

ANGUS COUNCIL
EDUCATION COMMITTEE
23 JANUARY 2001
IMPROVING SCIENCE EDUCATION 5-14
REPORT BY THE DIRECTOR OF EDUCATION

ABSTRACT

This report seeks the Committee's approval for follow-up activities to a recently published HMI report.

1 RECOMMENDATIONS

It is recommended that the Education Committee:

- a notes the contents of the HMI publication "Improving Science Education 5-14" (a copy of which is available for perusal in the Members Lounge)
- b endorses the response prepared by a staff working group (Appendix)
- c authorises me to take forward the draft Action Plan outlined in Section 4 of the Appendix

2 BACKGROUND

- 2.1 In December 1999, Her Majesty's Inspectors of Schools published a report entitled "Improving Science Education 5-14."
- 2.2 This report is one in a series of similar reports, each of which is being assiduously considered in the Angus education service with a view to building in improvements to current practice wherever possible.
- 2.3 A short-life working group consisting of members of the Council's Education Development Service and school-based staff was brought together to consider this particular report and to prepare a draft Council response to it.
- 2.4 The deliberations of the working group are summarised in the Appendix to this report.

3 CONCLUSIONS

- 3.1 The working group is to be congratulated for having timeously and efficiently completed the remit given to it.
- 3.2 It is recommended that the Education Committee should endorse in full the contents of the working group's report.

4 HUMAN RIGHTS IMPLICATIONS

There are no Human Rights implications arising from this report.

5 CONSULTATION

- 5.1 In accordance with the Standing Orders of the Council, this report has been the subject of consultation with the Chief Executive, the Director of Finance and the Director of Law & Administration.

Jim Anderson
Director of Education

No background papers, as defined by Section 50D of the Local Government (Scotland) Act 1973 (other than any containing confidential or exempt information) were relied on to any material extent in preparing the above report.

APPENDIX

JAA/CJ

ANGUS COUNCIL - EDUCATION DEPARTMENT

DRAFT RESPONSE TO IMPROVING SCIENCE EDUCATION 5-14 HMI REPORT

1 BACKGROUND

1.1 “Improving Science Education 5-14” was published by HMI in 1999 and is the third in a series which provides advice aimed at improving learning and teaching and raising attainment in the 5-14 age range. This report reiterates the main messages, given in the previous reports, relating to the importance of high expectations and an emphasis on achievement.

1.2 The evidence underlying the report’s analyses, conclusions and recommendations has been obtained from the following sources:

- HMI Reports
- Assessment of Achievement Programme (AAP)
- Scotland’s participation in the Third International Mathematics and Science Study (TIMSS)

Account has also been taken of a review of national and international research evidence carried out by SCRE, and of HMI visits to four cities in the USA to investigate good practice in Science education.

1.3 The report identifies weaknesses in science courses and programmes, makes specific mention of concerns about the upper primary and lower secondary stages, and makes a number of recommendations for improvement in the context of forthcoming simplified and clarified national guidelines for Environmental Studies 5-14.

1.4 Advice and/or recommendations have been made in relation to:

a) Improving the Quality of Science Courses and Programmes

b) Improving the Quality of Learning and Teaching

- direct teaching
- practical work
- assessment
- raising expectations, particularly at the upper stages of primary and at S1/S2

c) Staff Development – providing clearer advice and better support, particularly for primary teachers

- d) Improving the Organisation and Management of Science in Primary and Secondary Schools
 - class groupings
 - resources
 - use of time allocation
 - monitoring and evaluation
- 1.5 The report provides an “Agenda for Action” for teachers, school managers, education authorities, teacher education institutions and national bodies with an interest in improving standards in science.
- 1.6 An Angus Council short life working group was set up in March 2000 to:
- Consider the issues raised, and the recommendations made, by HMI.
 - Recommend appropriate steps to be taken by the Authority, School Managers and teachers in relation to these recommendations.
- 1.7 The group had representation from primary school managers and teachers, secondary school Science teachers and members of the Educational Development Service.

2 SUMMARY OF THE REPORT’S FINDINGS

Improving the Quality of Science Courses and Programmes

- 2.1 The teaching of Science in primary schools, either through Environmental Studies topics or through Science Programmes, was found in general to be of variable quality and there was little consistency in the delivery of Science across associated primary schools.
- 2.2 In secondary schools S1/S2 Science course were also found to be of variable quality. They were often inadequately matched to national guidelines and there was a lack of continuity and progression in relation to Science being taught in associated primary schools.
- 2.3 The report anticipated that the publication of the revised national guidelines for Environmental Studies and related Teacher Guides would provide detailed information to support the review of Science courses and programmes.
- 2.4 The report recommended that Authorities should ensure that staff from associated primary and secondary schools work together to agree content coverage at each stage. It also noted that some Authorities had provided Science programmes for all of its primary and secondary schools.

- 2.5 The report indicated that some Authorities had provided practical kits for primary schools.

Improving the Quality of Learning and Teaching

- 2.6 There was little evidence of primary and secondary schools assessing and reporting levels attained in Science in line with national advice.
- 2.7 HMI evidence indicated that the reasons for the poor practice in assessment and reporting included a lack of clarity in definition of the Science attainment targets and a lack of understanding by many teachers of the close link between what is taught and what is to be assessed.
- 2.8 Research evidence indicates that, where thinking skills have been taught, there have been long-term improvements in achievement, not only in Science but also in English and Mathematics.
- 2.9 The report recommends that learning and teaching should be improved by more effective use of direct teaching, questioning and discussion, investigative practical work and assessment.
- 2.10 The collection of evidence for reporting and offering advice about the next steps in pupils' learning was only observed in a small number of schools. The Report indicated that there was a need to raise expectations of what pupils can achieve in Science particularly in the upper stages of primary and at S1/S2.
- 2.11 The report encourages Science Departments to discuss as whole departments ways of improving courses, teaching and learning approaches, assessment and raising pupils' attainment.
- 2.12 The report recommends that "Appropriate bodies at national level working as necessary with local authorities" should produce assessment materials in Science to support teachers' judgements in measuring pupils' progress and attainment against more clearly defined targets for teaching and learning. It was anticipated that this would promote consistency across cluster primary schools and associated secondary schools.

Staff Development

- 2.13 The report recommends that primary school Head Teachers should deploy staff who have specialist qualifications, interest or expertise in Science to develop the 5-14 Science Curriculum. It suggests that such teachers might devise Science programmes for use throughout the school; support the teaching of less experienced or less confident colleagues eg through co-operative teaching or exchanging classes; lead staff development sessions and liaise with secondary Science colleagues.
- 2.14 HMI recommend that secondary school Senior Management Teams should find innovative ways of supporting their primary colleagues so as to enhance the quality of pupils' learning and attainment in Science.
- 2.15 "Appropriate bodies at national level working as necessary with local authorities" are encouraged to consider how more flexible use might be made of the specialist skills of teachers in both primary and secondary sectors to improve pupils' attainment in Science.
- 2.16 The report recommended that teachers should be supported to focus their teaching of Science-based topics or Science programmes on the knowledge, understanding and skills of Science.

Improving the Organisation and Management of Science in Primary and Secondary Schools

- 2.17 Primary School Head Teachers are asked to ensure that “Science programmes” are adequately resourced. This, of course, presupposes that there are comprehensive Science programmes/topics in place.
- 2.18 The report reiterates advice about classroom organisation which was given in the Improving Mathematics Education 5-14 Report. It recommends that primary teachers should:
- employ whole-class teaching to introduce and consolidate work
 - use a small number of attainment groups where appropriate
 - ensure that all groups receive work which is appropriately challenging.

The report gives similar advice to secondary teachers with an additional recommendation that broad band setting should be considered when sufficient evidence about pupils’ attainment has been accumulated. It should be noted that Angus Council does not support this latter recommendation and instead would recommend that priority be given to supporting staff in reviewing and developing classroom practice in relation to the teaching of mixed ability classes. To this end staff are referred to the Authority’s evaluation of learning and teaching in S1/S2 – the Boyd-Simpson Report - and to the policy paper “Class Organisation in the Later Stages of Primary Schools and in S1 and S2 of Secondary Schools”.

The above recommendation, of course, **is** consistent with the HMI recommendation for Science departments as a whole to discuss ways of improving S1/S2 courses, approaches to learning, teaching and assessment and raising attainment. (See 2.11 of this paper).

- 2.19 HMI found that the amount of time devoted to Science teaching in primary schools was well below the average time in other countries. However, in secondary schools the time allocation for Science in S1/S2 was slightly above average.
- 2.20 The report recommends that primary Head Teachers should monitor pupil progress to ensure that they are achieving suitable standards in Science in line with national targets and should allocate additional time if required.
- 2.21 The report also recommends that all of the Principal Teachers of Science in secondary schools should have responsibility for the implementation of 5-14 Science and should be actively involved in systematically monitoring and evaluating the quality of work of each member of staff through sampling pupils’ coursework and attainment and working alongside teachers.
- 2.22 Senior Management Teams are encouraged to use the recommendations in Section 6.7 of the HMI Report to evaluate the effectiveness of Science Departments.

3 NATIONAL DEVELOPMENTS

- 3.1 Revised national guidelines for Science will be published in November 2000.
- 3.2 A 5-14 Programme of Study produced by Renfrewshire Council is available for purchase by other Authorities – this is being amended in the light of the revised guidelines. The Programme is available on both paper and CD ROM.
- 3.3 As part of the “Science On-line Support Network” (SOLSN) national pilot project the Renfrewshire Programme of Study has been converted into an interactive web-based format available on CD ROM. This provides access to a range of additional resources and can be set up to enhance communication among a number of establishments eg Clusters.
- 3.4 A longer-term aim is for the web-site to be annually updated with new resources.

- 3.5 Also in the longer term, a curriculum development project, to be lead by Learning and Teaching Scotland and the Scottish Science Advisory Group, will produce support materials, assessment materials and practical advice for 5-14 Science.
- 3.6 In view of the statements in Section 3.23 of the HMI Report it is anticipated that National Testing in Science will be introduced.

4 IMPROVING SCIENCE EDUCATION 5-14: ANGUS COUNCIL DRAFT ACTION PLAN

4.1 Apart from the recommendation on broad band setting in secondary schools, Angus Council endorses the recommendations of this HMI Report. For convenience these have been reorganised under the following four headings:

- Improving the Quality of Science Courses and Programmes
- Improving Learning and Teaching
- Staff Development
- Organisation and Management of Science in Primary and Secondary Schools

They are attached as an Appendix to this paper.

4.2 A Staff Tutor will be appointed to support the development of 5-14 Science in Angus.

4.3 Excellence fund monies will be used to purchase the Renfrewshire Programme of Study for each primary and secondary school.

November 2000

4.4 Comprehensive information about resources and where to purchase them will be provided.

March 2001

4.5 Local Support Groups will be set up in order to:

- ensure that the programme refers to a suitable range of resources
- provide support for the delivery of Science in composite classes
- link classroom materials already prepared in Angus to the Renfrewshire Programme of Study
- produce Teachers' notes to accompany each topic. These will either contain basic knowledge and understanding for staff or make reference to available texts.

May 2001

4.6 Cluster Groups through the Cluster Science Groups which were established in March 2000, will manage the implementation of the Renfrewshire Programme of Study and thereby promote consistency, in the delivery of Science across associated primary schools, and continuity and progression between stages.

Ongoing

4.7 Local Support Groups will be set up to provide extension materials/ideas to support the introduction of Level F in secondary schools.

November 2000

4.8 Staff Development will be provided for Cluster Science Groups through a six-day programme which is being delivered over three years – the first two days of this programme were delivered in March 2000.

Prior to each of the activities being held in 2001 and 2002, Cluster Groups will be asked to report on progress made in the previous year and to identify staff development and resource needs.

March 2000 – March 2001

- 4.9 Secondary School Senior Management Teams should seek to enable Secondary Science staff to work closely with staff from associated primary schools.

June 2000

- 4.10 Cluster Groups should provide opportunities for primary and secondary teachers to share examples of good practice in relation to learning and teaching and assessment.

June 2001

APPENDIX

Recommendations of the HMI Report

1 Improving the Quality of Science Courses and Programmes

In Primary Schools

- Teachers should focus their teaching of science-based topics or separate science studies on the knowledge, understanding and skills of science (2.10 – 2.12)
- Head Teachers should ensure that science is taught systematically throughout the school and that good quality and challenging science programmes provide suitable breadth, balance, continuity and progression (2.2, 2.3)
- Head Teachers should adopt a consistent approach to the science content being covered at each stage before pupils move into S1. Staff from all associated primary schools and the receiving secondary should work together to agree content coverage at each stage (5.12).

In Secondary Schools

- Science Departments should improve the quality of the S1/S2 science course to take account of 5-14 content, skills and levels of attainment, including Level F. (2.2, 2.3, 2.7)
- Science Departments should work with staff from all associated primary schools to agree content coverage at each stage (5.14)
- Senior Management Teams should ensure that 5-14 guidelines for environmental studies are implemented.

Appropriate bodies at national level, working as necessary with local authorities

- should ensure that staff from primary and secondary schools work together to agree content coverage at each stage (5.12)
- should consider what further forms of support, including staff development, would be most effective in helping to address primary teachers' lack of confidence and competence in teaching science (4.4 – 4.10)

- should ensure that the review of the science component of the 5-14 Guidelines addresses the concerns of teachers by:
 - providing better and simpler specification of the attainment targets
 - providing clearer exemplification of learning and teaching in science, and
 - making the planning and assessment of science more manageable. (2.4 – 2.7)
- should provide examples of good quality 5-14 science courses/programmes including practical kits for primary schools.

2 Improving the Quality of Learning and Teaching

In Primary Schools

- Teachers should make better use of assessment to plan pupils' learning and to report on their attainment in knowledge and understanding and practical investigative skills (3.19 – 3.23)
- Teachers should employ whole-class teaching for introducing and consolidating work (5.5, 5.6)
- Teachers should use direct teaching to attainment groups where appropriate. In particular, group-teaching arrangements should be used to provide higher attaining pupils with additional challenge and lower attaining pupils with necessary support (5.5 – 5.7)
- Head Teachers should make arrangements to ensure that pupils, parents and other teachers, as appropriate, receive summative reports of pupils' progress and attainment in science (5.2, 5.3, 5.12).

In Secondary Schools

- Science Departments should reduce significantly the use of individualised or resource-based learning approaches and adopt an approach which allows teachers to give more structured lessons to attainment groups or to whole classes (3.3, 5.9)
- Science Departments should take account of pupils' levels of attainment, not only in science but also in English language and mathematics when planning tasks for pupils (5.8)
- Science Departments should generally set more demanding work, including homework, for S1/S2 classes (5.8 – 5.11)
- Science Departments should reject a “fresh start” approach and build on pupils' prior attainment by checking pupils' prior knowledge, understanding and skills, including any misconceptions, at the start of each new topic (5.8)
- Science Departments should discuss as whole departments ways of improving courses, teaching and learning approaches, including assessment, and raising pupils' attainment at S1/S2 (3.11, 5.17).

Appropriate bodies at national level, working as necessary with local authorities

- should produce assessment materials in science to support teachers' judgements in measuring pupils' progress and attainment against more clearly defined attainment targets for teaching and learning (3.23)

3 Staff Development

In Primary Schools

- Head Teachers should make use of specialist staff qualifications, interest or expertise in science to develop the 5-14 science curriculum. This might include, for example, devising a balanced science programme for

use throughout the school; supporting the teaching of less experienced or less confident colleagues, for example through co-operative teaching or exchanging classes; leading staff development sessions; or liaising with secondary science colleagues (5.13)

In Secondary Schools

- Senior Management Teams should find innovative ways of supporting their primary colleagues so that the quality of pupils' learning and attainment in science can be enhanced (5.14, 5.15)

Appropriate bodies at national level, working as necessary with local authorities

- should consider how more flexible use might be made of the specialist skills of teachers in both primary and secondary sectors to improve pupils' attainment in science (5.13, 5.15)
- should review initial teacher education courses to ensure that the advice being given to students is consistent with this report (6.3)

4 Improving the Organisation and Management of Science in Primary and Secondary Schools

In Primary Schools

- Head Teachers should ensure that the science programme is adequately resourced with books, equipment and other necessary materials to allow class lessons to take place (3.17)
- Head Teachers should monitor pupils' progress to ensure they are achieving suitable standards in science in line with national targets, and allocate additional time to science when required (5.2, 5.3, 5.12)

In Secondary Schools

- Science Departments should follow the advice of *Achievement for All* and move to broad band setting when sufficient evidence about pupils' attainment has been accumulated (5.10)

NB: As already noted in section 2.18, Angus Council does not support this recommendation and would instead recommend that priority be given to supporting staff in reviewing and developing classroom practice in relation to the teaching of mixed ability classes. To this end staff are referred to the Authority's evaluation of learning and teaching in S1/S2 – the Boyd-Simpson Report – and to the policy paper "Class Organisation in the Later Stages of Primary Schools and in S1 and S2 of Secondary Schools".

- Science Departments should follow the advice offered in *Achieving Success in S1/S2* where it recommends that secondary schools should 'minimise the occasions upon which classes are taught by more than one teacher in a given subject' (5.18)
- Science Departments should ensure that principal teachers of science systematically monitor and evaluate the quality of work of each member of staff through sampling pupils' coursework and attainment and working alongside teachers. Where necessary, the remits of promoted staff should be reviewed to make clear that all principal teachers of the sciences have responsibility for the implementation of 5-14 science, although responsibility for certain aspects may be delegated to other staff. All science staff should share in the development and successful implementation of 5-14 science (5.19)
- Senior Management Teams should use the recommendations made for science departments as a means of evaluating the effectiveness of Science Departments.