

Science Education and Education for Citizenship and Sustainable Development

Ronald Johnston
University of Wales, Newport, UK

In the United Kingdom (UK) and Europe, the need for education for sustainable development and global citizenship has recently been emphasised. This emphasis has arguably found its major home in the social studies in higher education. Concurrently, there has been a decline in interest in 'the sciences' as evidenced by a reduction in the number of students undertaking science degrees. It is proposed that basic scientific literacy is essential for effective education and participation in society's decision making processes associated with many socio-scientific issues. This paper considers the challenges facing science teaching as an essential component of education for sustainable development and global citizenship. The results of a survey of students in Wales where this is compulsory and in France where it is optional are referred to as indicators of the effectiveness and challenges and the role of science teaching in this context.

Introduction

There is an essential and specific role for science teaching and learning within education for sustainable development and global citizenship at all levels of education – secondary, vocational, post-compulsory, and beyond. While on first examination this may seem obvious, issues of sustainability and citizenship appear to find their fora most commonly in other disciplines. Over the past decade, in the United Kingdom (UK) and Europe, this state of affairs has been exacer-

bated by a noticeable decline in student uptake of science as a degree choice and career pathway. There has been a similar decline in the public understanding of science and those issues associated with many scientific and technological developments. This may be viewed as a reduced *scientific literacy* which has the potential to exclude considerable sections of society from the decision making processes associated with many controversial applications of science and technology. This also

raises serious concerns about the long term social consequences of a scientifically illiterate society. It is not my intention here to separate the sciences from other disciplines, but rather to identify ways in which a basic understanding of science may complement educational initiatives addressing major issues of sustainability and citizenship. In this undertaking it is useful to compare the Welsh and French approaches to education for sustainable development and global citizenship. In Wales, education for sustainable development and global citizenship embedded within subjects is compulsory whereas in France such educational initiatives are optional dependent on the interest of the teacher/lecturer.

At all educational levels in Wales, *The Revised Curriculum for Wales* (Welsh Assembly Government, 2008) closely associates issues of sustainability with those of *global citizenship* addressing these as Education for Sustainable Development and Global Citizenship – thus, linking local, regional, and national issues within a global perspective. England, Scotland, and Northern Ireland each have similar themes in their curricula, identified as Education for Sustainable Development within which global citizenship is also addressed to a greater or lesser degree. In Canada these issues are addressed under the banner of science-technology-society-environment. Clearly the dual aspects of sustainability and citizenship are intimately linked in the international consciousness by design or perhaps *parallel evolution*. However, it is the effectiveness of education for sustainable development and global citizenship and the role of science education in the context of *citizenship* and *global citizenship* that forms the central interest of this paper.

Goals and Challenges

The professional standards developed for teachers embedding education for sustainable development and global citizenship in Wales advises that the goals of the teacher should be to, “enable action via informed discussion and recognise the responsibility to present balanced information from a range of sources in order to enable critical thinking and informed

debate” (Lifelong Learning UK, 2009, p. 8). These goals aim to support the development of informed opinions and decision making processes required by the complex decisions associated with issues of sustainability and the ethical decisions that society has to make. With reference to science education this necessarily entails consideration of socio-scientific issues – being those issues which “have a basis in science and which have a potentially large impact on society” (Ratcliffe & Grace, 2003). Since citizenship implies participation in decisions made by society, scientific literacy is essential to enable the effective participation in a heavily scientifically dependent society. Waghid (2005) identifies the important role citizenship education plays in preparing students for informed participation in public dialogue about questions of justice and morality. It follows then that the greater the understanding of socio-scientific issues that an individual or group has, the better equipped they will be to make such decisions or adopt/oppose policies relating to these issues. It would appear then from the foregoing that science education should be an excellent vehicle for citizenship issues and that all should welcome the role it has to play. Nevertheless, embedding citizenship education into science teaching and vice versa is not without problems.

One of the key findings of the UNICEF 2000 survey of Citizenship in UK Schools (Mackenzie, 2000) was that Religious Education, History, Geography, and Personal Social and Health Education are the most likely areas for teaching citizenship issues – perhaps because the terminology of the subject is familiar. An unintentional effect of this can be the development of a polarised understanding of the natural world (and perhaps society), where science and global citizenship and other social studies are viewed as belonging to separate conceptual frameworks (Johnston, 2002). Surprisingly, currently science would appear not to be the ‘natural home’ for the teaching of citizenship-related issues – and surprisingly, because a basic understanding of science would appear to be essential in order to appreciate the complexities of the social and political impacts of socio-scientific issues of the type referred to above. In the absence of such an understanding, many learners and the public in general are frequently mis- or ill-informed and

effectively excluded from or become a liability in the decision making process (Hodson, 2003).

For most people, the association between science and sustainable development is clear in terms of efficient food production, resource utilisation, and environmental management. This may result from the fact that education for sustainable development has grown out of a blend of environmental science and development studies curricula (Ratcliffe & Grace, 2003). However, it is not always so clear how science teaching may underpin citizenship issues. While this may have clear associations for academics and educators, there may not be such a clear association in the minds of non-specialists, students, and pupils. In fact, science may often be perceived as being the root cause of many non-sustainable and antisocial developments – especially when its findings conflict with opinion, faith, or are simply unpleasant truths. One problem is that scientific information is communicated by means of a complex technical language. This in itself has the capacity to disenfranchise people from a democratic role in socio-scientific decision making processes. In comparison with most humanities or social studies subjects there is a commonly understood initial vocabulary whereas, science requires a complex technical language which must be learned first before personal understanding and effective communication of ideas can take place. This is often outside the comfort zone of many learners – particularly true of mature students returning to study who may find it difficult to know where to start learning this ‘obscure’ language. Consequently, many people are resigned to holding views informed by popular, generalist media sources which also often suffer themselves from incomplete understanding and misinterpretation of facts.

An example of this is the controversy surrounding the proposed link between autism and the measles mumps and rubella vaccine in the UK where public reaction in the first instance was in response to alarmist and misinformed reporting and publication of jargon-heavy discussion. The issues here are of course far from clear (Deer, 2010) but what is clear is that the science underpinning this particular socio-scientific issue was greatly misunderstood and muddled by alarmist reportage to a confused and concerned public. A survey reported

in the *British Journal of General Practice* asking the source of parental information about the measles mumps and rubella issue, established television and tabloid newspapers as the major source of their information (Pareek & Pattison, 2000) and possibly their confusion too! Similar confusion is associated with topics such as climate change and genetically modified crops, fuelled considerably by speculations presented as proven facts by the media, thus giving rise to confusion and distrust of the underlying scientific claims. Such misinformation extends into the most respected sources, for example the BBC, which has recently had its integrity questioned by allegations of bias in its science coverage (Fox, 2010; Khan, 2010). This and other instances of loose reporting and erroneous speculation is prompting a demand for an increased responsibility and rigour from all media sources in their interpretation of socio-scientific issues. These examples highlight the problem and present instances where science education for citizenship could certainly result in a more informed public better equipped to make personal judgements and enquiries about these complex issues.

The Survey Approach

Education for sustainable development and global citizenship is embedded within every subject all educational sectors and at all levels throughout Wales whereas; in France this is optional and reliant on each practitioner for inclusion into the curriculum. This presented a good opportunity to understand the effectiveness of such embedded approaches as used in Wales. The survey discussed here was undertaken to compare responses to key issues of education for sustainable development and global citizenship and science education between students attending Paul Duez Lycee, Cambrai in Northern France and University of Wales, Newport in South Wales. This was a qualitative study with no control group and the subjects of the survey were not randomly selected. The sample group consisted of students in the age range 16-20 in secondary education in south Wales and higher education courses at the University of Wales, Newport in the academic year 2009/2010

(n=104) and also Paul Duez Lycee, Northern France (n=130). The group was chosen on the basis of their engagement in a multi-disciplinary educational programme and the age groups and backgrounds represented. Respondents were asked about the importance of science to themselves and society (see Appendix 1). The full survey was extensive in its enquiry (available from Ronald.johnston@newport.ac.uk) however, only those questions relevant to this discussion are presented here. A 4-point Likert scale (ranging from very negative to very positive) was used in order to estimate the intensity of the respondent's point of view. In this instance on the 4-point scale the lowest two values (1.0 and 2.0) represent negative responses, whilst the highest two values (3.0 and 4.0) were taken as positive responses. With reference to the three direct questions used in the survey, it was made clear to respondents that an affirmative response would be indicated by Likert scores 4 & 5

and a negative response would be indicated by Likert scores 1 & 2. The ambiguity and controversial rigour of Likert analyses is discussed elsewhere (Johnston, 2009) and on these grounds I have preferred the use of descriptive analyses in this current study. However, a more rigorous sampling design to investigate hypotheses generated by this survey is planned for the coming year.

The Results & Points for Further Consideration

An interesting starting point for reviewing the results of this survey relates to students' preferred sources of information on education for sustainable development and global citizenship and socio-scientific issues. Figure 1 shows that in this sample,

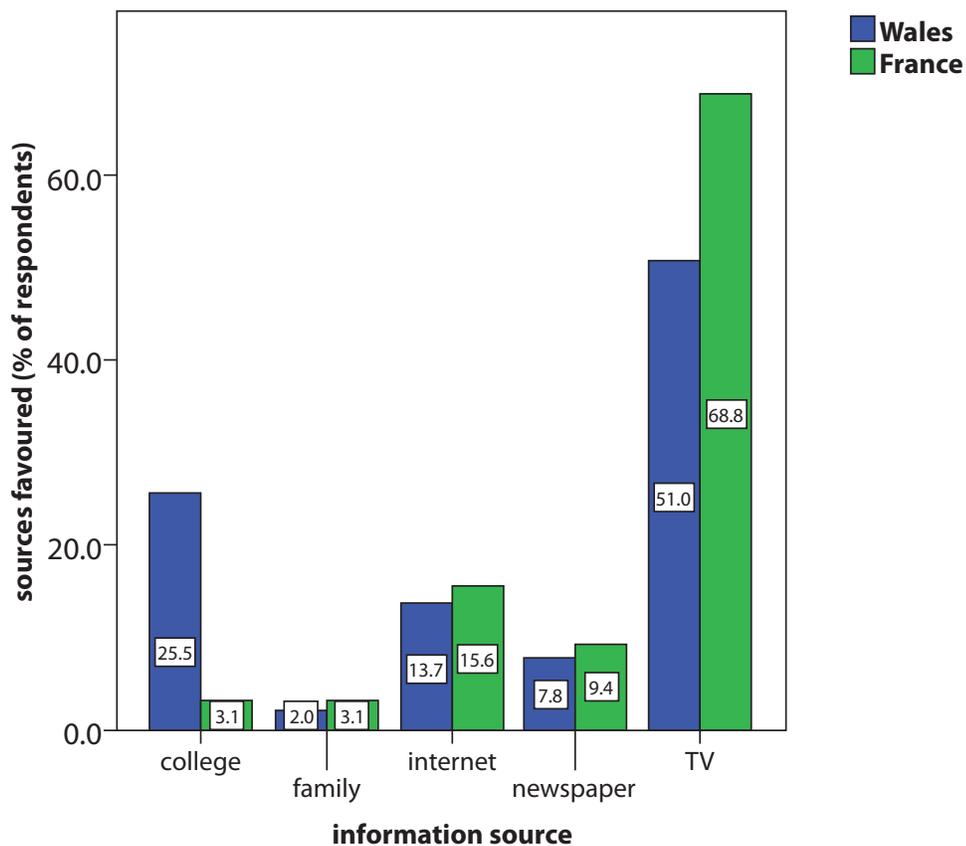


FIGURE 1

What is your main source of information regarding environmental and scientific issues?

Welsh respondents (68%) refer less to television preferring educational / professional sources, whereas in France (51%) television is clearly the preferred choice. There may be many reasons for this, however this begs the question : Is this related to the requirement to embed education for sustainable development and global citizenship within each subject at all levels in Welsh education in contrast to France where this is not a requirement? What requires further exploration is: *Does this lead to a more informed position on such these issues?*

Figure 2 and Appendix 1 provide responses to specific questions relevant to this discussion. Some interesting contrasts appear here which may

indicate the positive effects of embedding subject specific education for sustainable development and citizenship and science education. Some questions prompted similar responses, with others there was a clear difference of opinion – these differences are discussed below.

A clear difference of opinion exists between sample groups about how effective their education has been in preparing them for understanding the complexities of environmental issues. Welsh students (46.8%) agreed that their education had been effective in this compared with 28.5% agreement from French students. Regarding whose responsibility it is to address environmental problems, there is a

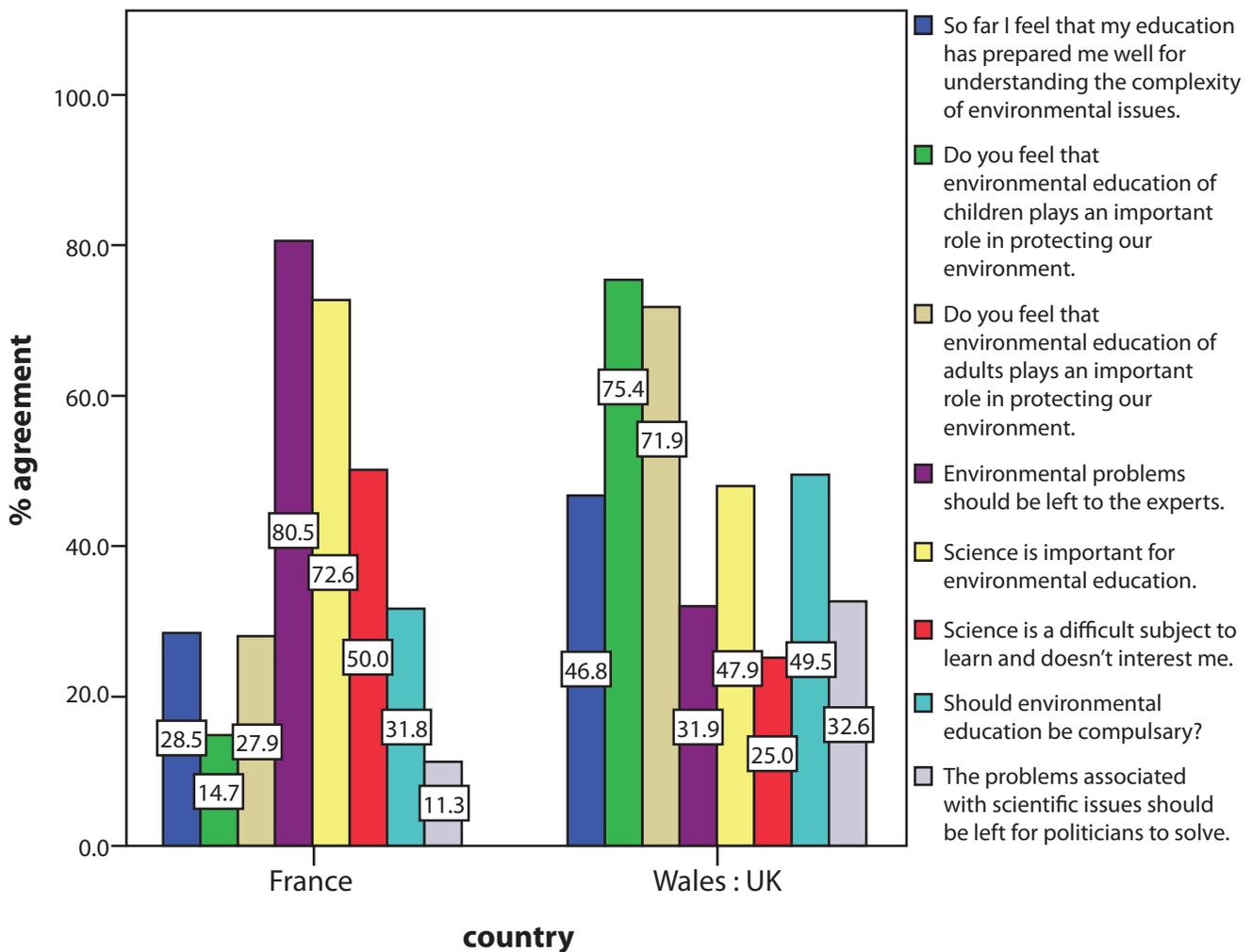


FIGURE 2
Response to specific issues in environmental, citizenship, and science education.

clear difference of opinion: 80.5% French students agreed that “environmental problems should be left to the experts” whereas, only 31.9% in Wales agreed with this. One can ask in this case: Is this an indication that compulsory embedded education for sustainable development and global citizenship in Wales is promoting a greater sense of environmental responsibility?

In considering the target groups for such educational initiatives there is again a noticeable difference of opinion: only 14.7% French students agreed that environmental education of children plays an important role in protecting our environment whereas in Wales, 75.4% students were in favour of this. There is a similar response in considering adults as a target group for education for sustainable development and citizenship with 27.9% agreement from French students in contrast to 71.9% in favour of adult education for sustainable development and global citizenship in Wales.

Regarding the overall importance of science in education for sustainable development and global citizenship French students (72.6%) agree strongly that science has an essential role to play whereas, there is not as strong an agreement from the Welsh response (47.9%). However, French students feel less well disposed to learning science – 50% agreeing that it is hard to learn and that they have no interest in it. Both groups appear to have reservations about this and I think this a key area to address since it is perhaps the approach to teaching science in context that might reduce these negative responses.

French students (11.3%) are less willing to leave (socio) scientific issues to their politicians to resolve whereas in Wales there appears to be a little more faith in political leadership. Nevertheless, neither group seems in a hurry to trust scientific issues *solely* to their politicians Wales (32.6%). Finally, there seems less appetite for education for sustainable development and global citizenship as a compulsory component of education in the French response than is the case in Wales, although both groups show less enthusiasm for this than might have been expected. The underlying reason for this begs further investigation.

Conclusions

Most people are generally aware of the impacts of socio-scientific issues and development related problems but frequently do not have the scientific basis to appreciate their origin or identify the appropriate actions to take towards their resolution. It would seem from the foregoing that education for sustainable development and global citizenship contributes to greater understanding of these issues and is most effective when subject oriented and embedded within subject-specific teaching. To enable such education to be truly effective it should associate socio-scientific issues with key concepts in science. Students (as members of the public) need not achieve a career level understanding of science but the aim should be to provide key concepts in science sufficient to form a basic scientific literacy. The embedded nature of education for sustainable development merits further discussion and more widespread trialling. The premise here is that it should relate to the subjects being studied and the career pathways being followed rather than be presented as an abstract which it would be ‘useful’ or ‘nice’ to be aware of. From this starting point judgements may be made allowing fuller participation in decision making processes relevant to the students involved thus fulfilling the goals of active citizenship whether it be local national or global.

References

- Deer, B. *The Lancet scandal*. Retrieved from <http://briandeer.com/mmr-lancet.htm>
- Fox, F. (2010, January). How MMR saga shaped science’s rules of engagement with the media. *Times Online*. Retrieved from <http://www.thetimes.co.uk/tto/health/child-health/article1791862.ece>
- Hodson, D. (2003). Time for action: Science education for an alternative future. *International Journal of Science Education*, 25, 645-670.

- Johnston, R.A.S. (2002). Wild Berwyn or coy nature reserve: A changing landscape. *Canadian Journal of Environmental Education*, 7(2), 166-178.
- Johnston, R.A.S. (2009). The role of science within education for sustainable development and citizenship: Sustainable development and citizenship within science education. *Proceedings of the Newport NEXUS Conference Linking Research and Teaching in Higher Education*, University of Wales, Newport, 27-33.
- Khan, U. (2010, January). BBC to launch review into allegations of bias in its science coverage. *Telegraph Online*. Retrieved from <http://www.telegraph.co.uk/culture/tvandradio/6941616/BBC-to-launch-review-into-allegations-of-bias-in-its-science-coverage.html>
- Lifelong Learning UK. (2009). *Application of the professional standards for teachers embedding education for sustainable development and global citizenship*. Cardiff: Welsh Assembly Government.
- Mckenzie, A. (2000). *Citizenship in schools: A baseline survey of curriculum & practice in sample English, Welsh & Northern Irish education authorities in Spring 2000*. London: UNICEF.
- Pareek, M. & Pattison, H. (2000). The two-dose measles, mumps and rubella (MMR) immunization schedule: Factors affecting maternal intention to vaccinate. *British Journal of General Practice*, 50, 969-971.
- Ratcliffe, M. & Grace, M. (2003). *Science education for citizenship: Teaching socio-scientific issues*. Maidenhead: Philadelphia: Open University Press.
- Waghid, Y. (2005). Action as an educational virtue: Toward a different understanding of democratic citizenship education. *Education Theory*, 55(3), 323-343.
- Welsh Assembly Government. (2008). *Education for sustainable development and global citizenship guidance for teacher trainees and new teachers in Wales*. Cardiff : Welsh Assembly Government.

Biography

Ronald Johnston (Ph.D. BSc., PGCE) teaches Biology, Chemistry, & Environmental Studies on undergraduate and post-graduate courses at the University of Wales, Newport, UK and Environmental Studies in Northern France. His research in the fields of Environmental Science and Biogeography includes the plant/soil relationships of the heather moorland of the Berwyn Mountains in Mid Wales and vegetation succession on derelict land in Wales and Scotland. He is also researching the continuing environmental impacts of war on the landscape of the WW1 Verdun battlefield. The importance of environmental education across all age groups and levels of study has become an increasingly important element of this research in recent years.

Appendix

Responses to specific issues of environmental and citizenship education.

Question	France 16-20 % agreement		UK 16-20 % agreement	
	disagree	agree	disagree	agree
So far I feel that my education has prepared me well for understanding the complexity of environmental issues.	71.5	28.5	53.2	46.8
Do you feel that environmental education of children plays an important role in protecting our environment?	85.3	14.7	24.6	75.4
Do you feel that environmental education of adults plays an important role in protecting our environment?	72.1	27.9	28.1	71.9
Environmental problems should be left to the experts.	19.5	80.5	68.1	31.9
Science is important for environmental education.	27.4	72.6	52.1	47.9
Science is a difficult subject to learn and doesn't interest me.	50.0	50.0	75.0	25.0
Should environmental education be compulsory ?	68.2	31.8	50.5	49.5
The problems associated with scientific issues should be left for politicians to solve.	88.7	11.3	67.4	32.6