

EDUCATIONAL VALUES AND SUMMATIVE ASSESSMENT A VIEW ACROSS THREE EDUCATIONAL SYSTEMS.

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Values pervade all educational assessment processes, whether it is the design of the curriculum, the assessment model or the content of the assessment and its corresponding grading. Large-scale assessment programs play an important role in the communication of values and the expectations of what is considered worthy of recognition and reward. As a consequence the design and operation of an assessment system can influence teacher behaviour and what the students consider to be important.

This paper will explore the values found in 3 different high stakes assessment regimes. The examination boards under consideration are the International Baccalaureate Diploma Programme, the Danish Upper Secondary A levels and a UK A levels examination board, in each case the unit of analysis will be mathematics assessment. A comparison of the values portrayed in each of the boards assessment policies will be provided along with a discussion of how these values influence the implemented assessment in each.

1 Introduction

Educational values are evident in the official policy documentation produced by all national and international education systems including national assessments Beyer & Apple (1998); Moon & Murphy (1999) and as Planel, Broadfoot, Osborn, Sharpe, & Ward (2000) recognises "Enshrined within the contents and form of national tests are the values of educational systems and cultures." National tests at the end of high school have a number of uses within an educational system

- that are used to rank students,
- selection process for universities,
- for teachers, a guide to the implemented aims of the course, and as such they are a teaching resource. (Adler, 2001)

Examinations are also indicators of what knowledge is valued within a system Bernstein (2000) which influences the way that teachers both perceive their role and their practice.

This paper will explore the values found in the forms of assessment in three different high stakes¹ assessment regimes. The examination boards under consideration are the

¹ Where high stakes assessment regimes is defined as one which is takes place at the end of high school and is principally used for selection purposes for tertiary education.

International Baccalaureate Diploma Programme, the Danish Upper Secondary A levels and the Assessment and Qualifications Alliance (AQA) A level examinations. A comparison of the values portrayed in each of the boards assessment policies will be provided.

2 Values

To define values is problematic. Rokeach (1973) states that “A value system is an enduring organisation of beliefs concerning preferable modes of conduct or end states of existence along a continuum of relative importance” (p.5). While Allport (1961), states that “A value is a belief upon which a man (sic) acts by preference.” (p.454), and Raths recognises the importance of values as they influence one’s behaviour (Raths et al. 1966). More recently Bishop, Clarkson, Fitzsimons, & Seah (2000) have described values as “the deep affective qualities which education aims to foster through the school subject of mathematics.” (p.155)

It is evident from the above definitions that there is little agreement on the definition of the term values though it is also apparent that there is a consensus that values are about choices that a made by a person. Also as Bishop et al. (2000) have noted there is the converse view of the educational system fostering particular values at the expense of others. These values will be evident in both the aims of the subject as stated by the examination board as well as in the assessments that are taken by the students.

Bishop (1991) in his pioneering work on values in mathematics developed three categories of values for mathematics, which were developed from the work of White (1959) categorisations of culture. To these Bishop added values for Mathematics Education which were categorised as either pedagogical or cultural which were written as contrasting pairs as shown in Table 1 below.

| Values in Mathematics | | | Values in Mathematics Education | |
|---|---|---|---|--|
| Ideology Rationalism - Objectism | Sentiment Control - Progress | Sociology Openness - Mystery | Pedagogical Formalistic – Activist Continuum Instrumental-Relational Continuum | Cultural Relevance-Theoretical Continuum Accessibility -Specialism Continuum Evaluation - Reasoning continuum |

Table 1 Values in Mathematics and Mathematics Education as found by Bishop (1991)

2.1 Values evident in mathematics assessment.

The importance of assessment is recognised by many authors including Barnes, Clarke, & Stephens (2000) who highlight the significant role that assessment plays in the curriculum when they state “It is our contention that assessment should be recognised, not as a neutral element in the curriculum, but as a powerful mechanism for the social construction of competence. The imperative is to realize and exploit the significant role that assessment plays in the process. Investment in quality assessment offers governments

and school authorities a powerful, cost-efficient means to model exemplary practice, while meeting the evaluative obligations of public accountability.” (p.625) And as Cresswell notes that "Values permeate assessment processes ... The values of the designers and operators of educational systems influence every step of the assessment process and it is possible to identify two distinct aspects of the role of values in educational assessments:

decisions concerning **what** is assessed, and
 judgments of the **quality** of students responses. (Cresswell, 1998)

The focus of this article considers what is assessed, from the perspective of the policy makers within the assessment board.

3 The forms of assessment in each of the examination boards under consideration.

Table 2 which follows contains an overview of the assessment structure in each of the examinations boards. For the International Baccalaureate and the Danish Upper Secondary A levels assessment is the same for all the mathematics subjects, though examination times may vary in length. The AQA A level’s are dependent on the specification chosen and can incorporate a coursework component.

| Assessment Design Features | International Baccalaureate | UK A Levels | Danish Upper Secondary A Level |
|-----------------------------------|--|--|---|
| Subjects Considered | Mathematical Methods SL Mathematics HL | Pure Mathematics (Specification B) | Mathematics A level 3 yr. |
| Forms of Assessment Used | 1. Two written examinations 2. Internal Assessment Component | Depending on Specification 1. Two written examinations 2. Coursework component for Specification A. | 1. Two written examinations 2. Oral Examination |
| Type and duration of Examinations | Paper 1: 1.5 hrs Paper 2: 3 hrs. Graphing calculators allowed for both papers. | Paper 1: Pure Mathematics Unit P4. Graphic Calculator allowed Paper 2: Pure Mathematics Unit P5. Scientific Calculators only. | Paper 1 Formula book and graphic calculator, 4 hours. Paper 2 no formulas, no technology, 2 hours. |
| Structure of each paper | Two papers Paper 1: 20 questions. Paper2: 5 questions from the core + 1 question from the optional section. | Two papers One paper: graphic calculator allowed. One paper: Scientific calculator only. | Two papers. Paper 1 (With aids) 7 questions approximately Paper 2 (No aids) 13 questions approximately |
| Other Assessment Components | A portfolio of assignments is to be submitted for moderation, with a sample being provided to an external moderator. | None for specification B. | Students will attend an oral examination lasting 30 minutes in which they are to answer a predetermined question for which they have had 30 minutes to prepare. |

Table 2 Overview of the assessment programmes for each of the examining boards.

3.1 International Baccalaureate

The International Baccalaureate Diploma programme caters for over 1000 schools in more than 100 countries. There are four mathematics subjects all of which include topics found in most upper high school curricula world-wide. (See Brown (1999) for further information.) There are two examinations in each of the course a short answer examination consisting of 20 questions and a longer analysis type examination including questions from the optional topics that are studied as well. In parallel with these examinations there is an internal assessment component.

The International Baccalaureate therefore provides an interesting contrast to a national system, its cross cultural mix of students and examiners as well as its three different languages it could be assumed therefore to offer a different set of values to those which appear in a national system. The international focus of the diploma and in all of the IBO's marketing literature is indicative of its appeal to an internationally mobile population seeking a credential that is acceptable around the world. (Lowe, 2000)

3.2 Written examinations in the IB.

The written examination component consists of two papers.

3.2.1 Paper 1

1. Paper 1 consists of compulsory short-response questions based on the compulsory core of the syllabus and according the subject guide the intention of Paper 1 is intended to test

candidates' knowledge across the breadth of the common core. However it should not be assumed that the separate topics from the core will be given equal weight or emphasis. (International Baccalaureate Organization, 1997)

The types of questions are described as requiring

- *A small number of steps will be needed to solve each question.*
- *Questions may be presented in the form of words, symbols, tables or diagrams, or combinations of these. (International Baccalaureate Organization, 1997)*

Instructions for how to respond to the questions on paper 1 includes "Full marks are awarded for each correct answer irrespective of the presence of working." International Baccalaureate Organization (1997, p.44). While a wrong answer with some correct working could receive partial marks.

3.2.2 Values in Paper 1

The value of **instrumentalism** is indicated by the use of the term "*A small number of steps will be needed to solve each question*" while the value of **relational** is signified by the use of the different representations as indicated by the term "*words, symbols, tables or diagrams, or combinations of these*". **Evaluation** is highlighted by the statement "Full marks are awarded for each correct answer" where it is apparent that the answer is paramount, while the method is of less importance in this case.

3.2.3 Paper 2

Paper 2, is made up of two sections,

- (a) Section A: consisting of five compulsory extended-response questions based on the compulsory core of the syllabus.
- (b) Section B: one question is to be chosen from five extended-response questions, one on each of the optional topics in the syllabus.

Questions in both sections will require extended responses involving sustained reasoning.

Individual questions may develop a single theme or be divided into unconnected parts.

Questions may be presented in the form of words, symbols, diagrams or tables, or combinations of these. Normally, each question will reflect an incline of difficulty from relatively easy tasks at the start of a question to relatively difficult tasks at the end of a question. The emphasis will be on problem-solving.

According to the mathematics guides marks will be awarded using the following categories;

Method: evidence of knowledge, the ability to apply concepts and skills, and the ability to analyse a problem in a logical manner.

Accuracy: computational skill and numerical accuracy.

Reasoning: clear reasoning, explanation and/or logical argument.

Correct statements: results or conclusions expressed in words.

3.2.4 Values evident in paper 2.

Reasoning is indicated by “*Questions in both sections will require extended responses involving sustained reasoning.*” The value of **perseverance** is indicated by the use of the term “sustained”. **Accessibility** is signified by the phrase “*Normally, each question will reflect an incline of difficulty from relatively easy tasks at the start of a question to relatively difficult tasks at the end of a question*” that is the beginning of the question will be accessible to all students but the increasing difficulty will make the later parts less accessible. It is also noted that **activist** is exemplified the need to “analyse a problem” and the ability to apply mathematics, and therefore **relevance**, is also expected within the questions. The use of terms such as concepts and skills is indicative of a **formalist** approach to mathematics while accuracy, logic and **communication** are explicitly stated within the paper 2 outline.

If there is no working (indication of method) even when a correct solution is given then the instruction is clear.

A correct answer with no indication of the method used (for example, in the form of diagrams, graphs, explanations, calculations) will normally be awarded no marks.

The use of systematic working is clearly expected in paper 2 as those students who provide evidence of this working are more likely to be rewarded over those who do not.

3.2.5 Internal assessment: The portfolio

Three pieces of work assigned by the teacher are to be completed by the student during the course. The assignments must be based on different areas of the syllabus and represent all three activities:

- (a) mathematical investigation, which is defined as enquiry leading to a general result
- (b) extended closed-problem solving, a multi-part problem leading to a specific result
- (c) mathematical modelling, the solution of a practical problem set in a real world context requiring the use of elementary mathematical modelling skills

The portfolio is internally assessed by the teacher and externally moderated by the IBO.

3.2.6 The values evident in the portfolio

The values of **activist** and **relevance** are exemplified in the terms of problem solving and modelling, while the value of **reasoning** is indicated by the term “leading to a general result. **Perseverance** is also needed for the student to provide a detailed piece of work.

3.2.7 Summary of Values evident in assessment instruments of the International Baccalaureate

Mathematics assessment within the International Baccalaureate can therefore be categorised under the following headings Table 3.

| Values in the International Baccalaureate Mathematics Programmes |
|---|
| Accessibility |
| Activist |
| Communication |
| Evaluating |
| Formalistic |
| Instrumental |
| Perseverance |
| Reasoning |
| Relational |
| Relevance |

Table 3 Values found in the International Baccalaureate Assessment Programme

3.3 Denmark A levels

The Danish National Curriculum for Gymnasiums is made up of three mathematics subjects

- Matematisk Linje 3-Årigt Forløb Til A-Niveau, (three year A level, for students studying the Mathematics line)
- Matematisk Linje Og Sproglig Linje 2-Årigt Forløb Til B-Niveau, (two year B level mathematics course for students completing either the mathematics line or the language line)
- Matematisk Linje 1-Årigt Forløb Til A-Niveau, (a one year course for those wishing to transfer from the B level to A level)

3.3.1 The aims for the three year A level curriculum

The aims of the mathematics curriculum are

- (a) The students should gain an understanding of a number of fundamental mathematical modes of thinking, concepts and methods.
- (b) The students should become familiar with mathematics as a means of formulating, analysing and solving problems in various areas of the subject.
- (c) The students should further develop their ability to use mathematical concepts and methods on their own, and they should become able to acquaint themselves with, analyse and evaluate problems that can be formulated and dealt with by means of mathematical concepts and methods. (Danish Ministry of Education, 2000)

There are two written examinations for the A level as well as an oral examination.

3.3.2 The written examination.

The first written examination is of four hours duration and students are able to take calculators and books of formulas into the examination. The examinations for 2000 and 2001 consisted of 7 long answer analysis type questions. The second written examination consists of approximately 13 short answer questions and is to be completed without access to a calculator or books of formulas.

3.3.3 The values evident in the written examinations.

After analysis of the past two written examinations in conjunction with the guide to mathematics *Danish Ministry of Education (2000)*, and the aims as given in 3.3.1. The values of **evaluation**, **activist** and **reasoning** can be seen. The flexibility of method as an indicator of **accessibility** is evidenced by the less structured problems in the examination when compared to those given by the other examination boards. **Formalism** is indicated by the need for accuracy and the **relational** aspect is indicated by the use of multiple representations in paper 1. Paper 2 emphasises the use of rules and procedures implying an **instrumental** and **formalist** approach to mathematics.

3.3.4 Oral Examination.

The subject guide for mathematics outlines the requirements for the oral examination in mathematics as

Approximately 30 minutes are allotted for preparation for the oral examination, including time spent on instructions and handing out material.

Including the time spent deciding on a final mark, two candidates are to be examined per hour.

The questions must be drawn up in such a way as to make it possible to assess the candidate's ability to give an independent presentation of important parts of a topic from the subject, as well as to assess the candidate's overall grasp of an area of the subject. Although the candidate's ability to structure the material in an independent manner is included in the final assessment, the examination must not consist merely of a monologue by the candidate.

(Danish Ministry of Education, 2000)

Students randomly select a question, for which then they have thirty minutes to prepare their response. The questions are initially compiled by the classroom teacher who then submits them to the external examiner who selects the questions to be used from those submitted, for use with the students.

3.3.5 Values evident in the oral examination.

Though it is not possible to ascertain all the values that would be exhibited with in the particular oral examination. The instructions on the oral examination provide an indicator of some the expected values. These include **communication, activist, reasoning and evaluation.**

3.3.6 Summary of Values evident in assessment instruments of the Denmark Secondary Mathematics curriculum

Mathematics assessment within the Danish secondary curriculum can therefore be categorised under the following headings Table 3.

| Values in the Denmark Secondary Mathematics curriculum |
|---|
| Accessibility |
| Activist |
| Communication |
| Evaluation |
| Formalist |
| Instrumentalism |
| Reasoning |
| Relational |

Table 4 Values found in the Denmark Secondary Mathematics Assessment Programme

3.4 United Kingdom A Levels

A level examinations are offered by four boards within England, the Assessment and Qualifications Alliance (AQA) Specimen Unit papers Assessment and Qualifications

Alliance (2000b) has been chosen for the analysis of values. The AQA sets out a set of five assessment objectives Assessment and Qualifications Alliance (2000a) which will be analysed in conjunction with the examination papers.

The Assessment Objectives (AOs) are common to both AS and A Level. The schemes of assessment will assess candidates' ability to:

AO1. recall, select and use their knowledge of mathematical facts, concepts and techniques in a variety of contexts;

There is evidence in this objective of the values of **instrumental** with the use of the word "techniques", **formalism** is evident with the use of the words "facts and concepts" while a "variety of contexts" indicates the potential for **relevance** in the contexts that are used.

AO2. construct rigorous mathematical arguments and proofs through use of precise statements, logical deduction and inference and by the manipulation of mathematical expressions, including the construction of extended arguments for handling substantial problems presented in unstructured form; (The use of clear, precise and appropriate mathematical language is expected as an inherent part of the assessment of AO2.)

The use of the term "rigorous" implies that students will need to use **perseverance** to complete the tasks which will be **specialist** in nature. **Instrumentalism** is again indicated by the use of the term "manipulation" while extended arguments implies that **reasoning** is required for the completion of the problems which can be both substantial and unstructured which would indicate that the value of **activist** is indicated in the assessment tasks.

AO3. recall, select and use their knowledge of standard mathematical models to represent situations in the real world, recognise and understand given representations involving standard models, present and interpret results from such models in terms of the original situation, including discussion of the assumptions made and refinement of such models;

This assessment objective is not included in the examinations under consideration but appears in the alternative units for Statistics, Mechanics and Discrete Mathematics. The values evident though in this objective are **relevance** as indicated by the use of the term "mathematical models" as well the values of **communication** and **activist** are indicated by the problem solving and the mathematical modelling process. Interpretation and representation of different models is an indicator of the **relational** aspect to this objective.

AO4. comprehend translations of common realistic contexts into mathematics, use the results of calculations to make predictions, or comment on the context and, where appropriate, read critically and comprehend longer mathematical arguments or examples of applications;

Values which are evident within assessment objective 4 include **relevance**, the ability to make predictions (or conjecturing) as well criticality is evident in the statement and the ability to reason. This assessment objective is particularly focussed on problem solving and therefore an **activist** viewpoint.

AO5. use contemporary calculator technology and other permitted resources (such as formulae booklets or statistical tables) accurately and efficiently, understand when not to use such technology and its limitations. Give answers to appropriate accuracy.

Assessment objective 5 is focussed on the use of tools in mathematics particularly the calculator. Accuracy criticality and efficiency are indicated in this statement which also provide evidence of **evaluation** and **efficiency**.

The AQA specification also includes a statement of synoptic assessment

Synoptic assessment in mathematics will address candidates' understanding of the connections between different elements of the subject. It involves the explicit drawing together of knowledge, understanding and skills learned in different parts of the A level course, focusing on the use and application of methods developed at earlier stages of the course to the solution of problems. Making and understanding connections in this way is intrinsic to learning mathematics. (Assessment and Qualifications Alliance, 2000a)

The use of indicates the importance of **relational** thinking as part of the overall assessment process.

Table 5 provides a list of values that have been found in the AQA assessment objectives.

| Assessment Objectives |
|------------------------------|
| Activist |
| Evaluation |
| Formalist |
| Instrumental |
| Perseverance |
| Reasoning |
| Relational |
| Relevance |
| Specialism |

Table 5 Values found in the AQA A level mathematics Assessment Programme

4 Conclusion

A summary of the values found in the forms of assessment for each of the examination boards is given in Table 6.

| IB | DK | A levels |
|---------------|---------------|--------------|
| Accessibility | Accessibility | |
| Activist | Activist | Activist |
| Communication | Communication | |
| Evaluation | Evaluation | Evaluation |
| Formalist | Formalist | Formalist |
| Instrumental | Instrumental | Instrumental |
| Perseverance | | Perseverance |
| Reasoning | Reasoning | Reasoning |
| Relational | Relational | Relational |
| Relevance | | Relevance |
| | | Specialism |

Table 6 Summary of values found in the three assessment programmes.

The **activist** value is evident in all three examination boards and is a result of the use of problem solving in all assessments. The value of **evaluation** is to be expected particularly with the need for exact responses and the consideration of appropriate solution strategies. While the presence of **accessibility** in two of the examination boards is interesting as this value is derived from different aspects within each. For the IBO it is a recognition of the incline of difficulty of problems while for Denmark it is the flexibility of method which is reflected in this value. **Accessibility** and **communication** do not appear to be valued by the AQA assessment objectives. **Relevance** is not found in the objectives of the Danish system but is evident in both the IBO and the AQA, for the AQA it only appears in assessment objective 3 which is not assessed in the examinations. **Perseverance** is no doubt required in all three examination boards but it is more clearly spelled out in the IBO and the AQA systems.

It could be implied from Table 6 that there is possibility for a set of universal values in mathematics assessment. But a note of caution needs to be made. At best these values are indicators of a western European perspective of mathematics. This analysis would need to be extended to include other examination boards, from a non western European perspective, before clear conclusions could be drawn on the possibility of whether a set of universal mathematics assessment values exist. It is also recognised that these results are very much dependent on my view of mathematics and as a consequence the results are influenced by my own perspectives and another researcher could obtain a different set of values.

There may also be differences between the stated aims of each of the organisations and the assessment objectives and the actual examinations and their grading. The Intended,

Implemented Actual continuum. (Robitaille & Dirks,1982) An audit of the values in each of the stages of the assessment program for each examination board needs to be carried out to determine if the values which are evident in the work completed are typical of the entire assessment program.

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