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ARTIFICIAL INTELLIGENCE LARGE LANGUAGE MODEL INTERROGATION

REPRESENTATIONAL MEASUREMENT FAILURE IN HEALTH TECHNOLGY ASSESSMENT

AUSTRIA: CURRICULUM INVERSION IN HEALTH TECHNOLOGY ASSESSMENT

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ABSTRACT

The document argues that Austrian HTA is characterized by curriculum inversion: the methods of the reference-case paradigm are taught before the scientific principles required to determine whether those methods can support lawful quantitative claims. Drawing upon a large language model interrogation of the Austrian curriculum knowledge base, the study evaluates the extent to which the educational foundations of HTA recognize the concepts required by representational measurement. These include specification of the target attribute, the principal scales of measurement, admissible arithmetic, representational measurement, unidimensionality, the distinction between manifest and latent attributes, lawful ratio measurement, Rasch measurement for latent constructs, and the requirement that therapy-impact claims be prospectively evaluable, independently replicable, and capable of falsification.

The interrogation employs ten canonical statements representing the minimum scientific foundations expected in a curriculum committed to quantitative assessment. Across all statements, endorsement is consistently weak. The Austrian curriculum knowledge base gives priority to evidence synthesis, comparative effectiveness, health economic evaluation, utilities, QALYs, decision modelling, and reimbursement methodology while providing little recognition of the measurement principles upon which those methods depend. The findings closely parallel those of the companion interrogation of the Austrian methodological knowledge base, where measurement inversion was shown to characterize HTA practice. Together, the two studies demonstrate that curriculum inversion provides the educational mechanism through which measurement inversion is reproduced across successive generations of researchers, practitioners, consultants, and policy advisers.

The paper argues that this omission is not a minor curricular deficiency but a fundamental scientific failure. Without lawful measurement, arithmetic cannot generate valid quantitative claims, regardless of the sophistication of the statistical or simulation methods employed. Utilities, QALYs, and reference-case models therefore remain numerical constructions rather than scientifically defensible measures of therapy impact. Teaching these methods without first establishing the standards of representational measurement leaves students technically proficient in analytical procedures while lacking the conceptual framework necessary to evaluate their scientific legitimacy.

The study concludes that Austrian HTA requires educational reconstruction rather than incremental methodological refinement. A measurement-based curriculum should begin with attributes, representational measurement, scale theory, unidimensionality, the distinction between manifest and latent attributes, and the application of linear ratio and Rasch logit ratio measurement before introducing economic evaluation and decision modelling. Austria possesses the academic expertise to lead this transition. By restoring measurement to its proper place as the foundation of quantitative science, Austrian universities and HTA institutions can strengthen both the scientific integrity of national HTA and their contribution to the future development of measurement-based health technology assessment throughout Europe.

INTRODUCTION

A large language model interrogation of the Austrian health technology assessment knowledge base has demonstrated strong endorsement of measurement inversion [i]. Across HTA agencies, academic research groups, public health institutes, university teaching, professional training, and methodological publications, the same pattern emerges: the scientific principles required for lawful quantitative measurement receive little recognition, while utilities, QALYs, cost-effectiveness analysis, and decision-analytic modelling are treated as though they provide scientifically valid measures of therapy impact. These findings indicate that measurement inversion is not confined to a particular institution or program but characterizes the Austrian HTA knowledge base as a whole.

The present paper addresses the complementary question of whether this pattern of measurement inversion is accompanied by curriculum inversion. This is a critical issue because HTA practice is not reproduced spontaneously. It is reproduced through education, professional training, doctoral supervision, methodological guidance, workshops, agency procedures, and the wider academic literature. If students and practitioners are introduced to the techniques of HTA before they are introduced to the scientific standards required to evaluate those techniques, then curriculum inversion becomes the mechanism through which measurement inversion is sustained.

Austria provides an important case for this interrogation. The Austrian Institute for Health Technology Assessment, UMIT Tirol, the Medical University of Vienna, the Institute for Advanced Studies, the Austrian National Public Health Institute, and associated university and policy networks together constitute a sophisticated HTA and health economics environment. Austria is not methodologically isolated. Its HTA community is closely linked to European assessment traditions, evidence-based medicine, decision analysis, health economics, EUnetHTA experience, and the emerging European Union HTA framework. For that reason, the Austrian curriculum knowledge base is not merely a national concern. It is part of the wider European educational environment through which contemporary HTA methods are transmitted and legitimized.

The purpose of the present interrogation is to determine whether the Austrian HTA curriculum knowledge base introduces students and practitioners to the scientific foundations of measurement before presenting the established methods of contemporary HTA. In particular, the interrogation asks whether curricula and training materials begin with specification of the target attribute, the principal scales of measurement, the axioms of representational measurement, unidimensionality, the distinction between manifest and latent attributes, lawful ratio measurement, Rasch measurement for latent constructs, and the requirement that therapy-impact claims be prospectively evaluable, independently replicable, and capable of falsification.

The results demonstrate a consistent pattern of curriculum inversion. Across the ten canonical statements, the foundational concepts required for quantitative science receive uniformly weak endorsement. By contrast, the curriculum knowledge base emphasizes evidence synthesis, comparative effectiveness, health economic evaluation, utilities, QALYs, modelling, reimbursement relevance, and policy support. Students and practitioners are therefore taught how to apply the accepted procedures of HTA before they are taught the measurement standards required to determine whether those procedures can support lawful quantitative claims.

These findings closely parallel those of the companion paper on measurement inversion. There, the Austrian HTA methodological knowledge base was shown to endorse analytical methods that fail the accepted standards of representational measurement. Here, the educational knowledge base is shown to reproduce those same assumptions by transmitting methodological practice without first establishing its scientific foundations. Curriculum inversion therefore emerges as the educational mechanism through which measurement inversion is institutionalized and perpetuated within Austrian health technology assessment.

STANDARDS FOR MEASUREMENT

The starting point for any scientific discipline that seeks to make quantitative claims is measurement. Before quantities can be manipulated mathematically, it must first be demonstrated that they possess the properties necessary to support the proposed arithmetic operations. This principle is fundamental to both the physical and social sciences. Measurement precedes arithmetic. Quantitative claims are valid only when the quantities involved satisfy the requirements of measurement. If these requirements are absent, arithmetic operations may still be performed, but the resulting outputs have no scientific standing as measures.

The importance of this principle is reflected in the theory of measurement scales [ii]. Not all numerical assignments possess the same properties. Nominal scales classify. Ordinal scales rank. Interval scales support differences between values. Ratio scales alone support the full range of arithmetic operations because they possess a true zero and permit proportional comparisons. Consequently, the admissibility of arithmetic depends upon scale type. Addition and subtraction require at least interval properties. Multiplication and division require ratio properties. This is not a matter of convention. It is a requirement imposed by the structure of measurement itself.

The central importance of ratio measurement follows directly from these considerations. Any claim involving multiplication, division, proportional comparison, growth rates, averages of ratios, or cost-effectiveness ratios requires quantities that possess ratio properties. If ratio measurement has not been demonstrated, these operations are inadmissible. Numerical manipulation cannot create measurement properties that are absent from the underlying scale. Arithmetic cannot substitute for measurement.

These requirements are formalized in the axioms of representational measurement [iii]. Representational measurement provides the scientific framework that links empirical observations to numerical representations. Its purpose is to ensure that numerical assignments preserve the structure of the attribute being measured. Only when this correspondence is demonstrated can arithmetic operations be regarded as meaningful. The axioms of representational measurement therefore establish the conditions under which quantitative claims can be considered scientifically legitimate.

Among the most important of these requirements is unidimensionality. Measurement requires that an attribute represent a single dimension. If multiple attributes are combined into a composite score, numerical aggregation may be possible, but measurement has not necessarily occurred. Without unidimensionality there is no assurance that a numerical value represents a coherent quantity. The distinction between aggregation and measurement is therefore fundamental. Numbers can always be combined. Measures cannot be assumed.

Equally important is the distinction between manifest and latent attributes. Manifest attributes are directly observable and, where appropriately specified, support linear ratio measurement. Latent attributes are not directly observable and require a measurement model capable of estimating possession of the attribute. In the latter case, the required measure is the Rasch logit ratio scale [iv]. These two forms of ratio measurement, linear ratio measurement for manifest attributes and Rasch logit ratio measurement for latent attributes, provide the only scientifically defensible basis for quantitative claims regarding therapy impact.

Taken together, these principles establish a clear standard. Measurement must precede arithmetic. Scale properties determine admissible operations. Ratio measurement is required wherever proportional comparisons or multiplication are involved. Unidimensionality must be demonstrated before measurement can be claimed. Representational measurement provides the governing scientific framework. Any discipline seeking to generate quantitative claims must satisfy these requirements. Without them, numerical outputs remain constructions rather than measures, and quantitative claims become matters of assumption rather than science.

CURRICULUM EXPECTATIONS

A curriculum intended to prepare students for health technology assessment should provide more than instruction in economic evaluation, evidence synthesis, utility assessment, and simulation modelling. It should equip students with the conceptual tools necessary to evaluate the scientific legitimacy of quantitative claims.

At a minimum, students should be introduced to the role of attributes in therapy assessment and the requirement that the target attribute be specified before evaluation begins. They should understand the principal scales of measurement and the implications these have for admissible arithmetic. They should be familiar with the distinction between nominal, ordinal, interval, and ratio scales and appreciate that different scales support different forms of analysis.

A scientifically grounded curriculum should also introduce students to representational measurement and its role in determining whether numerical assignments constitute valid measures. This includes an understanding of the relationship between measurement and arithmetic, the importance of unidimensionality, and the conditions required for quantitative claims.

Students should further be expected to recognize the distinction between manifest and latent attributes. Observable outcomes such as survival, hospital admissions, adverse events, and treatment persistence present different measurement challenges from latent constructs such as pain, fatigue, quality of life, functioning, and patient satisfaction. A curriculum should therefore provide an understanding of the different measurement frameworks required for these two classes of attributes.

Finally, students should be exposed to the principles of empirical evaluation and falsification. Quantitative claims should not be treated as self-validating simply because they are numerical. Rather, students should understand that scientific claims must be capable of evaluation, replication, and potential refutation through observation and evidence.

These expectations do not represent advanced or specialist topics. They constitute the foundational knowledge required for any discipline that seeks to support quantitative claims regarding therapy impact. Their presence would indicate a curriculum grounded in measurement and scientific inquiry. Their absence would suggest that students are being trained to apply analytical techniques without first acquiring the conceptual framework necessary to evaluate whether the resulting claims are scientifically defensible.

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. 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 scientific 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, reviewers, and decision makers. Curriculum inversion therefore becomes the educational mechanism through which measurement inversion is institutionalized within a discipline.

The importance of curriculum inversion extends beyond education. Universities and research centers are responsible for training the individuals who subsequently populate HTA agencies, reimbursement committees, consulting organizations, professional societies, and academic departments. If the concepts necessary to evaluate quantitative claims are absent from the curriculum, they will also be absent from research, policy, and practice. The omissions identified in educational programs therefore become embedded throughout the wider HTA environment. What begins as a curriculum deficiency ultimately becomes a disciplinary norm.

For this reason, curriculum assessment is a critical component of any evaluation of the scientific standing of HTA. 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 evaluation of those methods possible. A curriculum that emphasizes modelling, economic evaluation, utility assessment, and decision analysis while neglecting measurement theory will inevitably reproduce the same conceptual limitations observed in current HTA practice.

This is why curriculum inversion provides an important explanation for the persistence of the reference-case paradigm. Utilities, QALYs, cost-effectiveness ratios, and simulation models have survived not because their measurement foundations were demonstrated, but because the concepts required to challenge those foundations were largely absent from the educational environment. Curriculum inversion reproduces measurement inversion. Together they explain how a framework built on arithmetic before measurement could become established, institutionalized, and defended for more than four decades.

DEFINING THE AUSTRIAN KNOWLEDGE BASE

The Austrian curriculum knowledge base for health technology assessment is concentrated, technically sophisticated, and closely connected to wider European HTA methodology. It is formed through the combined educational and methodological activity of the Austrian Institute for Health Technology Assessment, UMIT Tirol, the Medical University of Vienna, the Institute for Advanced Studies, the Austrian National Public Health Institute, and associated university, policy, and professional networks. Unlike larger jurisdictions where HTA education is dispersed across many universities and research centers, Austria has a smaller but highly identifiable HTA community. This makes the curriculum knowledge base easier to define, but it also means that a relatively limited number of institutions can exercise substantial influence over how future practitioners understand HTA.

The Austrian Institute for Health Technology Assessment occupies a central position. Through its assessments, methodological reports, policy-facing work, and participation in international HTA networks, it helps define the applied language of Austrian HTA. The emphasis is on evidence synthesis, comparative effectiveness, health economic evaluation, decision support, reimbursement relevance, and the translation of evidence into policy. These are the topics most likely to be visible to students, researchers, agency staff, and professional audiences engaging with Austrian HTA.

UMIT Tirol provides the most explicit academic base for HTA teaching and training. Its work in public health, medical decision making, health services research, health economics, and HTA places it at the centre of Austrian curriculum formation. It is especially important because it links HTA to decision analysis, modelling, epidemiology, clinical evaluation, and health policy. The Medical University of Vienna, the Institute for Advanced Studies, and the Austrian National Public Health Institute further reinforce this knowledge base through health economics, public health, epidemiology, outcomes research, and health systems analysis.

The resulting curriculum knowledge base is therefore not methodologically weak in the usual sense. Austria has considerable technical competence in evidence appraisal, health economic modelling, clinical evaluation, policy analysis, and reimbursement-relevant assessment. The problem identified by the curriculum interrogation is different. It concerns the ordering of knowledge. Students and practitioners appear to encounter the established procedures of contemporary HTA before they encounter the scientific principles required to determine whether those procedures can support lawful quantitative claims.

The interrogation therefore treats the Austrian curriculum knowledge base as a collective educational environment rather than as a single syllabus. The relevant question is whether that environment gives foundational priority to attributes, target attribute specification, scale types, representational measurement, unidimensionality, the distinction between manifest and latent attributes, lawful ratio measurement, Rasch measurement, and falsifiable therapy-impact claims. The evidence suggests that it does not. Instead, the curriculum knowledge base normalizes the reference-case vocabulary of utilities, QALYs, cost-effectiveness analysis, decision modelling, and reimbursement support without first establishing whether the quantities entering those analyses satisfy the requirements of measurement.

This is the basis for identifying curriculum inversion in Austria. The Austrian curriculum knowledge base teaches the methods of HTA before teaching the measurement standards required to evaluate them. As a result, technical competence may be developed without measurement competence. In a discipline that claims to support quantitative decisions, this is not a minor educational omission. It is the mechanism through which measurement inversion is reproduced.

INTERROGATING THE CURRICULUM KNOWLEDGE BASE

The purpose of the present interrogation is not to determine what a large language model "believes." Large language models possess no beliefs, opinions, or independent understanding. Their value lies in their ability to interrogate and summarize the conceptual content of a defined knowledge base. The objective is therefore to examine the intellectual environment represented within a curriculum and to determine which concepts are present, absent, weakly represented, or strongly reinforced.

In the context of curriculum assessment, the knowledge base is defined as the totality of publicly accessible materials through which a research center communicates educational and methodological content. These materials include curriculum descriptions, course outlines, learning objectives, training programs, methodological guidance documents, workshop and seminar content, faculty publications, doctoral training resources, technical reports, conference presentations, and other educational materials associated with the institution. Taken together, these sources provide a representation of the concepts and analytical frameworks that students, researchers, and professional staff are most likely to encounter.

The interrogation therefore focuses not on individual instructors or specific courses but on the broader intellectual environment that the curriculum creates and sustains. A curriculum functions as a mechanism for transmitting knowledge across successive generations of students and researchers. Concepts that are consistently emphasized become embedded within professional practice. Concepts that are absent or weakly represented are unlikely to become part of the analytical framework employed by future practitioners. The curriculum knowledge base therefore provides an important indicator of the intellectual foundations of a discipline.

For the purposes of the present assessment, the objective is straightforward: to determine the extent to which the curriculum knowledge base recognizes and reinforces the concepts required for a measurement-based approach to health technology assessment. Particular attention is given to attributes, measurement scales, representational measurement, admissible arithmetic, unidimensionality, the distinction between manifest and latent attributes, ratio measurement, Rasch measurement, and the requirement that scientific claims be evaluable and potentially falsifiable. These concepts constitute the foundational framework necessary for evaluating the validity of quantitative claims.

The interrogation proceeds through a series of canonical statements representing concepts that would be expected to appear within a curriculum grounded in measurement science. The resulting endorsement probabilities provide an indication of the extent to which these concepts are embedded within the curriculum knowledge base. High endorsement probabilities suggest that the concept is visible and reinforced within the educational environment. Low endorsement probabilities suggest that the concept is absent, weakly represented, or largely ignored.

The significance of this approach is that it allows the curriculum to be evaluated as a coherent intellectual system rather than as a collection of individual courses. The question is not whether students are taught contemporary HTA methods. The question is whether they are taught the concepts necessary to evaluate the scientific legitimacy of those methods. The resulting profile provides a measure of the extent to which the curriculum supports, neglects, or potentially undermines the foundations of measurement-based scientific inquiry.

TOOLS FOR INTERROGATION

The identification of measurement inversion across HTA research centers, reimbursement agencies and academic programs raises an obvious question: where does this inversion originate?

The objective of 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 these UK 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.

ENDORSEMENT OF CURRICULUM INVERSION IN AUSTRIA

The Austrian curriculum knowledge base demonstrates a strong pattern of curriculum inversion. Across the ten canonical statements, the concepts required for measurement-based HTA receive consistently weak endorsement. Austrian HTA education and training appear to emphasize evidence synthesis, comparative effectiveness, health economic evaluation, decision analysis, cost-effectiveness, reimbursement relevance, and policy support before establishing the measurement foundations required for lawful quantitative claims.

This finding is important because Austria has a sophisticated HTA and health economics environment. The Austrian Institute for Health Technology Assessment, UMIT Tirol, the Medical University of Vienna, the Institute for Advanced Studies, and the Austrian public health infrastructure contribute to a technically advanced knowledge base. The weakness identified by the interrogation is therefore not technical inadequacy. It is the ordering of the curriculum. Students and practitioners are introduced to the procedures of HTA before they are introduced to the standards required to determine whether the quantities entering those procedures are measures.

TABLE 1: CURRICULUM CONTENT ENDORSEMENT - AUSTRIA

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	0.15	-1.75
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	0.15	-1.75
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 weakest results concern the axioms of representational measurement and the distinction between the ratio requirements for manifest and latent attributes. These are decisive omissions. If representational measurement is absent, there is no explicit framework for determining whether numerical assignments preserve the structure of the attribute being measured. If manifest and latent attributes are not distinguished, observable clinical endpoints, patient-reported outcomes, utilities, QALYs, preference weights, and model outputs can all be treated as though they possess comparable measurement status.

The results also indicate weak recognition that the measurement status of the target attribute must be established before quantitative claims are advanced. This is the core of curriculum inversion. The curriculum develops competence in applying HTA methods without first developing competence in evaluating whether those methods can support lawful quantitative claims.

The implication for Austria is clear. HTA education should be reconstructed around first principles: specification of the target attribute, scale type, representational measurement, unidimensionality, the manifest-latent distinction, lawful ratio measurement, and falsifiable therapy-impact claims. Without this reconstruction, Austrian HTA education will continue to reproduce measurement inversion through curriculum inversion.

STATEMENT-BY-STATEMENT REVIEW

Statement 1. An attribute is the specific outcome of interest in a therapy assessment. Probability 0.20 (Logit –1.40)

The Austrian curriculum knowledge base demonstrates only limited recognition that every quantitative assessment must begin by identifying the attribute to be measured. Discussion is generally organized around concepts such as clinical effectiveness, patient-reported outcomes, quality of life, economic evaluation, or value assessment rather than around the explicit specification of the target attribute. Consequently, the attribute itself is not presented as the central scientific object of measurement upon which all subsequent analysis depends.

Statement 2. Every therapy assessment begins with specification of the target attribute. Probability 0.15 (Logit –1.75)

The interrogation indicates that Austrian HTA education introduces students to evidence assessment, comparative effectiveness, economic evaluation, and reimbursement methodology before emphasizing specification of the target attribute. The logical sequence required by representational measurement is therefore reversed. Rather than first defining what is to be measured, the curriculum proceeds directly to the analytical methods used to evaluate therapies.

Statement 3. The principal scales of measurement (nominal, ordinal, interval and ratio) have different properties and support different forms of analysis.
Probability 0.15 (Logit –1.75)

Recognition of the principal scales of measurement is weak. Statistical analysis receives considerable attention, yet there is little indication that students are taught that the admissibility of arithmetic depends upon the measurement properties of the underlying scale. Without this understanding, numerical analyses may be accepted simply because they are mathematically sophisticated rather than because they are scientifically admissible.

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 one of the weakest endorsements. The curriculum appears to assume that numerical outputs generated from clinical studies, utilities, questionnaires, composite indices, or economic models already constitute measures. The prior scientific requirement—that the measurement properties of the target attribute must first be demonstrated—is largely absent. Measurement is effectively assumed rather than established.

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

This represents the strongest evidence of curriculum inversion. The interrogation found virtually no recognition that quantitative claims derive their legitimacy from the axioms of representational measurement. Concepts such as admissible transformations, dimensional homogeneity, cancellation, solvability, and empirical relational structures are largely absent from the curriculum knowledge base. Quantitative analysis therefore proceeds without explicit reference to the scientific principles that make quantitative analysis possible.

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

The concept of unidimensionality receives little explicit attention. Patient-reported outcomes and quality-of-life instruments are discussed largely in terms of reliability, validity, responsiveness, or preference weighting rather than whether they measure a single latent attribute. Yet without demonstration of unidimensionality, quantitative measurement of latent constructs cannot be justified.

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

The curriculum demonstrates partial recognition of observable outcomes such as mortality, hospital admissions, adverse events, laboratory measurements, treatment persistence, and healthcare resource utilization. However, these outcomes are rarely presented explicitly as manifest attributes possessing their own measurement properties. Consequently, the conceptual importance of manifest measurement remains underdeveloped.

Statement 8. A latent attribute is not directly observable and requires a measurement model to estimate possession of the attribute.
Probability 0.15 (Logit –1.75)

Although Austrian HTA education recognizes patient-reported outcomes, quality of life, and other subjective constructs, there is little evidence that students are taught that these represent latent attributes requiring an explicit measurement model. The curriculum generally proceeds directly from ordinal questionnaire responses to scoring systems, utilities, or composite indices without first addressing the measurement problem itself.

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

This is the weakest conceptual area identified by the interrogation. There is virtually no indication that Austrian curricula distinguish between the measurement requirements of observable and latent attributes. The unique roles of linear ratio measures for manifest attributes and Rasch logit ratio measures for latent attributes are absent. This omission removes one of the principal scientific foundations for lawful quantitative assessment and permits fundamentally different forms of evidence to be treated as though they possess equivalent measurement properties.

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

The curriculum demonstrates only weak recognition that quantitative claims should be prospectively evaluable, independently replicable, and capable of falsification. While evidence-based medicine emphasizes critical appraisal and uncertainty, there is little indication that individual therapy-impact claims are expected to function as scientific hypotheses open to empirical refutation. Instead, attention is directed toward interpretation of published evidence and model outputs rather than construction of claims capable of subsequent empirical testing. This completes the pattern of curriculum inversion identified throughout the Austrian HTA knowledge base.

MANIFEST AND LATENT ATTRIBUTES: THE MISSING FOUNDATION OF AUSTRIAN HTA

A central finding of the Austrian 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 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 Austrian 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, health-related quality of life, clinical effectiveness, utility assessment, health economics, economic evaluation, outcomes research, and health-services research. 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 class 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, clinical observations, resource-use counts, and modelled outcomes are brought together within the same analytical framework despite possessing fundamentally different measurement properties. A numerical value becomes sufficient evidence of quantity. The consequence is a loss of measurement discipline in which numerical construction is mistaken for quantitative measurement.

For Austria, this omission is particularly striking. Austrian universities and research institutions have substantial traditions in medicine, psychology, statistics, epidemiology, health economics, outcomes research, and health-services research. Austria has also developed a visible institutional presence in HTA and evidence-based health-policy assessment. The scientific expertise required to recognize the distinction between directly observable and latent attributes is therefore available within the Austrian academic and research environment. Yet this expertise has not reorganized mainstream HTA education around the target attribute and the form of measurement required.

There is an additional historical irony. Rasch measurement is not an obscure or inaccessible methodological tradition within the wider Central European scientific environment. Georg Rasch's contribution to measurement is well established internationally, and Rasch methods are encountered in psychometrics, psychology, educational measurement, rehabilitation, and outcomes research. Yet within Austrian HTA, Rasch does not occupy the foundational position required for the measurement of latent therapy attributes. The problem is not simply that Rasch is unknown. It is that the implications of Rasch measurement for the structure of HTA have not been recognized.

Austria's position within the wider European HTA environment adds a further dimension. Universities, research institutions, assessment bodies, health economists, consultants, and the pharmaceutical sector operate within an analytical framework strongly influenced by European and international conventions. Utilities, QALYs, cost-effectiveness analysis, patient-reported outcomes, and model-based assessment enter teaching and professional practice as accepted methods. European methodological cooperation reinforces these conventions and encourages harmonization around established analytical procedures. The prior requirement to establish the measurement status of the quantities entering those procedures remains absent.

Austria has therefore absorbed and institutionalized a wider HTA framework in which the manifest–latent distinction was never established as a foundational organizing principle. Technical expertise in statistics, epidemiology, psychometrics, health economics, and clinical research cannot compensate for failure to ask the prior measurement question. Sophisticated analytical methods applied to quantities whose measurement status has not been established remain scientifically inadmissible.

If the distinction between manifest and latent attributes remains absent from Austrian HTA education, the same omission will continue to be reproduced across health-economic research, patient-reported outcome assessment, economic evaluation, reimbursement analysis, consultancy, and professional practice. Austria's challenge is not simply to add measurement theory or Rasch analysis as specialist topics within an established curriculum. It is to reorganize HTA education around the nature of the target attribute itself. Manifest attributes require linear ratio measurement. Latent attributes require Rasch logit ratio measurement. Until this distinction becomes an organizing principle of Austrian HTA education, curriculum inversion will continue to reproduce the measurement inversion embedded within contemporary European HTA.

THE ABSENCE OF RASCH IN AUSTRIAN HTA

The absence of the manifest–latent distinction also explains the marginal position of Rasch measurement within the Austrian HTA curriculum knowledge base. If latent attributes are not explicitly recognized as presenting a distinct measurement problem, there is no perceived requirement to introduce the one measurement framework capable of constructing lawful quantitative measures of latent attribute possession. Instead, ordinal questionnaire responses are scored, aggregated, transformed into composite indices and utility values, and subsequently incorporated into quality-adjusted life years (QALYs) as though measurement has already been achieved. The measurement problem is therefore bypassed rather than solved.

From the perspective of curriculum design, this represents curriculum inversion. Students and practitioners are introduced to patient-reported outcomes, health-related quality of life, utility assessment, QALYs, health economic evaluation, cost-effectiveness analysis, and model-based assessment before they are required to distinguish between manifest and latent attributes. Consequently, they are not systematically encouraged to ask the fundamental scientific question that should precede every HTA assessment: What is the target attribute, is it manifest or latent, and which lawful form of ratio measurement is required?

For Austria, this omission is particularly significant. Austrian universities and research institutions possess substantial expertise in psychology, psychometrics, rehabilitation, outcomes measurement, epidemiology, biostatistics, health economics, and clinical research. Rasch methods and latent trait approaches are not unknown within the Austrian academic knowledge base. They may be encountered in specialist psychometrics, psychology, educational measurement, rehabilitation, instrument development, and patient-reported outcome research. The scientific expertise required to recognize the latent measurement problem therefore exists. Yet it has not reorganized mainstream Austrian HTA around the requirements of measurement.

This creates a disciplinary separation similar to that observed in other technically advanced HTA systems. Psychometric researchers address dimensionality, item functioning, invariance, response-category performance, and latent trait estimation. Health economists and HTA practitioners address utilities, QALYs, cost-effectiveness ratios, economic evaluation, evidence assessment, and model-based claims. The two traditions coexist, but the measurement requirements recognized within psychometrics do not govern the arithmetic accepted within HTA. The prior question of whether a latent attribute has actually been measured disappears between disciplinary boundaries.

Austria's established involvement in HTA and evidence-based health-policy assessment makes this separation particularly important. The development of institutional expertise in technology assessment, systematic evidence evaluation, health economics, and policy analysis has created a sophisticated analytical environment. Yet methodological sophistication has not been accompanied by a prior requirement to establish measurement status. The capacity to evaluate evidence rigorously has therefore coexisted with acceptance of utilities, QALYs, and modelled claims whose measurement foundations remain unestablished.

This places Rasch in a unique position. Rasch is not simply another psychometric technique competing with item response theory, PROMIS, classical test theory, utility instruments, or preference-based scoring systems. It addresses a prior 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 do not create measurement. Averages do not create measurement. Statistical weights and econometric coefficients do not create measurement. Utility algorithms and preference functions do not create measurement. Numerical manipulation cannot substitute for demonstrating that the underlying latent attribute has been measured.

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

The interrogation indicates that this perspective is not embedded within the Austrian HTA curriculum knowledge base. Rasch methods may be present within specialist psychometrics, psychology, rehabilitation, outcomes measurement, or instrument-development research, but they do not occupy the required foundational position within mainstream health economics and HTA education. Students and practitioners can be introduced to patient-reported outcomes, multiattribute health-status instruments, utilities, preference weights, QALYs, and economic evaluation without first confronting the latent measurement problem. The educational sequence moves directly from ordinal responses to scoring systems, valuation procedures, econometric algorithms, and economic models. The essential intermediate step of demonstrating that a latent attribute has been measured is bypassed.

The implications are particularly serious because the failure is sequential. Ordinal responses to multidimensional health-state instruments enter preference-valuation procedures. Numerical values assigned to selected health states are used in econometric models, where estimated coefficients are interpreted as utility weights or decrements. These values are subsequently applied to health-state responses and treated as quantitative utilities. Utilities are then multiplied by time to construct QALYs, incremental costs are divided by incremental QALYs to create cost-effectiveness ratios, and the resulting quantities are propagated through simulation models. At every stage involving multiplication or division, ratio measurement is required. That requirement has not been demonstrated. Each inadmissible operation therefore becomes the numerical input to the next.

For Austria, this conclusion cannot readily be explained by a simple absence of methodological expertise. The relevant expertise exists within a scientifically sophisticated academic and research environment. The failure lies in its compartmentalization. Measurement science has remained peripheral to mainstream HTA, while health economics and evidence assessment have proceeded as though numerical construction and statistical sophistication were sufficient evidence of measurement.

The absence of Rasch measurement is therefore not simply a gap in specialist psychometric teaching. It represents the failure of Austrian HTA education to apply available measurement science to the assessment of latent therapy outcomes. Until Rasch logit ratio measurement occupies its required foundational position, students will continue to learn how to generate utilities, construct QALYs, and populate economic models without first learning how possession of a latent attribute is measured. In Austria, the issue is not lack of access to measurement knowledge. It is the failure to require that knowledge as the foundation for quantitative claims regarding therapy impact.

CONCLUSION: CURRICULUM INVERSION AND THE FUTURE OF HTA IN AUSTRIA

The companion interrogation of the Austrian health technology assessment (HTA) knowledge base demonstrated that contemporary HTA in Austria is characterized by measurement inversion. The accepted principles of representational measurement receive little recognition, while utilities, quality-adjusted life years (QALYs), cost-effectiveness analysis, and model-based economic evaluation 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 this framework is transmitted, sustained, and reproduced across successive generations of practitioners. The answer is curriculum inversion.

The interrogation demonstrates that the Austrian 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, health economics, economic evaluation, utilities, QALYs, decision modelling, evidence synthesis, patient-reported outcomes, and health-policy assessment 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. Technical competence is therefore developed without the prior measurement framework necessary to determine whether the resulting quantitative claims are scientifically admissible.

For Austria, this conclusion is particularly significant. Austrian universities and research institutions have substantial traditions in medicine, psychology, psychometrics, epidemiology, biostatistics, clinical research, health economics, outcomes research, and health-services research. Austria has also developed an established institutional presence in HTA, evidence assessment, and evidence-based health-policy analysis. Measurement failure cannot therefore be explained simply by an absence of scientific or methodological expertise. The knowledge required to recognize the limitations imposed by scales of measurement, the distinction between observable and latent attributes, and the problems associated with ordinal observations exists within the wider Austrian academic system.

The failure lies in the compartmentalization of that expertise. Measurement science, psychometrics, health economics, and HTA have developed as partially separated analytical traditions. Psychometric researchers may examine dimensionality, invariance, item functioning, local independence, response-category performance, and latent trait estimation, while health economists and HTA practitioners construct utilities, QALYs, cost-effectiveness ratios, and modelled claims. The measurement requirements recognized in one field do not govern the arithmetic accepted in another. The result is a technically sophisticated assessment environment in which quantities whose measurement status has never been established continue to be manipulated as though they were lawful measures.

This is particularly striking given Austria's emphasis on evidence-based assessment. The capacity to evaluate clinical evidence, undertake systematic reviews, assess comparative effectiveness, and critically examine methodological quality has developed alongside an apparent failure to subject the constituent quantities of economic evaluation to equivalent scrutiny. Evidence may be evaluated rigorously while measurement is assumed. Yet no amount of methodological discipline applied after measurement failure can repair the failure itself. If the quantities entering an analysis are not measures, the sophistication of the subsequent evidence assessment is irrelevant to their quantitative legitimacy.

Curriculum inversion is the mechanism through which this separation is reproduced. Students encounter patient-reported outcomes, health-related quality of life, utility assessment, QALYs, cost-effectiveness analysis, and model-based evaluation as established components of HTA. They are not first required to specify the target attribute, determine whether it is manifest or latent, and establish the appropriate form of ratio measurement. The educational sequence therefore moves from observation to numerical representation and then directly to arithmetic and modelling. The essential intermediate question—has measurement actually been achieved?—is bypassed.

The failure is sequential and cumulative. Ordinal responses to multidimensional health-state instruments enter preference-valuation procedures. Numerical values are assigned to health states and incorporated into econometric models, where estimated coefficients are interpreted as utility weights or decrements. These values are treated as quantitative utilities and multiplied by time to construct QALYs. Incremental costs are divided by incremental QALYs to create cost-effectiveness ratios, and these already compromised quantities are propagated through simulation models. At every critical stage involving multiplication or division, ratio measurement is required. That requirement has not been demonstrated. Each inadmissible operation therefore becomes the input to the next.

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 or econometric methods, expanded real-world evidence, richer health 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. The problem lies beneath the methodology itself.

The implications for Austrian universities are therefore direct. Continuing to educate students in utility assessment, QALY construction, cost-effectiveness analysis, and model-based economic evaluation without first teaching the scientific principles governing lawful measurement is incompatible with the central purpose of higher education. Students should certainly understand the historical importance of utilities, QALYs, patient-reported outcome instruments, cost-effectiveness analysis, and reference-case methods. They should, however, understand them as components of a paradigm that failed to satisfy the accepted requirements of quantitative measurement. They should not be taught that these constructs provide valid measures of therapy impact because they do not.

The implications extend beyond universities. Austrian HTA and health-policy assessment activities, university research groups, health economists, outcomes researchers, consultants, social insurance institutions, and the pharmaceutical sector depend upon practitioners trained to construct, review, and interpret economic evaluations and modelled claims. Austria's engagement with wider European HTA further reinforces these methodological conventions. Universities teach the accepted methods; researchers refine them; manufacturers and consultants construct analyses within the same framework; assessment and policy institutions interpret those analyses using related conventions; and professional demand reinforces the curriculum. At no point is there a systematic requirement to return to the prior scientific question: are the quantities being manipulated lawful measures?

The only scientifically defensible path forward is reconstruction. Every HTA assessment 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 Austrian HTA has reached its intellectual limit. It has undoubtedly contributed to evidence synthesis, comparative effectiveness assessment, economic evaluation, and health-policy decision making. It has not, however, established the scientific legitimacy of the quantities upon which its central quantitative claims depend. The sophistication of evidence assessment cannot compensate for the absence of lawful measurement. A framework constructed upon measurement impossibilities has no scientific future.

Austria now faces a particularly uncomfortable choice. It can continue to reproduce measurement inversion through a curriculum that separates measurement science from HTA practice, or it can apply to HTA the standards of scientific measurement that should govern quantitative claims throughout the sciences. The future of Austrian HTA depends not upon further refinement of utilities, QALYs, cost-effectiveness ratios, and simulation models, but upon replacing them with a framework founded on representational measurement, lawful quantitative inference, and prospectively evaluable, independently replicable, and falsifiable claims regarding therapy impact. For Austria, the problem is not the absence of scientific expertise. The expertise exists. The question is whether Austrian HTA is prepared to require it.

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

[i] Austria: Institute for Health Technology Assessment (AIHTA) and the operationalizing of false measurement/ Logit Working Paper No 244. https://maimonresearch.com/logit-working-paper-no-244-february-2026-rev-8/

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

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

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

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