-adjusted life years (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, health economic evaluation, and reference-case modelling before they are taught to distinguish between manifest and latent attributes. Consequently, they are never encouraged to ask the fundamental 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 Sweden this omission is particularly significant because health technology assessment plays an increasingly important role in decisions concerning the adoption, reimbursement, pricing, and evaluation of pharmaceuticals, medical devices, and healthcare interventions within a publicly funded healthcare system. The interrogation suggests that the Swedish curriculum knowledge base has adopted the methodological conventions of contemporary HTA without first establishing the scientific foundations of measurement. Until the distinction between manifest and latent attributes becomes the organizing principle of Swedish HTA education, curriculum inversion will continue to reproduce measurement inversion throughout Swedish teaching, research, and policy evaluation.

One of the most striking findings from the interrogation of the Swedish 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 Sweden has established an international reputation for evidence-based medicine, clinical epidemiology, systematic reviews, registry-based research, health services research, and health technology assessment. Yet the educational framework underpinning these activities 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 within specialist psychometric publications or methodological 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, depression, anxiety, physical functioning, treatment satisfaction, need fulfilment, and 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 Swedish 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 Swedish 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 Sweden the implications are direct. A healthcare system internationally recognized for its commitment to evidence-based healthcare should equally require that the quantities informing reimbursement and policy decisions satisfy the accepted standards of representational measurement. Until Rasch measurement assumes its proper place within Swedish 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. Curriculum inversion will therefore continue to reinforce the broader pattern of measurement inversion that characterizes contemporary HTA, limiting the scientific legitimacy of quantitative claims regarding therapy impact.

CONCLUSION: CURRICULUM INVERSION AND THE FUTURE OF HTA IN SWEDEN

The companion interrogation of the Swedish HTA knowledge base demonstrated that contemporary health technology assessment in Sweden 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 Swedish 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, patient-reported outcomes, 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 contemporary HTA framework without first acquiring the scientific framework necessary to determine whether that framework supports lawful quantitative claims.

For Sweden this conclusion has important implications. Swedish universities, research institutes, and health authorities have earned an international reputation for rigorous clinical research, evidence-based medicine, registry-based epidemiology, systematic reviews, and health technology assessment. The interrogation indicates, however, that the educational framework supporting contemporary HTA has adopted the analytical conventions of the international reference-case paradigm without first embedding the scientific principles of representational measurement. The consequence is that curriculum inversion has become the mechanism through which measurement inversion is reproduced within Swedish HTA. Utilities, QALYs, cost-effectiveness ratios, and reference-case simulation models continue to occupy a central position in professional education despite depending upon quantities that fail the accepted requirements for lawful measurement.

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 statistical methods, expanded real-world evidence, richer national registry data, or increasingly elaborate simulation techniques. None of these developments can create measurement where measurement does not exist. Arithmetic cannot rescue quantities that are not measures. Decades of methodological refinement have failed to resolve this problem because the problem lies beneath the methodology itself, in the absence of lawful measurement.

The implications for Swedish 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 rather than perpetuate analytical traditions whose measurement foundations cannot support quantitative claims. Students should certainly understand the historical importance of utilities, QALYs, patient-reported outcome instruments, 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 methodological framework underpinning Swedish HTA has reached its intellectual limit. It has undoubtedly succeeded in strengthening evidence synthesis and standardizing administrative decision making, yet it has failed to establish the scientific legitimacy of the quantities upon which those decisions depend. That framework has no scientific future because it rests upon measurement impossibilities. Its place is no longer at the centre of HTA education but in the history of the discipline as an instructive example of how methodological sophistication can evolve independently of measurement science. The future of Swedish HTA therefore depends not upon refining the existing paradigm but upon replacing it with one founded on representational measurement, lawful quantitative inference, and empirically evaluable claims regarding therapy impact.

To facilitate this transition, Maimon Research LLC has developed a comprehensive nine-unit HTA Reconstruction Program [5]. 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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REFERENCES

[1] Sweden: TLV rejects representational measurement. Logit Working Paper No 231. https://maimonresearch.com/logit-working-paper-no-231-february-2026-rev-8/

[2] Stevens S. On the Theory of Scales of Measurement. *Science*. 1946;103(2684):677-80

[3] Krantz D, Luce R, Suppes P, Tversky A. Foundations pf Measurement Vol 1: Additive and Polynomial Representations. New York: Academic Press, 1971

[4] Bond T, Zi Yan, Heene M. Applying the Rasch Model: Fundamental Measurement in the Human Sciences (4th Ed). New York Routledge, 2021

[5] Maimon Research. HTA Reconstruction. https://maimonresearch.com/hta-reconstruction-program-and-fees/