Academic Research News
Peer-Reviewed Journal

Volume 3, Issue 2, December 2025 **E-ISSN: 2584-167X**

Parameters for Outcome-Based Education Question Setting for Arts and Science Disciplines

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Abstract

The shift towards outcome-based Education (OBE) has altered the situation of higher Education by demanding a corresponding transformation in assessment practices. This paper argues that the traditional, often intuitive, method of setting examination questions is no longer sufficient to measure the complex learning outcomes expected of graduates in Arts and Science disciplines. The challenge lies in designing questions that move beyond the mere recall of factual information to assess higher-order cognitive skills such as analysis, synthesis, and evaluation. This paper proposes a structured framework of parameters to guide the creation of such questions. It delineates a set of core principles that includes cognitive rigour, disciplinary authenticity, and constructive alignment, and translates these into practical parameters for question design. For the Sciences, the focus is on parameters that assess experimental design, data interpretation, and problem-solving. For the Arts, the emphasis is on parameters evaluating critical analysis, contextual understanding, and creative synthesis. The paper further explores the challenges of implementation, including faculty development and the logistical difficulties of marking, before concluding with a discussion of the critical role of feedback loops in refining the question-setting process. Ultimately, this paper contends that a systematic, parameter-driven approach to question setting is essential for ensuring that assessments are valid, reliable, and effective instruments for measuring and promoting genuine learning.

Keywords: Outcome-Based Education, Assessment Design, Higher-Order Thinking, Question Setting, Disciplinary Pedagogy.

Introduction

The modern university is no longer a place for the passive transmission of knowledge. The prevailing pedagogical philosophy, known as Outcome-Based Education (OBE), has shifted the focus from what the teacher teaches to what the student can do by the end of a programme of study (Spady 12). This profound shift has placed assessment at the very heart of the educational process. It is not merely a concluding event but a fundamental component of the learning cycle, providing evidence of student achievement and, when designed effectively, a powerful driver for learning itself (Boud and Falchikov 400). The core of this transformation rests on the design of assessment tasks, most critically the questions posed to students in formal examinations. In the arts and science disciplines, these questions must be meticulously crafted to serve as valid measures of the specific, pre-defined learning outcomes.

The problem this paper addresses is the persistent gap between the rhetoric of OBE and the reality of examination questions. In many institutions, questions still predominantly test lower-order cognitive skills, such as memorisation and simple comprehension, even when the stated outcomes aim for higher-order abilities like critical thinking, problem-solving, and creativity (Krathwohl 212). This creates a fundamental dissonance. A student

Volume 3, Issue 2, December 2025 E-ISSN: 2584-167X

can memorise a scientific formula or a historical date perfectly yet be entirely incapable of applying that knowledge to a new problem or evaluating a historical source. This paper argues that the solution lies in establishing a clear and practical set of parameters for question setting. These parameters act as a guide for educators, ensuring that every question is intentionally designed to elicit evidence of a specific learning outcome. The purpose of this paper is to propose such a framework, outlining parameters that are rigorous, practical, and adaptable to the distinct epistemological cultures of the arts and sciences. To achieve this, the paper will first establish the theoretical foundations by linking the principles of OBE with established theories of cognitive development. It will then propose a set of generic parameters applicable across disciplines before delving into the specific nuances of question design for the sciences and the arts. Subsequently, it will address the practical challenges inherent in this approach, and finally, it will underscore the importance of a feedback loop for continuous improvement. By moving from abstract theory to practical parameters, this paper aims to provide a concrete guide for educators seeking to align their assessment practices with the transformative goals of outcome-based Education.

Learning Outcomes to Assessment Questions

The connection between a stated learning outcome and an examination question is not always direct. The bridge between them is built upon two key theoretical pillars: the structure of cognitive processes and the principle of constructive alignment. Understanding these foundations is essential before any practical parameters can be established. The most influential model for understanding cognitive skills remains Bloom's Taxonomy, particularly the revised version by Anderson and Krathwohl. This taxonomy categorises cognitive processes into a hierarchy: remembering, understanding, applying, analysing, evaluating, and creating (Anderson and Krathwohl 45). A well-designed question must be mapped onto this hierarchy to ensure it targets the desired level of cognitive rigour. For instance, if an outcome requires a student to "critique a historical argument," a question that asks them to "list the main points of the argument" is fundamentally flawed. The former targets evaluating, while the latter targets remembering. This misalignment is a primary source of invalid assessment.

The second pillar is the principle of constructive alignment, a concept championed by Biggs. This principle posits that the curriculum, teaching methods, and assessment tasks must be aligned with the intended learning outcomes (Biggs 27). In this model, the assessment is not an add-on but the defining structure of the course. The question setter's role is to create tasks that require students to demonstrate the very outcomes that the teaching was designed to cultivate. Constructive alignment demands that the question-answer process directly reflects the stated outcome. Therefore, the primary parameter for any question is its demonstrable alignment with a specific, predetermined outcome. This principle forms the bedrock of the entire framework, guiding the design and evaluation of every assessment item.

Generic Parameters for Outcome-Based Question Setting

Before considering disciplinary specifics, it is useful to establish a set of generic parameters for question setting in both the arts and the sciences. These are the fundamental principles that ensure a question is valid, reliable, and fair. The first and most critical parameter is constructive alignment. As established, every question must be designed to provide evidence for a specific learning outcome. The question setter should be able to justify which outcome a particular question is designed to assess. This parameter prevents the common error of designing a "clever" question that lacks a clear educational purpose.

The second parameter is cognitive demand. Questions must span a range of cognitive levels, from lower-order recall to higher-order thinking. An examination should not be a test

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of memory alone. It must include questions that require students to analyse, synthesise, and evaluate information (Resnick and Resnick 15). A useful heuristic is to ensure that a significant portion of the marks is allocated to questions that require applying knowledge to new contexts or critically evaluating presented information. This parameter directly addresses the need for assessments to measure deep, transformative learning.

Third is the parameter of authenticity and context. Questions should be framed in contexts that are meaningful to the discipline. This does not mean every question must be a "real-world" scenario, but it must be "authentic" in the sense that it reflects the kinds of problems or questions that practitioners in that field would actually encounter. A history question might ask students to evaluate a primary source, a task that is central to the work of a historian. A biology question might ask students to interpret experimental data, a core skill for a biologist. This authenticity not only enhances validity but also increases student engagement.

The fourth parameter is clarity and precision of language. The question must be unambiguous. The task expected of the student should be crystal clear. Ambiguous phrasing can lead students to misinterpret the question, rendering their answers invalid evidence of their learning (Johnston 89). Using precise command words is essential. For example, "analyse" implies a different task than "describe" or "criticise." A question that asks a student to "discuss" a topic is notoriously vague; a better question would specify the angle of the discussion, for instance, by asking them to "evaluate the strengths and weaknesses of" the topic.

The fifth parameter is accessibility and fairness. The assessment should not be biased against any student group. The language and content must be accessible to all students who have had the opportunity to achieve the learning outcome (Linn and Miller 102). This means avoiding overly complex vocabulary that is not central to the discipline and avoiding assumptions about cultural knowledge that not all students possess. A fair question assesses a student's knowledge of the subject matter, not their fluency in a particular dialect or their familiarity with a specific cultural reference.

Parameters for Question Setting in the Sciences

The sciences, including the natural and physical sciences, are built on the principles of empiricism, observation, and the scientific method. Consequently, the outcomes for science students often focus on their ability to understand scientific concepts, apply them to solve problems, design experiments, and interpret quantitative data. The parameters for question setting must reflect these specific epistemic demands. A primary parameter for science questions is the incorporation of experimental design and data interpretation. A question that asks for the definition of a law or a theory assesses only recall. A more valid question would present students with a novel experimental scenario and ask them to design a procedure, identify variables, or predict the outcome based on their theoretical knowledge. For example, a biology question could present a scenario involving a new drug and ask the student to design an experiment to test its efficacy, including controls and methods for data analysis (Handelsman et al. 58). This directly assesses the outcome of applying scientific methodology. Another crucial parameter is quantitative reasoning and problem-solving. Questions in the sciences frequently involve calculations and numerical problem-solving. However, the parameter here is not just about getting the right number. A well-designed question requires the student to: 1) identify the relevant scientific principles from a word problem; 2) select and apply the correct mathematical model; 3) perform the calculation; and 4) interpret the numerical result in a scientific context. This was a key finding in a study by

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Wieman and Perkins, who argued that physics questions must move beyond plug-and-chug to genuine problem-solving (56). A question that asks a student to "calculate the pH of a solution" without a real-world context is far less effective than one that asks, "A biologist finds a fish in a stream with a pH of 4.5 and is concerned. Calculate the concentration of hydrogen ions and explain what this might mean for the fish's survival." Finally, science questions must incorporate the element of scientific communication. A scientist is not only a practitioner but also a communicator. Questions should therefore assess a student's ability to write clearly and logically about scientific topics. This could involve asking them to explain a complex concept to a layperson, justify an experimental procedure, or write a brief conclusion summarising the evidence from a set of presented data. This parameter assesses the crucial outcome of communicating scientific ideas effectively, a skill often overlooked in traditional testing.

Parameters for Question Setting in the Arts

The Arts and Humanities, which include literature, history, philosophy, and the fine arts, are concerned with the interpretation of human experience, culture, and expression. Learning outcomes in these fields typically centre on critical analysis, contextual understanding, creative and critical thinking, and persuasive argumentation. The parameters for question setting here must support the evaluation of these complex, often subjective, skills.

The central parameter for the arts is the analysis and evaluation of primary sources and texts. A history examination, for instance, should not simply ask for a narrative of events. A well-parameterised question would present a primary source, such as a letter, a newspaper editorial, or a painting, and ask the student to critically analyse its content, identify its bias, and evaluate its usefulness as a historical source (Stearns 92). This assesses the student's ability to practice the historian's craft, moving beyond mere content recall to the analytical process of interpretation. The question itself must provide the raw material for the analysis, ensuring that the assessment task is one of evaluation rather than recollection.

A second, crucial parameter is the emphasis on contextualisation and synthesis. A single text or artwork does not exist in a vacuum. A higher-order question in the arts requires the student to place a work within its broader intellectual, historical, or cultural context. For example, a question in a philosophy course might ask a student to "compare and contrast the concept of justice in the works of Plato and Rawls, and explain how each thinker's conception is a response to the social conditions of their respective eras." This question demands the synthesis of ideas from two thinkers and the application of historical context to understand them. It moves the student from simply describing each thinker's view to a more sophisticated act of analysis and synthesis.

The third parameter is the encouragement of creative and interpretive synthesis. In many arts disciplines, especially in literature and the arts, students are expected to develop their own interpretations. The questions should be open-ended enough to allow for a range of valid, well-argued responses. A question that asks a student to "analyse the use of symbolism in a poem by Seamus Heaney" is a closed task with a predetermined, "correct" answer. A more appropriate parameter-driven question might ask, "Explore how Heaney's use of symbolism in a poem of your choice contributes to its overall meaning. Support your argument with close textual reference." This question assesses the student's ability to construct a personal, evidence-based interpretation, a skill that is a cornerstone of literary study. The question must specify the task, such as "explore," "justify," or "construct an

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argument," and clarify the required evidence, thereby setting the parameters for a successful response.

Challenges and Implementation

Despite the clear theoretical advantages of a parameter-driven approach to question setting, its implementation in the real world of higher Education presents significant challenges. The first major hurdle is the need for faculty development. Many academics, particularly in research-intensive universities, are hired for their subject-matter expertise rather than for their pedagogical knowledge. The process of designing questions according to a structured framework of parameters is a skill that must be learned and practised (Fink 105). Institutions must invest in professional development workshops and resources to train faculty in the principles of OBE and the mechanics of designing outcome-based questions. Without this support, the parameters will remain a theoretical exercise.

A second challenge, which is particularly acute in the sciences, is the logistical difficulty of marking. Higher-order questions often require constructed responses, such as essays or extended problem-solving, which are more time-consuming and potentially more subjective to mark than multiple-choice questions (Bennett 36). This introduces issues of reliability. How can a department ensure that two different markers will award the same grade for the same answer to a question about the ethical implications of a scientific discovery? The solution lies in creating and using robust rubrics. A rubric that breaks down the expected elements of a response, such as "identifies the key ethical principle" or "provides a logical chain of reasoning," can guide markers and improve the consistency of marking. Rubrics are not a panacea but are an essential tool for making the marking of these complex questions reliable.

A third, more systemic challenge is the constraint of traditional examination formats. The standard three-hour, unseen written examination is not always the best format for assessing certain outcomes. An outcome related to "research skills," for instance, is arguably better assessed through a project-based portfolio or a take-home exam that allows for the use of resources. Administrators and faculty must therefore be willing to challenge the hegemony of the traditional exam and adopt more authentic and flexible assessment formats. This requires institutional will and a willingness to redesign curricula and timetables (Knight 88). For some outcomes, such as those involving complex problem-solving or creative projects, the traditional exam is an inherently flawed instrument, no matter how well parameterised the questions are.

Refining the Question-Setting Process

The process of setting outcome-based questions is not a one-off event but a cyclical one that must be continuously refined. The most crucial element of this cycle is the post-examination analysis. After an examination has been administered and marked, the data generated should be used to evaluate the quality of the questions themselves. This can be done through item analysis, which uses statistical techniques to determine whether a particular question was too easy, too hard, or failed to discriminate between high- and low-achieving students (Crocker and Algina 115). For example, if 90% of the class gets a "hard" question correct, it is likely not a difficult question at all, or the teaching was exceptionally effective. Conversely, if a question intended to be a "soft" introductory question is answered correctly by only 20% of the class, it may be poorly phrased or test an untaught skill. This data provides empirical evidence to guide revisions for future examinations. Beyond simple statistics, a deeper review involves a qualitative analysis of student answers. A sample of student responses can be examined to identify common misconceptions or misinterpretations.

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If many students provided the same incorrect answer to a question, it might indicate a flaw in the question's wording rather than a gap in their knowledge. For instance, a poorly structured question might have inadvertently led them down a wrong path (Sadler 110). This feedback is invaluable for a teacher, as it highlights not only what students do not know but also how they understood the question itself. This insight can then inform adjustments to both the wording of the question and the pedagogical strategies used in the classroom.

This process of review and revision can be formalised within a department or a teaching team. Colleagues can be invited to a "question-setting review" session, where they critique each other's drafts before they are finalised. This peer-review process can catch ambiguous language, identify questions that may inadvertently favour certain groups, and ensure that the questions are truly aligned with the intended outcomes. Ultimately, the feedback loop turns the examination from a final judgment into a diagnostic tool for continuous improvement. It demonstrates that the parameters are not a rigid set of rules but rather guidelines that are themselves subject to refinement based on evidence.

Conclusion

The transition to outcome-based Education is one of the most significant shifts in higher Education in recent decades, and its success hinges on the integrity of its assessment practices. This paper has argued that the simple act of writing an examination question is a complex pedagogical task that must be guided by a clear, principled, and practical framework. The parameters proposed here—grounded in theories of cognitive development and constructive alignment—provide such a framework. They move the question setter from an intuitive to a deliberative process, ensuring that every question is a conscious act of measuring a specific learning outcome. The paper has delineated both generic parameters applicable to all disciplines and specific parameters tailored to the distinct epistemic cultures of the sciences and the arts. In the sciences, the focus is on experimental design, quantitative reasoning, and scientific communication. In the arts, the emphasis is on critical analysis, contextualisation, and interpretive synthesis. This distinction is crucial, as it respects the nature of knowledge in each field and ensures that the assessment is authentic and valid. However, the paper also acknowledges that this approach is not without its challenges. The demands on faculty time, the logistical difficulties of marking, and the constraints of traditional examination formats are significant barriers that must be overcome through institutional support, the use of rubrics, and a willingness to innovate. Ultimately, the most important takeaway is that the question-setting process does not end when the examination is printed. It is part of a continuous feedback loop that includes statistical analysis, qualitative review of student answers, and peer critique. This cycle of design, implementation, and evaluation is essential for refining the parameters themselves and for improving the overall quality of teaching and learning. By embracing this systematic, parameter-driven approach, educators in both the arts and the sciences can create assessments that are not just tests of memory but powerful instruments for measuring and promoting the deep, transformative learning that is the ultimate goal of a university education. The journey from a simple question to a meaningful measure of student achievement is paved with thoughtful design, rigorous review and a commitment to the core values of outcome-based Education.

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Author Contribution Statement: NIL.
Author Acknowledgement: NIL.
Author Declaration: I declare that there is no competing interest in the content and authorship of this scholarly work.