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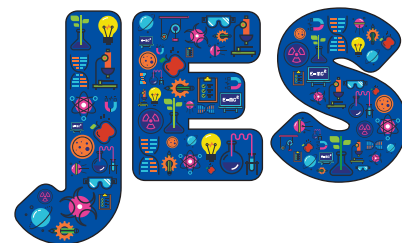
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Committing curriculum time to science literacy: the benefits from science-based media resources



● Billy McClune

Abstract

Science reported in the media is authentic source material to stimulate interest in science research and innovation, to learn how science works and to consolidate science literacy skills and subject knowledge. Media reports, intended to communicate science research and innovation, provide opportunities for teachers to develop among their pupils the critical reading skills that are essential for promoting literacy in science.

This study focuses on a curricular intervention with upper primary pupils (age 11 years) and uses science reported in the media to facilitate the development of critical reading. It investigates the use of media-based resources and teaching approaches that systematically address the critical reading at a foundational level. It reports on classroom observation and pupils' behaviour in relation to dialogue that supports negotiation and clarification, as pupils experience opportunities within the curriculum to revisit, consolidate and develop their critical reading skills.

Keywords: Science literacy; critical reading; media-presented science; school science teaching

Introduction

Science-based media reports are part of the fabric of young people's media-driven science experience. They do not have to systematically tune in to news broadcasts to be aware of science-based issues relating to environment, climate and health. These are reported, shared and talked about alongside space science, gene therapy, and the latest applications of Nanotechnology. News is pervasive and pupils can know about and be motivated as much by the challenge to produce clean water and boost crop yield in the developing world as by innovations in 'smart' materials built into their mobile phone, or the prosthetic appliances for Paralympic athletes.

However, awareness of science-based issues provokes a response in each of us. It may be the distrust that emerges from unfamiliarity, curiosity that is fuelled by confidence and growing understanding, or the engagement that is stimulated by a sense of ownership and citizen responsibility. The critical nature of the individual and community response that we make to these media-driven experiences will be influenced by the nature and degree of 'science literacy' that the experience of school science has engendered. Encounters with science-based news are inevitable and science education can have a role to play in equipping young people to engage critically with the concerns of today and the yet-to-be-discovered science-related issues that will affect us tomorrow.

'Science literacy' is multi-dimensional and includes the capability to read and respond critically to news reports with a science component (Millar & Osborne, 1998). In the context of science-based media reporting, it is demonstrated, at least in part, in the ability to evaluate the validity and reliability of scientific claims, methods or designs that are reported. In addition, it can be seen in the reader's awareness of, and response to, media-driven constraints that influence the language and substance of media reports with a science component.

Newswise is a media science project, which was the basis of this study. It proposed a three-phase curricular intervention based on reading news with a science component. Teachers' commitment to the programme involved the use of a media source as stimulus material. The media source news report about micro-needles dictated the content area and required them to commit curriculum time to an interdisciplinary project under the theme 'science in the world around us'.

The programme was original in its emphasis on an interdisciplinary approach to media literacy and



science with primary age pupils, and the integration of strategies not commonly used in the same curricular areas or in conjunction with one another. These strategies were based on critical reading and response tasks described elsewhere (Jarman & McClune, 2011; McClune & Alexander, 2015).

This paper reports on one of three parts (the foundational reading task) of an exploratory science programme to promote reading science news with upper primary pupils (age 11 years) in the UK. The intervention included foundational, intermediate and higher-level tasks to promote critical reading of science-based news reports. The foundation level activity contains two reading and comprehension tasks, which are specifically tuned to news media. They require pupils to carefully examine the news text. News is a unique genre, with characteristics that differ from much of the textbook material that primary pupils experience in school. Two foundation tasks – 'News Bug' and 'Sketch-pad' – structure critical reading in a media context. Pupils completing these foundation tasks should be able to:

- Use 'key questions' to examine a science news report;
- Decide if a science news report can stand up to scrutiny; and
- Make a graphic to supplement a science news report.

Figure 1 illustrates the end point of one activity, where the model and supporting documentation are indicators of pupils' engagement with the task.

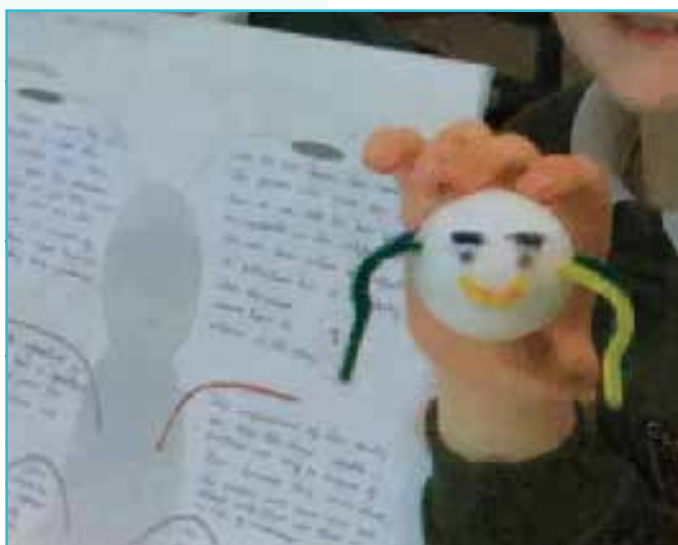


Figure 1: The News Bug completed.

Development

A number of theoretical constructs underpin current thinking and practice in relation to the inclusion of science-based media reports as an element of the school science curriculum. These include the ideas that:

- Science literacy should equip young people to engage with science in the world beyond the classroom. As such, it is considered an important goal of a science education;
- Science reported in the media has unique and challenging characteristics and requires particular attention in the science classroom;
- The learning intentions and pedagogies associated with effective use of media-reported science have implications for interdisciplinary approaches to teaching; and
- The development of a pupil's capability for critical reading of science-based media reports is an essential skill in the development of science literacy.

In their review of literature relating to science in the media, McClune and Jarman (2012) explored more fully the links between these perspectives. A number of key ideas are summarised below.

The concept of science literacy is contested. It has multiple definitions and may be interpreted differently, depending on the audience and the context in which it is discussed. Yore (2012) describes visions of science literacy. Historically, science education focused on the preparation of a scientific elite or a well-educated workforce. It was located around recall and use of established and uncontested knowledge – textbook science. While this view of science education is still evident, it is now common to see science literacy defined more widely to include, among other things, the capability to handle with confidence science encountered in the world beyond the classroom, i.e. the science that is woven into the fabric of everyday life; the science of home and work, of leisure and entertainment. Consequently, one acknowledged goal of science education is that pupils should be able to read and respond critically to media reports with a science component. This idea is expressed consistently in policy documents and curricular discussion papers that have influenced the development of science education in recent years (Millar & Osborne, 1998; Millar, 2006; National Research Council, 2012). It can be argued

that, in promoting science literacy, science educators are endorsing the role of science in equipping individuals and communities to engage with significant cutting-edge and sometimes contested science-based issues that have local, national and global impact.

News, including science-based news reports, come in many formats. Newsprint competes with television and radio broadcasts. More recently, these traditional sources have been supplemented or overtaken by a host of Internet sources, from commercial websites to news Apps. Increasingly, news is distributed by celebrity 'Tweets' and by individuals through shared links with 'Facebook friends' or in the form of *YouTube* and other platforms.

Newsworthiness is a common element linking this abundance of science news sources. In all of these, 'News Values' underpin the science reporting. Jarman and McClune (2007), in addressing the role of news media in the development of scientific literacy, point out that science is often newsworthy, i.e. it is characterised by well-defined news values, so it satisfies the needs of the journalist who is looking for a story. Science is interesting and sometimes entertaining, so it meets the programme-scheduling guidelines followed by directors and producers working in the broadcast media. Science news often relies on a 'WOW' factor, the capacity of science to surprise and amaze.

Within these categories of newsworthiness and entertainment, the science component of the report may be dominant or recessive, i.e. it may be the main focus of the report or simply a supporting element underpinning the story, linking it to one or more big ideas in science. The focus is often on science research and technological innovation. In addition to news values, it must be acknowledged that these sources of news also have their own agenda, sometimes clearly evident in the reporting style, but often presented more subtly.

Media-based science presents teachers with new opportunities and new pedagogical challenges.

The 'textbook science experience' and the 'media-driven science experience' differ in a number of respects:

- School science and media science differ in their setting – media science is free choice, unplanned, unstructured. We meet it in informal settings and we choose it. In contrast, school science is structured, planned, often assessed. We meet it in formal settings and it is imposed, rather than selected.
- School science and media science differ in their purpose – media science is intended to entertain and to inform. It can be profit-making. School science is intended to build knowledge, develop skills and promote learning.
- School science and media science differ in their content – media science is cutting-edge and sometimes contested, speculative and uncertain. School science is factual, established, generally agreed textbook science.

To some, school and media-driven science may appear to be incongruous, even incompatible, while others would view them as complementary. There are acknowledged limitations when science is reported as news. While it is important that teachers acknowledge different viewpoints, the opportunities, particularly for interdisciplinary learning, are an important benefit (McClune, Alexander & Jarman, 2012).

As a consequence of these differences, school science and media science invoke different responses from the learner to basic questions: Why am I doing this? What is in it for me? Is it important to my family, my community, and me? There are questions also for the teacher. When compared to school science, media science has a greater element of pupil choice, pupil ownership and relevance. Hence media stimulates the contextualisation of science, highlighting its relevance to the world beyond the classroom.

Consequently, media sources give access to some learning goals and anticipated outcomes that include the ability to:

- Read opinion-text thoughtfully, identifying and assessing the impact of limiting clauses and persuasive language;
- Explore factual-text to assess its accuracy and reliability and substance;
- Read purposively, seeking to identify claims and evaluate links between claim and evidence; and
- Read and respond critically to news with the science component.

These outcomes are more likely to be associated with the development of literacy than with science education. They do however represent a transition between science literacy and what has been described as literacy in the fundamental sense (Norris & Phillips, 2003).

While science-based media sources can be used to promote and consolidate science learning alongside a range of literacy skills, the development of critical reading skills is a primary objective. The basic concept and the developmental stages of critical reading are well described elsewhere (OECD, 2006). In applying these ideas in the context of this study, they have been refined and are described as a series of levels that are increasingly challenging for the reader (see Figure 2).

The framework of strategies and resources used in the study is based on a model of critical engagement developed for science in the media. That model identified science knowledge, literacy skills, media awareness and aspects of critical thinking (discerning habits of mind), which were necessary elements in making a critical response to science-based news. A subsequent framework of learning intentions, described at foundational, intermediate and higher levels based on this model, was developed (McClune & Jarman, 2010; 2011).

Methods

This empirical study focuses on news text and on activities intended to promote aspects of critical reading. Classroom practice was scrutinised in order to gauge the influence of teaching approaches and the subsequent learning opportunities on pupils' ability to critically examine a media report with a science component. The teacher's lesson management skills, subject knowledge, confidence and the tone of teacher-pupil relationships all had an influence on the classroom atmosphere and the learning environment. However, the teachers' approach to their role as facilitator or controller was most significant. Approaches that were characterised by questioning and discussion that was pupil-led were well suited to the news-based critical reading activities.

This study was based on classroom observation and aimed to shed light on elements of classroom practice, in particular pupils' behaviour in situations that supported dialogue and questioning. It was a qualitative study, observing activities that signal pupils' conceptual understanding when engaging with activities based around a news report about a groundbreaking medical development. Researchers looked for pupils' appropriate reference to media sources when negotiating the outcomes of the tasks. A variety of types of data

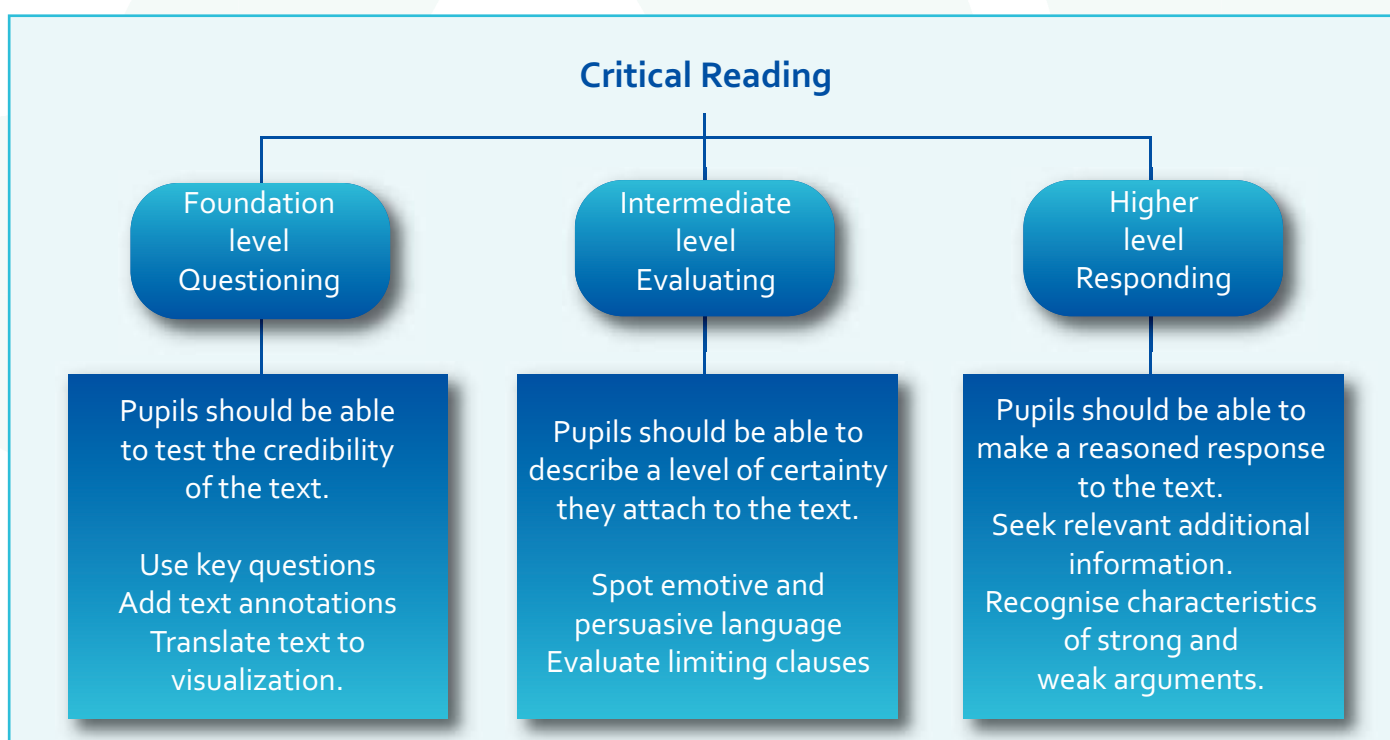


Figure 2: A model for levels of critical reading

was collected, including examples of writing, drawing and modelling completed by pupils individually and in groups. Pupils made audio-visual recordings of their group tasks and discussions. The aim of this pupil-controlled approach to data collection was to minimise any disruption to the group dynamic or distraction due to an unfamiliar adult 'listening in' to the group. Pupils usually passed the camera around to ensure that all participants were recorded. The study also draws on observational records from researchers who spent time in the classroom. Audio-visual recordings intended only to supplement or confirm researchers' field notes were not transcribed. Data were also collected from pupils using questionnaires and semi-structured interviews. Analysis of the outcomes of two core tasks relating to different elements of critical reading at a foundational level, which provided the most substantive evidence of pupils' engagement with the tasks, will be reported here.

Core activities

The two core activities focused on accessing and extracting information – 'building a News Bug' (see Appendix 1), and on translating information extracted from the text for the purpose of communication, using a 'Sketch-pad' (see Appendix 2), to make a visual representation based on the text. Researchers used teachers of science and English as experienced readers to provide a benchmark standard for these critical reading tasks.

In the first core task, 'build a News Bug', pupils demonstrated their ability to assess the value of the report as a reliable source of science-based reporting. Pupils working in their usual class groups, assigned by the class teacher, used information from the text to construct a three-dimensional representation of a news report (a 'News Bug') and used this to determine the robustness and stability of the news report under scrutiny. Critical reading in this context involves assessing the text against 6 key questions and deciding if it reaches what they consider to be a satisfactory standard for a comprehensive and credible news source. Each question is linked to a 'leg' of the News Bug. For each question area in turn, the readers add a leg to the bug if they consider that the text stands up to scrutiny in that

area. The model bug produced by the group represents their analysis of one text. A bug with only a few legs indicates a news text that does not stand up to scrutiny. The group's News Bug and the insights that they demonstrate in justifying their assessment of the text in key areas are indicators of their critical reading capability at a foundational level (see Figure 2).

In the second core task, 'Sketch-pad', pupils demonstrated their ability to access core science ideas underpinning the text by translating from written text to visual representations and explaining these to a peer group.

The News Bug activity

This focuses on three aspects of science-based news reporting to which a critical reader should pay attention. These are, firstly, the structure of the report; secondly, the plausibility of the report; and, finally, the reliability of the science component of the text. Table 1 illustrates how these aspects are explored in 6 key areas of the text: context, substance, language, science sources, methods and conclusions.

Pupils assessed the news report, *More needles means less pain*, using the News Bug activity. The source of the report was indicated to be the *Daily News* and the byline was attributed to 'a special correspondent'.

The opening paragraph stated that: '*For many people the thought of an injection brings back unpleasant memories of a visit to the doctor. That could all change. Researchers working at Queen's University Belfast hope to have a painless injection. They aim to replace a single needle with hundreds of tiny "micro-needles" made from the same material used in soft contact lenses*'.

A pupil reading critically and applying the key questions in relation to the structure of the text might conclude that there was insufficient information about the credentials of either the media source or the journalist. The substance of the news report – the possibility of pain-free injections – is likely to be a topic of interest and relevance to most people.

The article also reports that: '*They [micro-needles] have been described as feeling like Velcro on the skin*'.

Table 1: Characteristics of a comprehensive science-based news report

Aspects of a news report	Focus of the News Bug questions	A comprehensive news report should be:
Structure	1. Context	From traceable and reliable media source.
	2. Substance	Important and have meaningful consequences - A report that has impact.
Plausibility	3. Use of language	Balanced –Having measured use of fact and opinion, emotive and persuasive language.
	4. Science sources	Relying on identified, traceable and reliable science sources.
Reliability	5. Methods	Providing information about the research approach and methods.
	6. Conclusions	Presenting conclusions that relate to claims and evidence.

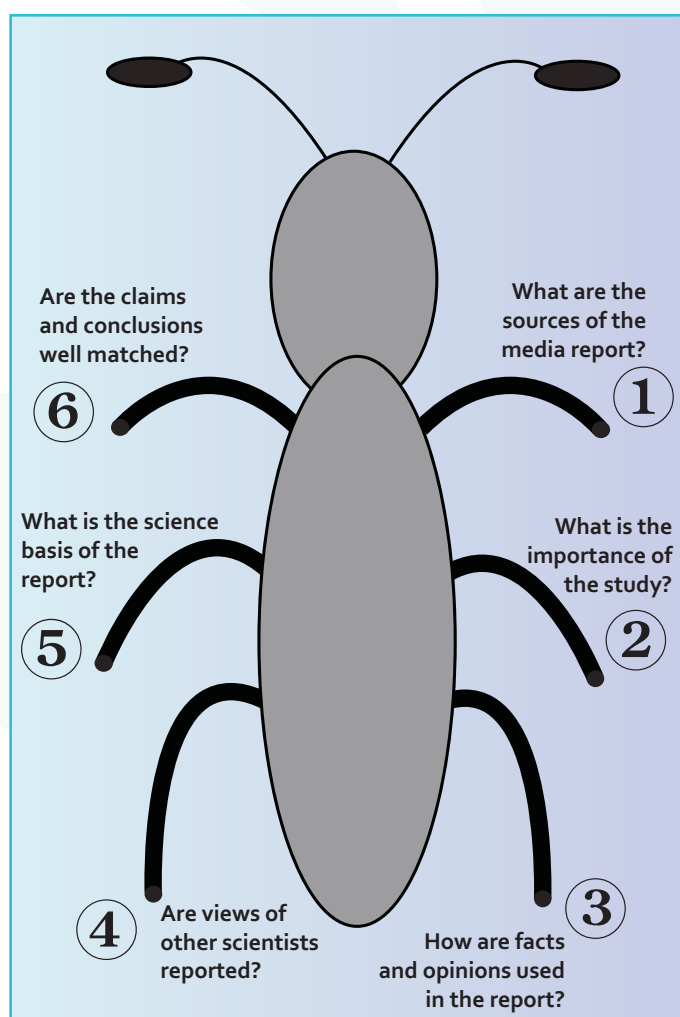


Figure 3: News Bug outline question framework

'Researchers claim that the micro-needles are painless. Each small, cone-shaped "needle" is around 600µm long (just over half a millimetre) and they do not touch the nerves beneath the skin.

'The work is still at the experimental stage. Scientists report that, using micro-needle patches, they can detect drugs such as caffeine in the body. Groups of volunteers have tested the micro-needles. In these tests, volunteers say there is no discomfort and further trials are planned.'

Figure 3 illustrates the key questions in each area. The News Bug questions used by pupils in this study, along with supplementary questions, are set out in Appendix 1.

The scientists referenced in this report are unnamed and there is no indication of their expertise in this field, though the name of the university is included. Neither complementary nor contradictory views of others in the science community have been included.

The language of the report is factual and moderate, acknowledging that the work is experimental and that more tests are planned. Pupils might use this information to make a judgement about the

plausibility of the report. The researchers' claim that micro-needles are painless is reported. The supporting evidence is based on two elements of data. Firstly, the dimension of the micro-needle – it is too short to reach the nerves and, secondly, reports from volunteers who tested the needles said they were painless, though pupils may question if any of these volunteers were primary school children? Pupils reading critically and applying the key questions may conclude that the article, in the area of science-based reporting, is reliable.

In the classroom, this activity stimulated discussion among pupils with occasional appropriate interventions from the teacher, sometimes to provide information to overcome an obstacle or ask a question to refocus a conversation. Elements of these discussions are evident in the final responses made by groups when explaining their reasoning in relation to the number of legs they gave their News Bug.

Two examples of responses from different groups to the question of inclusion of the views from other science sources give some indication of the thinking that may underpin the discussion activity. One group decided that the absence of other sources was a weakness, stating:
'It [the report] does not say that other scientists' opinions were brought into the report. They did get information from volunteers but scientists would be more experienced.'

In this example, the volunteers were acknowledged, but not as experts. Pupils commonly misunderstood references to volunteers as evidence of what other scientists think. For many pupils, this volunteer evidence was sufficient to validate the article, though not in the specific example given above. One group discussion had an insightful, if unconventional, opinion about the lack of comment from other scientists. They suggested that the absence of other scientists' views is reasonable because:

'...scientists in Ireland have made the discovery but won't tell scientists in other countries...because people in other countries could have more money and develop the micro-needles faster'.

There is some evidence here of very practical thinking about the development of technology.

This comment presents an opportunity for pupils to learn about how science knowledge is validated and expanded through co-operation and the acknowledgement of sources. This is an example of the type of conversation where the class teacher's confidence and background knowledge may enable him/her to exploit a learning opportunity. Further examples of pupils' writing (sample responses to News Bug questions) and comment on the responses are presented in Appendix 1.

Researchers analysed and coded the group responses to the News Bug tasks. Typically, these were in the form of written text to support the physical model as illustrated in Appendix 1 (Table 1). The theoretical framework for analysis categorised responses as insightful, accurate or naïve:

- An *insightful* response – shows awareness of other points of view and /or consequences
- An *accurate* response – makes use of direct quotation or reference to the text as supporting evidence
- A *naïve* response – demonstrates uncritical acceptance or rejection of text. Likely to attribute certainty to familiar, celebrity or well-known sources.

The Sketch-pad activity

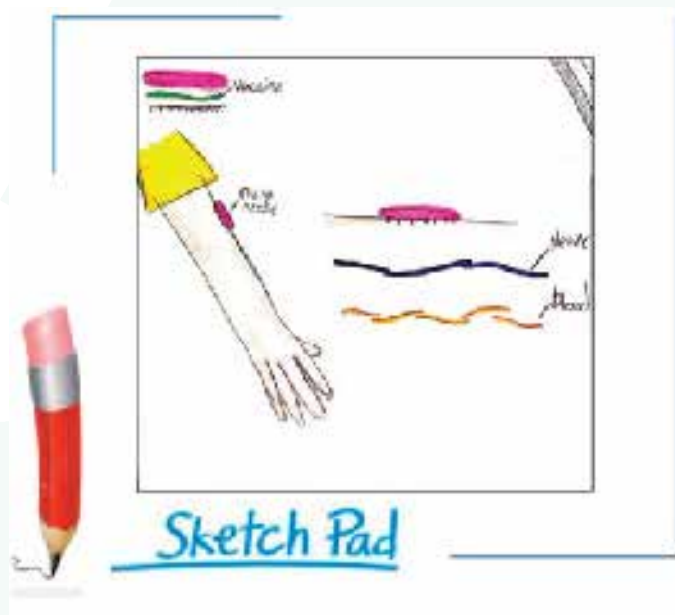
The Sketch-pad was intended to provide information about pupils' ability to read and access science content knowledge from the media text. Pupils highlighted specific elements of the written text that related to core science ideas underpinning the media report. The media report related to the development of an innovative approach to drug delivery and monitoring and the underlying 'big ideas' included the structure and function of skin as a human body organ. The media report placed the topic in context and the article, *More needles means less pain*, also reports that:

'Micro-needles only penetrate the skin's outer layer where the medicine leaks out...'

'It is safe and easy to get rid of used micro-needles because there is no risk of contamination. Used micro-needles are not dangerous because they never come into contact with blood...'

'Around 300 micro-needles are arranged on a backing layer patch no larger than a postage stamp. This can

Figure 4: A pupil sketch showing Micro-needles, nerves and blood vessels



be pressed onto the skin with gentle pressure. When they enter the skin, micro-needles...are stiff but they quickly swell with fluid from under the skin's surface...'

Pupils were asked to locate and highlight elements of the text and use the information to make a graphic that could help people to better understand the news report, in particular the structure of the skin, by using their own words and phrases to label their diagram, showing how the micro-needles deliver drugs into the skin. One example of a pupil's sketch illustrating their understanding of micro-needles and the skin structure is shown in Figure 4.

Pupils working in groups shared their individual diagrams and, together, modified these to produce what they believed to be a graphic to support the text. Researchers compared these final group images to appropriately detailed textbook images. Comparison focused on structure, detail and the appropriate use of labelling in order to highlight the role that pupil-constructed images played in learning. Tippet (2016) explored this idea further. Appendix 2 (Figure 2) illustrates a template used for analysis of the pupils' drawings.

Findings

Analysis of observational data and the outcomes of pupil activity revealed patterns of pupil behaviour that demonstrated their capability to access

science-based media reports. They used key questions, and associated prompts in the form of supplementary questions, to interrogate media text. In addition, they demonstrated a firm grasp of the big ideas of science that underpinned the text and communicated their understanding effectively in the form of a science graphic.

The outcomes suggest that these fundamental tasks, while challenging, were appropriate learning experiences within the capability of the majority of pupils and justify the commitment of curricular time to this approach. In doing so, teachers would provide a foundation for further development of higher-level skills.

Observations from scrutiny of the physical models (News Bugs) and visual representations (Sketches) constructed by pupils were supplemented by other data mentioned above. Together, these provided insights into children's understandings as they shared ideas about the text in order to promote discussion and complete the tasks set by the teacher (see Appendices 1 and 2). A News Bug with two or three legs is unlikely to stand. This would suggest that pupils did not believe the article stood up to scrutiny.

News Bug data

The News Bug outcomes generated by the pupils were compared to model outcomes generated in advance of the study by science and English teachers, who had experience in reading science news critically. In comparison to the group of experienced teachers, pupils completing the tasks were 'novice readers' in the context of science media reporting. Overall, there was a high level of agreement between model outcomes generated by experienced teachers and the efforts of pupils learning to use the structured question task.

At a foundational level of critical reading of science-based news, a competent critical reader would be expected to recognise which answers to key questions were included and identify what important information had been omitted, with his/her response illustrated by the inclusion or omission of legs on the News Bug constructed.

The majority of groups, after completing the learning tasks, constructed a model with a number and location of legs that suggested a reasoned

response. By accessing the media report, identifying relevant data and extracting appropriate information, pupils demonstrated foundational critical reading skills in the context of science-based media. Analysis suggested that pupils had more difficulty evaluating some aspects of the news report than others.

In relation to the structure of the report (Q1&2), many pupils did not pay sufficient attention to the origin of the news report and the credentials of the correspondent. However, when considering the substance of the news report and its value to them, many pupils took note of its relevance to them and their family or community. When commenting on the substance of the report, one group noted the value of painless injections, suggesting that: *'It's important to my community because some people don't like going for injection so they end up spreading the sickness'.*

It could be argued that the characteristics of relevance in news media, which by design make them attractive to a wide audience, are influential in stimulating the students' critical responses. This interest could act as an anchor point from which to promote critical reading.

Similarly, when considering the plausibility of the news report (Q3&4), it was evident that pupils were not always clear about the importance of the credibility of other sources referenced in the text, and the value of support from other scientists in establishing the article as a trustworthy science-based news report. However, a majority of pupils were able to recognise the influential role of emotive, persuasive and factual language in the report. Pupils used the questions and associated prompts effectively to identify the balance between fact and opinion and the use of emotive language, and commented on the presence or absence of 'other expert voices' in the news report. When describing the text language, one group commented:

'This is factual information from researchers...but thinking micro-needles are painless when they are not so sure, that is an opinion'.

This might suggest that pupils are able to draw on literacy skills more commonly promoted in other curriculum areas and apply these in an unfamiliar science context. The media report was observed to be both a context to use, and an opportunity to develop, fundamental literacy skills.

In relation to the reliability of the news text as science-based reporting (Q5&6), some pupils were critically aware of the importance of science method and the identification of the researchers or location of the research team. One group who were concerned about the absence of details relating to the micro-needle trials noted:

'There's not that much evidence to say that it is completely painless; they haven't said any details about the volunteers. There wasn't enough information'.

In addition, some pupils were able to recognise links between claim and evidence in relation to the reliability of the report. A lack of consistency in their use of questions and prompts in this area was evident and consequently greater variation between the pupils' conclusions and the outcome anticipated by experienced readers was observed. This might suggest that the element of media reports that address science reasoning presents a greater challenge for the novice critical reader than other elements of the report. However, the critical capacity demonstrated by some pupils would suggest that, with appropriate support, this might be an achievable goal for more pupils at the upper primary level.

Some elements of the media report were open to different interpretations. In these situations, the nature of the pupils' reasoning was a key factor in assessing the level of critical thinking. Two patterns were evident in the pupil responses. Firstly, they tended to view the report more positively than critical reading of the text might have warranted. Pupils readily attributed high status to the science sources and expressed confidence in the research done by scientists, commenting, for example, that *'the scientists must know what they are doing'.* Secondly, pupils' conversation in relation to these uncertain areas was limited and lacked judgement. It was not uncommon for a decision to have been made within the group, but no coherent reason to be evident. Observations in relation to the reliability of the text might suggest that pupils are least well equipped for tasks where the outcome can reflect differing interpretations of the news text. Two contributing factors may be relevant. Firstly, pupils may lack the maturity and/or the structure for argument and negotiation and so are hindered in expressing their reasoning. Secondly, they may have insufficient practical science experience and the necessary science process knowledge. In addressing both of these deficits,

appropriate interventions by the teacher in the role of 'the more experienced other' could facilitate learning. For example, as noted previously, some pupils suggested that scientists might not share their work with others so as to keep control of the development. The teachers took the opportunity to initiate a whole class discussion about how scientists have developed a way of writing about their work so that they can learn from others. These disputed text elements, while the most challenging, may provide the greatest opportunities for dialogue and, in turn, learning in relation to critical reading.

Sketch-pad data

The 'visual representations' constructed by the pupils were compared to diagrams of the type found in age-appropriate commercial science texts. These were similar to the type of graphic teachers might have expected to use in a more structured and teacher-guided lesson about the human body. Analysis focused on structure, detail and the appropriate use of labelling in the pupils' drawings.

In the absence of prior learning, pupils based their drawing and labelling of diagrams on their interpretation of the text. Though representations offered by individuals were often incomplete, these proto-diagrams were the basis of negotiation. Observations indicated a consistent pattern of refinement from initial incomplete rough drafts to structured and labelled diagrams that were consistent with their textbook comparators. Pupils used their visual representations to communicate what they had learnt from reading the text. To achieve this, they had to piece together a number of different references to the structure of the skin and so construct knowledge.

In doing so, they were handling their own ideas and consolidating their understanding. This is an important observation, which underlines the potential to use science-related drawing to give expression to pupils' understanding of a science idea that emerges from their critical reading. The process of negotiating and agreeing on the appropriate graphic to support the news article stimulated learning conversations. The effect of this dialogue could be seen in the refined final graphic produced by the group. It was evident from the visual product that pupils were able to translate the information from the written text to a visual representation, which is an indication of learning

that is intrinsically different from memorising a textbook diagram.

It was evident and noteworthy that teachers reporting on these visual tasks indicated that some previously reticent pupils found their voices. Here, the pupils were able to demonstrate a grasp of science knowledge that they had constructed as a result of careful and critical reading and discussion of the media text. This might suggest that visualisations provide opportunities for productive dialogue that arise naturally when pupils have to negotiate between different versions of a description. Inaccurate or incomplete diagrams from others are stimuli to explore and refine knowledge. It could be argued that the absence of detailed topic knowledge among the group placed everyone at an equal level.

Conclusion

This classroom-based study provides support for the role of science media in the development of science literacy and is relevant to teachers, teacher educators and those with responsibility for curricular evaluation and development. The study demonstrated primary pupils' capacity to access appropriately selected science-based news media. The study is significant in a field where evidence from the classroom is limited, in that it provides examples of the use of science media reports to support learning in science. These findings are important for practice. They suggest that appropriate frameworks to support critical reading based on science-based reports could be beneficial in the upper primary school and should warrant the allocation of curricular time.

As evidence of critical reading, pupils demonstrated an appropriate grasp of the ability to 'question a text' in order to assess its credibility. This observation is noteworthy and would suggest that this approach should be further refined and its value as a foundation to higher levels of critical reading capability be explored. In this context, the use of dialogue to develop pupils' capacity to promote their own ideas and accommodate the ideas of others through negotiation was observed. This type of activity is key to encouraging pupils to take ownership of their ideas in the process of learning. Opportunities to exploit this through the use of media resources in the classroom should be highlighted.



The recognition by pupils of the relevance of media-reported science was noted and this contributed to the level of engagement that was observed. In particular, the efforts that pupils made to construct knowledge were evident as pupils worked with news text to understand and explain a science idea. Engaging with news text was also observed to give pupils opportunities to explore and consolidate their literacy skills in a cross-curricular context.

Teachers effectively used media resources to support critical reading in ways that they believed suited their pupils, and they gave only as much support as pupils needed to access the activities. It may be reasonable to suggest that, with experience and the benefit of evaluation, teaching strategies could be further developed. Additional support provided by teachers might focus in particular on i) evaluating the validity and reliability of scientific methods or designs, ii) claims and supporting evidence that may appear in science media reports, and iii) the skills needed to judge between contesting positions that appear to draw on the same news-based evidence to support different conclusions.

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This is a task for pupils working in groups. This activity focuses on the news resource and asks the question: Does it (the news report) stand up to scrutiny?

Pupil guidance

Use the template (Figure 1). as a model for your own news bug. Each leg represents some of the key questions we should always ask about a news report. First read the whole news report carefully. Highlight any parts that were particularly interesting and make a note of any questions you have.

Share the question cards numbered 1 – 6 among the group. Taking the questions one at a time decide if the news report helps you to answer the question. Is there enough information? If you think the news report can help you answer the question, and your group agrees, add a leg to build your group bug. Use the template to keep a note of your answers and the reasons for your decision.

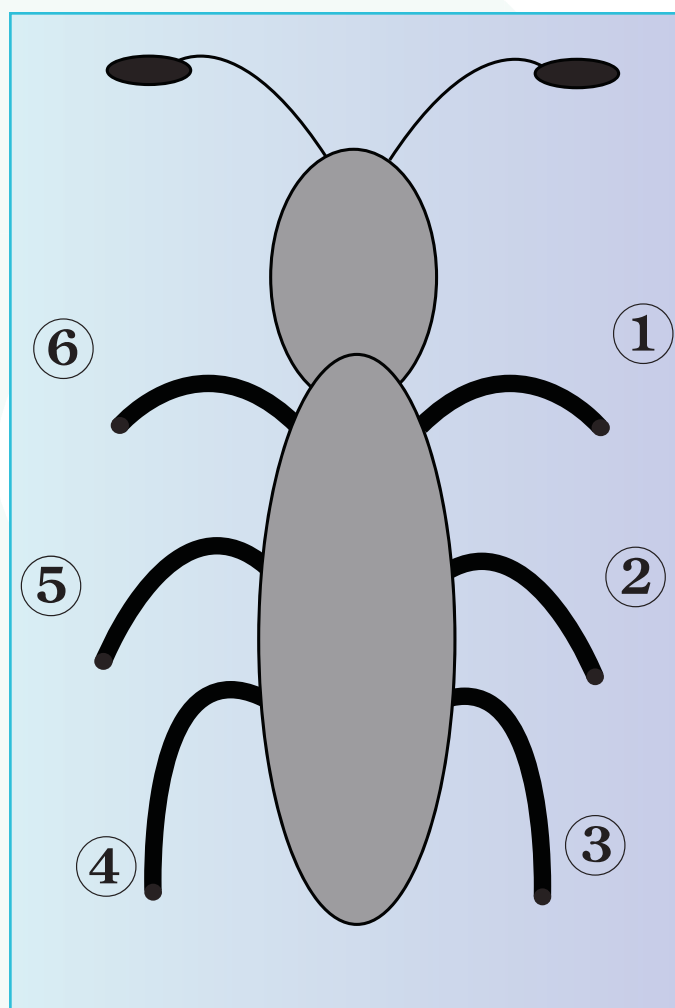
Outcomes

Pupils interrogate the text using the 6 key News Bug questions. Each main question and supplementary guidance questions focus on an important element in a credible and reliable science-based news report.

Samples of pupils' writing indicated different levels of understanding that pupils as a group demonstrated.

The responses illustrate different degrees of insight into the text (Table 1). These responses indicate the pupils' aptitude for critical inquiry and the levels of comprehension that were achieved within the group of pupils.

Figure 1: The News Bug template.



Appendix 1 Table 1: Categories of pupil responses to key questions.

Type of comment	Exemplar comments
Insightful – an awareness of other points of view and /or consequences	- It's important to my community because some people don't like going for injections so they end up spreading the sickness.
Accurate – use direct quotation or reference to the text as supporting evidence	It (the news report) does not say that any other scientist's opinions were brought into this report.
Naïve – uncritical acceptance. Likely to attribute certainty to familiar sources.	- A special correspondent wrote the news report. He uses lots of specific words like he knows how it works.

6

CONCLUSIONS

Are the conclusions or assertions supported by evidence?

Are there specific claims made?

Is there any explanation of findings or observations?

How certain are the scientists?

1

CONTEXT

What is the setting of the media report?

Who wrote the news report?

Does the writer have expertise or a special interest in the topic?

Where is the report published?

5

METHODS

What science research is the story based on?

Who did the research?

How was the research done?

Where did scientists report their work?

Is there information about new knowledge?

2

SUBSTANCE

What is the importance of the study?

What are the implications or applications of this study?

How important is it to me?

How important is it to others in my community?

4

SCIENCE SOURCES

Is there information about what other scientists think?

What do other scientists think?

Are different sources quoted?

Is there reference to other science research or knowledge?

3

USE OF LANGUAGE

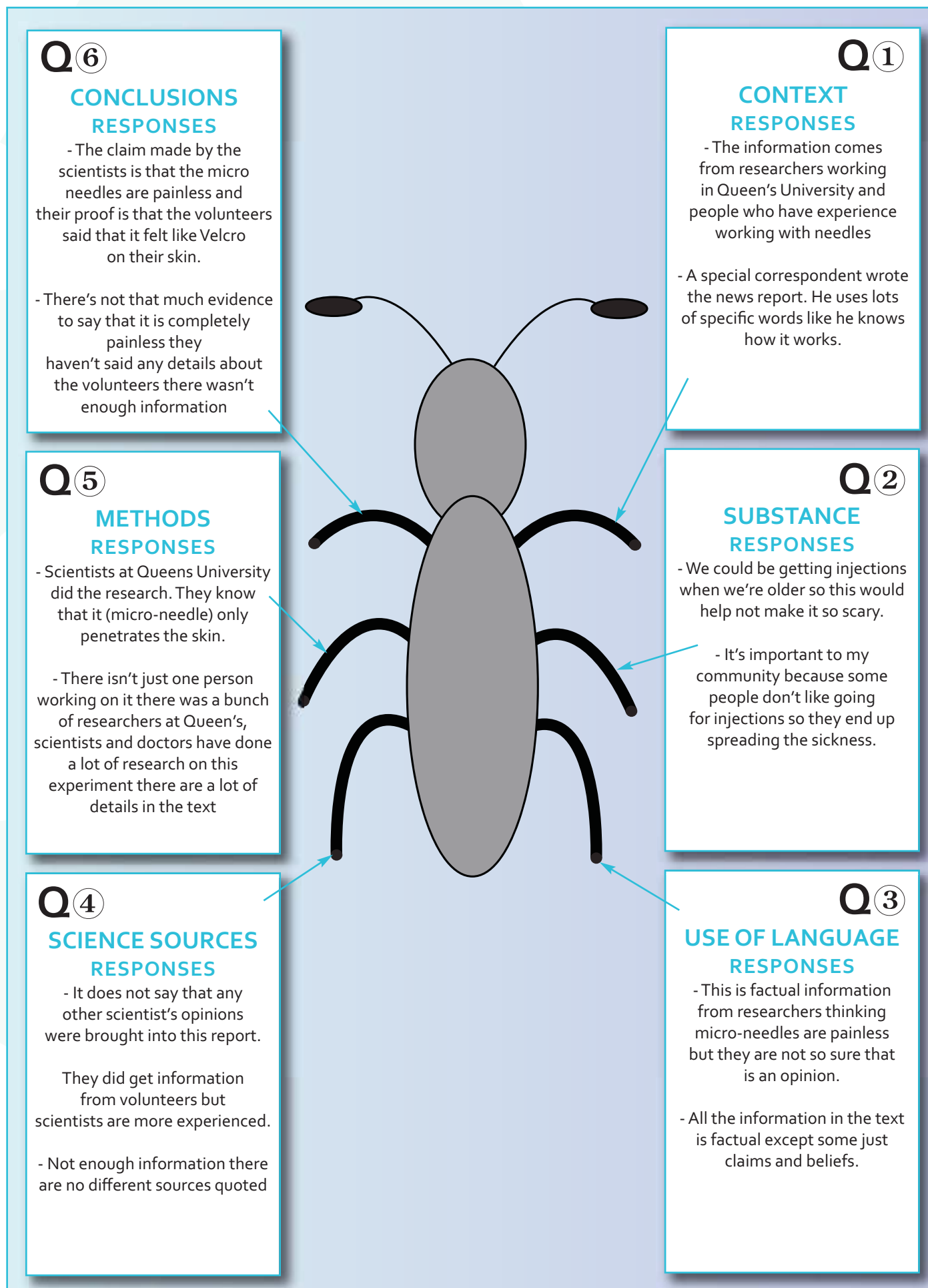
Are the main points reasonable and in agreement with facts?

Is there factual information?

Is there opinion supported by evidence?

Is the language emotive?

Are alternative views given?



Appendix 2: Sketch-pad overview

This is a task for pupils working in groups. As part of the theme of 'science in the world around us', pupils are thinking about a number of topics including the human body. The topic is contextualized using the media report about 'painless injections'. A news media report provided the stimulus resource materials. Pupils were encouraged to 'Find and highlight important words and phrases in the text'.

Pupil guidance

Use the information in the text to make a graphic (picture) that could help people understand the news report and how the micro-needles deliver drugs into the skin. Use some of your own words and phrases to complete your sketch (Figure 1).

Outcome

After reading these in context they worked in groups, using the text as reference, to talk about what they thought the micro-needles were like and how they could work to give a painless injection. They discussed the structure of the needles, the materials and importantly tried to visualize what was under their skin. The final stage was to agree what sort of graphic they could draw to could help explain how micro-needles work .



Appendix 2 Figure 1: Sketch-pad.

Samples of pupils' drawings illustrate the different levels of understanding that pupils as a group demonstrated.

The diagrams have different degrees of complexity that may indicate the different levels of understanding that was achieved within the group of pupils. In the examples shown here there is a progression from superficial to detailed. Pupil sketches were categorised as minimal, single element, complex or overview (Figure 2)

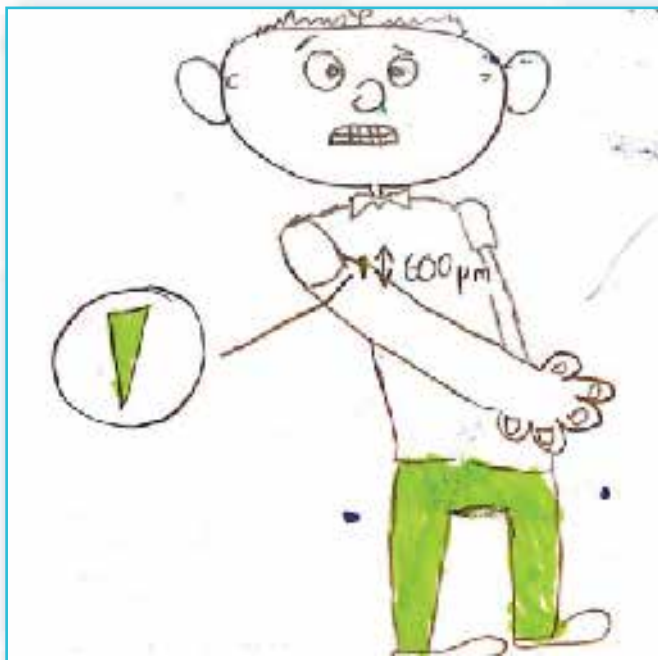
Appendix 2 Figure 2: Categories of pupil sketch

Sketch Category	Descriptor
Minimal	Sketch focuses on one specific feature
Single element	Sketch shows detailed information on a single element
Complex	Sketch shows detailed information on multiple elements
Overview	Sketch shows general description of the series of actions

Appendix 2 Figure 3: Examples of pupil sketches

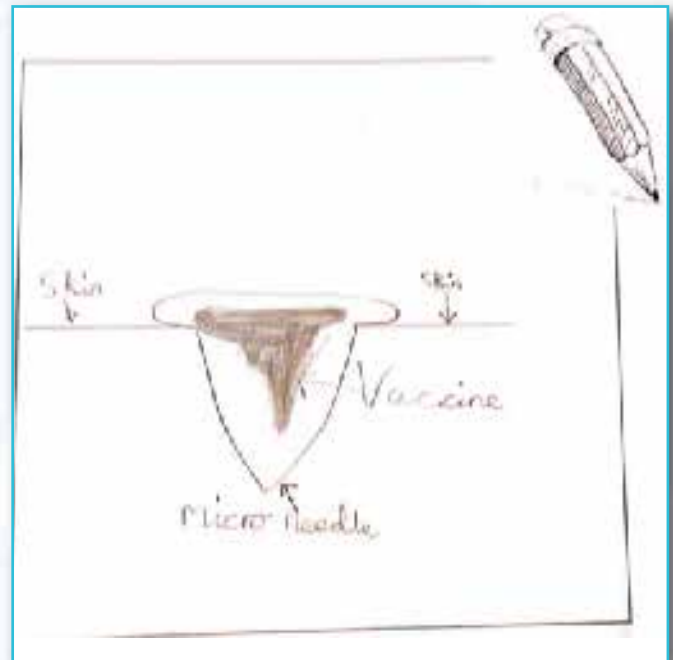
Sketch 1. Minimal –

focuses on one specific feature, (the length of the needle).



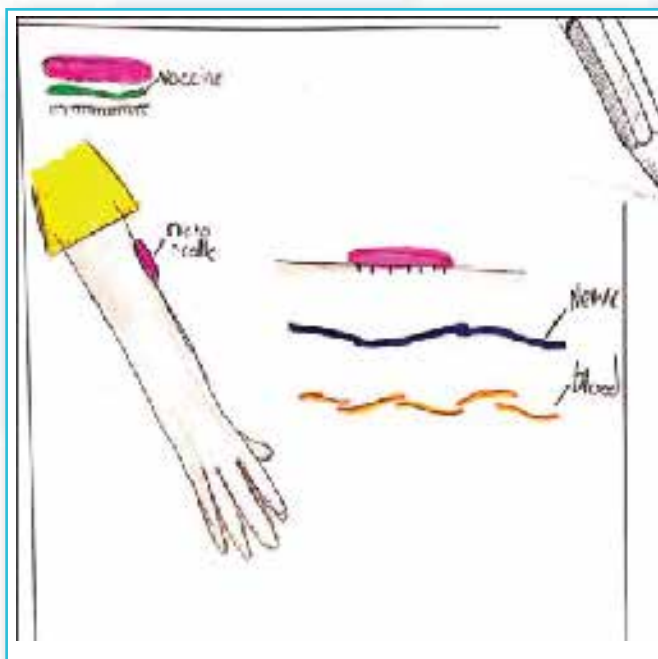
Sketch 2. Single element –

Detailed information on a single element (the structure of the needle)



Sketch 3. Complex –

Detailed information on multiple elements (needle patch, skin, nerves and blood vessels)



Sketch 4. Overview –

General description of the series of actions

