Collaboration between Science and Religious Education teachers in Scottish Secondary schools.

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Abstract

The paper reports on quantitative research that examines (1) the current practice in collaboration and (2) potential for collaboration between Science and Religious Education teachers in a large sample of Scottish secondary schools. The authors adopt and adapt three models (*conflict*; *concordat* and *consonance*) to interrogate the relationship between science and religion (and the perceived relation between these two subjects in schools) (Astley and Francis, 2010). The findings indicate that there is evidence of limited collaboration and, in a few cases, a dismissive attitude towards collaboration (*conflict* and *concordat* and very weak *consonance*). There is, however, evidence of a genuine aspiration for greater collaboration among many teachers (moving towards a more robust *consonance* model). The paper concludes by discussing a number of key factors that must be realized for this greater collaboration to be enacted.

Key Words: Science and Religious Education; Secondary Schools

Introduction

This paper reports on the findings of a quantitative survey conducted with Science and Religious Education teachers in secondary schools in eight local authorities in Scotland. The survey was conducted as the initial stages of a Research project aimed at exploring the potential for collaboration between Science and Religious Education teachers. The paper begins with a brief discussion of the relationship between science and religion and three models suggested by Astley and Francis that characterize this relationship. We modify and apply these models to the relationship between science and religious education in secondary schools. The paper then outlines the aims, methodology, sample and findings of the research. The findings are grouped in two main sections: (1) current practice and (2) potential for collaboration. The discussion of the findings examines the disjuncture between current practice and aspiration for greater collaboration and the practical stages that would have to be enacted to ensure this collaboration would be effective.

Science and Religious Education

A number of leading contemporary scientists and thinkers argue for a complete polarization between science and religion. Key figures such as Richard Dawkins (1986, 2006, 2011), A. C. Grayling (2007, 2011, 2013), Sam Harris (2004, 2006) and the recently deceased Christopher Hitchens (1995, 2007a, 2007b) are highly critical of the claims of 'unscientific' religion and warn of the harm caused by religion and religious beliefs. Daniel Dennett seeks to understand religion while remaining resolutely atheist (2006, 2011). These figures are often described as being *new atheists* and their views have been highly publicised and, arguably, have been influential on popular opinion. Dawkins has set up the *Richard Dawkins Foundation for Reason and Science* to promote science and to 'overcome religious fundamentalism, superstition, intolerance and human suffering' (Richard Dawkins Foundation, 2013). Similarly, Harris has established *Project Reason* to spread

'scientific knowledge and secular values', but also to challenge religious dogmatism (Project Reason, 2013).

This contemporary polarization between science and religion should be framed against the long and complex historical relationship that exist between these disciplines - disciplines that were not always easily distinguishable in their nascent stages (Harrison, 2010). Skirbekk (2012) points out that there was a strong relationship between the emerging natural sciences and religion from the late medieval period up to the eighteenth century. The disciplines of science and religion evolved, becoming more defined and developed from the seventeenth century onwards (Harrison, 2012). Post-enlightenment movements from the eighteenth century, such as Marxism, Historical positivism, Darwinism, logical positivism and secularization theory challenged the relationship between the disciplines and proposed a fundamental 'conflict' between science and religion (Turner, 2010; Skirbekk, 2012). This fundamental 'conflict' is championed by the *new atheists*, but the 'conflict' has been questioned, strongly challenged and remains a focus for intense academic debate (Cantor, 2010). The 'conflict' position has been criticized, for example, for distorting the complexity of both science and religion and for failing to recognize that many individuals engage with both science and religion (Cantor, 2010; Øyen, Vaage and Lund-Olsen, 2012).

Astley and Francis (2010) use 'conflict' in their discussion on the contemporary relationship between science and religion, but they helpfully contextualize it within a tripartite framework. Thus, they identify a *conflict* model, a *concordat* model and a *consonance* model. The *conflict* model supports a positive view of science but a negative view of religion, and, in its strongest sense, a 'necessary conflict between science and religion' (Cantor, 2010, 285). Poole (2012) likens it to a 'warfare model'. Astley and Francis cite Dawkins as a supporter of this model. The *concordat* model represents a mutually respectful relationship between science and religion - they suggest that Stephen Jay Gould and Michael Ruse support this model. The final model, the *consonance* model, proposes more than a respectful relationship and that there can be synchronization or compatibility between science and religion. They state that the *consonance* model is favored by Polkingthorne. Astley and Francis argue that young people often perceive a fundamental incompatibility between science and religion and, therefore, are more likely to be in sympathy with a *conflict* model rather than a *concordat* or *consonance* model.

We have adapted these three models for the relationship between science and Religious Education in schools and have exemplified the features of each model as follows:

Conflict model:

- Science is based on verifiable facts.
- Religion is mythology rather than verifiable fact and, as such, cannot be recognized as an academic discipline and can have no relationship with Science.
- The study of religion should not have a place in the school curriculum.

Concordat model:

- There are truth claims associated with religion.

- Religion is an area worthy of study and a valid academic discipline.
- Religion has an authentic claim to be in the school curriculum.

Consonance model:

- Recognition that there is a genuine interface between the two disciplines.
- Recognition that there are areas for interdisciplinary study and that interdisciplinary study would be beneficial.
- Willingness to collaborate in interdisciplinary study in the school context.

Science and Religious Education in the Scottish context

In Scotland, the recent initiative, Curriculum for Excellence (*CfE*), was introduced in 2004 to provide a 'coherent, more flexible and enriched curriculum from 3-18' (Scottish Executive, 2006, 2007, Scottish Government, 2008, 2009a, 2009b, 2011a). Learning was divided into eight curricular areas including Science and Religious and Moral Education for the non-denominational schools and the complementary Religious Education in Roman Catholic schools. The learning in each area was reviewed and updated (Scottish Executive, 2006; Scottish Government, 2008).[1] The inclusion of Religious and Moral Education in *CfE* is consistent with the history of the teaching of religion in Scottish schools which is a statutory requirement, guaranteed in law in the Education (Scotland) Act 1980 (Hartshorn, 2008).

One of the key aims of *CfE* is an increase in interdisciplinary learning and this is emphasized in *Building the Curriculum 1 The contribution of the curriculum areas* (2006). The section on Religious and Moral Education states that:

> There are important connections between themes in Religious and Moral education and, for example, in history, *science* and the arts. These connections can reinforce and enrich learning (our italics).

The section on Religious Education in Roman Catholic schools does not explicitly refer to cross-curricular links with Science *per se* but does state implicitly that:

> Learning in religious education is fundamentally interlinked with learning *throughout* the curriculum, the ethos of the school, and the wider community of faith (our italics).

And, in another reference in the same section:

> Learning in religious education should link with learning *across* the curriculum and the ethos and life of the school (our italics).

The links are explained more explicitly in the section on Science:

> To enhance learning, the guidance will promote links with other curriculum areas, including the technologies, social subjects, expressive arts, health and wellbeing and *religious and moral education* (our italics).

It can be safely presumed that the reference to Religious and Moral Education also refers to Religious Education in Roman Catholic schools. The aspiration of the Scottish Government, then, is greater emphasis on interdisciplinary learning within schools and this includes collaboration between Science and Religious and Moral

Education and Religious Education in Roman Catholic schools. This indicates a clear preference for the *consonance* model.

At this point, we add an important note on nomenclature. 'Science' refers to the following natural science subjects: Chemistry, Physics and Biology. It is more problematic when discussing the teaching of religion in Scotland. In the *CfE* documentation, 'Religious and Moral Education' refers to the non-denominational schools and 'Religious Education Roman Catholic' refers to the Roman Catholic schools. Aside from this documentation, there are a very confusing variety of terms used for studying religion in the denominational and non-denominational schools in Scotland, especially in the secondary schools. These include other terms in popular use: Religious Studies and Religious, Moral and Philosophical Studies. All of the terms above are used across the two sectors with great inconsistency (Nixon, 2012, 13-15; 173-176). While acknowledging the complexity of the debate surrounding nomenclature, we will follow the example of Nixon and adopt Religious Education as a useful generic term that can encompass both confessional and non-confessional approaches to the study of religion and, therefore, can be applied, for the purposes of this paper, to both denominational and non-denominational schools.

Aims of the research

The research was conducted by researchers from the University of Glasgow in conjunction with the Scottish Schools Education Research Centre and was funded by the Esmée Fairbairn Foundation. The aim of the research was to gather data on the values, beliefs and attitudes of teachers of Science and Religious Education towards interdisciplinary collaboration and those attitudes held by pupils concerning the potential links between Science and Religious Education. The research aimed to address the following questions:

- Can Science and Religious Education teachers work together on themes in a way which will enhance the pupils' understanding of science/religion issues?

- What are the resource and CPD needs of both groups and can we establish an effective model for interdisciplinary working?

Method and sample

The research was planned in two phases. First, an initial quantitative self-completion questionnaire was sent by mail to Science and Religious Education teachers in all of the secondary schools (124 in total) in 8 local authorities (there are 32 local authorities in Scotland) in summer 2011 (Simmons, 2008; Scottish Government, 2012). Second, the research team aimed to interview teachers and pupils in selected schools throughout the country to ascertain good practice (including use of resources) further resource and development needs and potential barriers in interdisciplinary work. This paper reports on outcomes from the initial quantitative survey.

The survey sought relevant background details and information in two major areas: (1) *current practice* and (2) *potential for collaboration*. In terms of (1) *current practice*, the survey sought to clarify: any current collaborative work between Science and Religious Education teachers; their confidence to teach their own subject and

their confidence to teach aspects of the other subject; their understanding of pupil views on the relationship between religious and scientific perspectives and CPD involving Science and Religious Education teacher. In terms of (2) *potential for collaboration*, the survey sought to clarify: the potential for collaboration (including areas with most and least potential); the benefits and potential impact of collaboration; the strategies that could support such collaboration and the barriers to effective collaboration. The survey was constructed with the assistance of experts in the teaching of Science and Religious Education and was piloted with a subsample –a number of Science and Religious Education teachers in schools out with the sample – to 'increase the reliability, validity and practicability of the questionnaire' (Cohen et al., 2011, p. 402; May, 2011). The pilot led to further refinement of the survey.

The survey covered 8 local authorities (124 schools) and provided a wide geographical and demographical distribution - at time of the survey: there were a total of 371 secondary schools in Scotland (Bryman, 2008; Scottish Government, 2011b). The sample schools constituted approximately one third of all secondary schools in Scotland. A total of 89 questionnaires were returned which represents an overall return rate of 40% of the sample. Most of the teachers who responded were experienced teachers: 41% had taught for 16 years of more and almost half were promoted (20% faculty head and 26% principal teachers). The majority of respondents were female (63%) and almost all worked full time (93%). There was no significant difference between the Science and Religious Education teachers in terms of gender, age, and size of school worked in, full time or part time employment and numbers of years worked. There was one significant difference: Science teachers were more likely to be faculty heads (35% compared to 4% of Religious Education teachers) and Religious Education teachers were more likely to be principal teachers (37% compared to 14% of Science teachers).

The analysis of the data was conducted using SPSS (Statistics Package for the Social Sciences) and involved running frequencies, cross-tabulations and significance tests (using Chi square) to identify any major differences between the responses of Science and Religious Education teachers. Where significant differences occur, these are reported at the level of 1% (00.1) unless otherwise stated.

Findings

We have grouped the findings in the two major areas identified above, under the following sub-headings.

(1) *Current practice*: significant differences in professional relationships with colleagues; confidence to teach 'science facts' and 'ethical and moral issues' and dealing with pupil questions; teachers indicating 'very confident' in addressing certain questions; how do pupils regard religious and scientific views; working with Religious Education or Science colleagues.

(2) *Potential for collaboration*: Curricular areas and topics offering most potential for collaboration between Science and Religious Education teachers; the potential impact of closer links between Science and Religious Education; priorities for supporting collaboration between Science and Religious Education teachers; commitment of leadership and commitment of staff; Greater understanding between the two

curricular areas; Joint Planning and Operation; Time and Timetabling Implications and Resource and Workload implications.

(1) Current practice

Significant differences in professional relationships with colleagues. Both Science and Religious Education teachers, perhaps unsurprisingly, were more likely to have collaborated on curricular developments and co-taught with colleagues in their own subject area, and there is a very low percentage who would have collaborated or co-taught with teachers in the other curricular area. Religious Education teachers were significantly more likely to collaborate on curricular developments and co-teach with colleagues from social subjects and humanities. Science teachers were significantly more likely to have collaborated with mathematics teachers. Interestingly, both Science and Religious Education teachers were much more likely to share ideas for teaching with colleagues from other subject areas (other than Science or Religious Education) than collaborate or co-teach with colleagues from other subject areas (except for Religious Education teachers collaborating with humanities or social science teachers).

Table 1 inserted here: *Significant differences in professional relationships with colleagues.*

Confidence to teach 'science facts' and 'ethical and moral issues' and dealing with pupil questions. Science and Religious Education teachers were asked to indicate how confident they are as teachers on a five-point scale (1 represented very confident and 5 represented a lack of confidence). Both Science and Religious Education teachers felt very confident (76%) or confident (20%) about teaching, but when they were asked about teaching 'science facts' and 'ethical and moral issues' significant differences emerged. Science teachers (82%) were very confident in teaching science facts compared to Religious Education teachers (15%) and Religious Education teachers (78%) were very confident in teaching ethical and moral issues compared to Science teachers (18%). Additional comments provided by 36 Science teachers and 23 Religious Education teachers suggested that experienced teachers felt more comfortable teaching in the other area of specialization, though some teachers pointed out that the two subjects were not mutually exclusive and that some topics are covered in both Science and Religious Education examinations (e.g. the Big Bang and theory of evolution). Some Science teachers stated that they had a responsibility to incorporate ethical and moral issues in the study of science.

Table 2 inserted here *Teachers indicating very confident in addressing certain questions.*

Teachers indicating very confident when addressing specific questions. Science and Religious Education teachers examined a number of pupil questions and were asked how confident they would feel in engaging with these questions in a classroom. The five point scale of 1 (very confident) to 5 (lack of confidence) was used again. Table 2 displays the descending results of the responses for each question. Religious Education teachers seemed to be more confident than Science teachers when addressing these questions, but both Religious Education and Science teachers were less confident when the focus of the question was more explicitly weighted towards

the other curricular subject. For example, a large number of Religious Education teachers (83%) were very confident addressing the interdisciplinary question of: how can there be a God and science? A much smaller number (33%) were very confident addressing the question more focused on science: can science solve our environmental problems? Similarly, a large number of Science teachers (71%) were very confident addressing Science questions that have an ethical and moral dimension: is preserving the Planet's resources an issue for science?, but much less confident (27%) in addressing questions with an explicit religious focus: did God make the world?

Table 3 inserted here: *How do pupils regard religious and scientific views?*

How do pupils regard religious and scientific views? The Science and Religious Education teachers were asked about pupil perceptions of the relationship between religious and scientific perspectives. If the percentage of those that chose *completely unrelated* are conflated with the percentage of those that chose *offering conflicting perspectives* to create a category of *no relationship*, the figures stand at 86% of Religious Education and 65% of Science teachers who think that pupils perceive no relationship (though 25% of Science teachers state that the pupils *don't know* rather than opt for *offering complementary perspectives*). Sixty-nine teachers (34 Science and 35 Religious Education) provided additional comments to illustrate their answers. These confirmed that they think that the pupils perceive no relationship and the comments were quite similar between the two curricular areas. One Science teacher stated:

> Most pupils do not see any relation between scientific views and religious views, as science views are often seen as fact whereas religious views are seen as opinion or belief.

This was mirrored in a comment from one of the Religious Education teachers:

> Pupils see science as teaching facts, religion as teaching opinions. They perceive that science shows religious views to be untrue.

Some teachers suggested that more senior pupils enjoyed the debate surrounding the relationship between religion and science and if pupils studied science or religion (or both) to more advanced levels, they were more likely to perceive the subjects as complementary rather than having no relationship.

Some Science teachers were in agreement with the pupil perception of no relationship between religion and science:

> Scientific belief is based on demonstrable and verifiable facts. Religious belief is based on unquestioning faith, often in spite of demonstrable verifiable fact. This conflict is obvious to most pupils.

Some Religious Education teachers argue that a polarized distinction between religion and science has been inculcated at an early age:

> Before they reach secondary school pupils have been persuaded that the false dichotomy (between religion and science) is factual.

The findings indicate that there is agreement between Science and Religious Education teachers that the majority of pupils see no relationship between Science and religion.

Working with Religious Education or Science colleagues. In this set of questions we sought a deeper understanding of any joint initiatives / activities between Science teachers and Religious Education teachers. Science and Religious Education teachers were asked to indicate the frequency of their involvement in activities with colleagues from the other curricular area. Table 4 summarizes the results.

Table 4 inserted here *Working with Religious Education or Science colleagues.*

Religious Education teachers are more likely to engage in joint activity with Science teachers than Science teachers with Religious Education teachers. The Science and Religious Education teachers are more likely to discuss areas of common interest rather than engage in joint activity – when they do, the Religious Education teachers are most likely to be involved in cross-curricular initiatives and sharing teaching resources and the Science teachers are more likely to support Religious Education teachers when they seek help with science facts or issues. It is noticeable that there is a very low occurrence of team teaching. The two examples of team teaching that were identified were:

- Comparison and contrast between scientific method and revelation as a means of understanding.
- In a denominational school, team teaching on sexual reproduction and relationships in S1 as part of the Catholic Relationships and Moral Education programme, *Called to Love* (Scottish Catholic Education Service, 2013).

While there was very little evidence of team teaching, the respondents provided information on the other ways in which they had worked together with teachers in the other curricular area. Some were clearly specific to the interface between Science and Religious Education:

- Science teachers provided support for S1/2 pupils preparing Religious Education projects in topics such as the Big Bang, Evolution and intelligent design theory.
- Science teacher support and input for citizenship issues and topics in Higher RMPS Christianity (belief and science; genetic engineering and cosmology).
- Debates – the scientist and the Christian on Evolution.

There are other examples that may be interpreted as the interface between Science and Religious Education or as a result of wider cross-curricular initiatives across the schools that have been prompted by *CfE*:

- Developing *Assessment is for Learning* techniques and also methods for assessment and recording progression for *CfE*.
- Observing each other teaching.

Despite these examples of working together, none of the respondents had engaged in any training or CPD that involved both Science and Religious Education teachers.

(2) Potential for collaboration

Curricular areas and topics offering most potential for collaboration between Science and Religious Education teachers. Respondents were asked to indicate curricular areas and topics that had (1) most potential for collaboration and (2) least potential for collaboration. Almost all respondents (97%) provided a response.

Table 5 inserted here *Curricular areas and topics offering most potential for collaboration between Science and Religious Education teachers.*

Table 5 presents the responses in rank order from most to least frequently cited. There were some marked similarities in the responses. The two areas that were perceived, by both sets of teachers, to offer the most potential for collaboration were: Ethics of medical and scientific developments (especially embryology) and Evolution. Interestingly, the origins of life featured as the most popular area for collaboration proposed by Religious Education teachers, but this was much less popular for Science teachers.

There was general agreement between Science and Religious Education teachers about the topics that offered the least potential for collaboration:

- Philosophy of Religion. Theology. Analysis of religious texts.
- Religious ceremonies, rites of passage, customs.
- Factual aspects of physics – e.g. mechanics, optics.
- Chemistry.
- Physiology.
- Plant Biology.
- Electricity.

The potential impact of closer links between Science and Religious Education. The vast majority of the teachers in the sample (94% of Religious Education teachers and 82% of Science teachers) believed that closer collaboration between the two subjects would be beneficial for their teaching and for the pupil experience. Teachers were presented with a list of statements regarding potential collaboration and asked to indicate their level of agreement with each statement.

Table 6 inserted here *The potential impact of closer links between Science and Religious Education.*

The responses can be examined using two inter-related categories (1) beneficial effect for the teacher, teaching and the implementation of the curriculum and (2) beneficial effect for pupils, pupil learning and pupil skills and attitudes. 57% of Science teachers and 81% of Religious Education teachers believed that greater collaboration would support their teaching. 71% of Science teachers and 93% of Religious Education teachers believed it would enhance the coherence of the curriculum and 86% of Science teachers and 98% believed it would contribute to the implementation of the new curriculum. A large percentage of teachers believed that greater collaboration would improve the teaching for the pupils (79% Science teachers and 96% Religious Education teachers). Noticeably, the greatest level of agreement between the two sets

of teachers (apart from anxieties about increased workload) is their belief that greater collaboration would benefit the pupils (more informed and more open and tolerant attitudes).

Priorities for supporting collaboration between Science and Religious Education. The Science and Religious Education teachers were asked to prioritize the activities that would provide effective support for greater collaboration between them. This is recorded in table 7

Table 7 inserted here. *Priorities for supporting collaboration between Science and Religious Education.*

There was support for all of the priorities that were suggested, and, in particular, greater knowledge and understanding of the other subject and planned collaboration. Many of the teachers provided further comments and identified a wide range of priorities, which we have outlined below.

Commitment of leadership and commitment of staff. A number of the respondents commented that the enthusiasm and the support of the school leadership is needed to enable successful collaboration between the two curricular areas. The school leadership, they argued, has to be open to new ideas and developments and willing to support them. While the encouragement from the leadership is needed and important, the collaboration, ultimately, will only be successful if the teachers themselves are also enthusiastic and motivated and engaged in the collaborative process. One Religious Education teacher commented:

> If collaboration is forced it will end in disaster and foster acrimony. It is far better to play the long game and achieve the desired goals through encouragement and enlightenment.

Greater understanding between the two curricular areas. Perhaps one the greatest challenges is the creation of a greater understanding and appreciation of the epistemological basis and role of the other curricular area. Some Science teachers were concerned that myths are sometimes suggested as facts in Religious Education. There were numerous comments from Religious Education teachers about negative attitudes from Science teachers about religion, religious beliefs and Religious Education. Religious Education teachers perceived a prevalent atheism existing in science. They also perceived that Science teachers could have a lack of respect and, consequently, lack of interest towards Religious Education. One Religious Education teacher stated:

> Too many Science teachers see religion and science as incompatible; there is a widely held belief that science disproves the existence of God.

Joint Planning and Operation. One of the key strategies to enable effective collaboration was identified as joint planning. It is possible to sketch out a number of stages suggested by the respondents. Initially, as discussed above, the collaboration would involve a greater mutual understanding about the role of the two subject areas in the curriculum. This would be followed by discussion and agreement on issues such as points of contact, joint topics, distribution of tasks and target setting. Some teachers suggested this collaboration should be formally consolidated by including it in development targets.

Time and Timetabling Implications. Collaborative work has implications for teaching staff time, management of class time and for the timetable. First there would need to be time conserved for joint meetings for planning, managing and monitoring the collaborative work and also evaluating the results. Secondly, adequate time would need to be allotted to allow the pupils to complete the joint or shared tasks. Third, there are implications for the timetable as any collaborative tasks/work would need to be taught within a specified time frame. Some teachers pointed out that this may be particularly problematic for two reasons: in some schools Science operates on a rota system (due to restricted access to equipment) and the current re-organization of courses to cohere with the new *CfE* experiences and outcomes.

Resource and Workload implications. Teachers commented that monetary and curricular resources would need to be allocated for the collaborative work. In the contemporary climate of drastic budget cuts, designated funding would be required – e.g. for teaching cover costs to create space for Science and Religious Education teachers to meet. The collaborative work would only be effective if the resources and support materials were high quality. A Religious Education teacher stated:

> …both groups (of teachers) will offer resistance unless/until good resources are made available.

In what emerged as a recurrent theme, there was anxiety that the collaborative work would create pressure on teacher workloads.

Discussion

It is clear from the results of tables 1, 2, 3 and 4 (*current practice*) that, within the scope of the sample, there is very little formal collaboration, or co-teaching between science and religious education teachers in current practice. The two sets of teachers have reported that they feel less confident when teaching a topic that is explicitly and substantially orientated towards the other curricular area. Both sets of teachers think that a high proportion of pupils perceive no relationship between Science and Religious Education (though pupils studying at advanced levels do perceive links). If taken on their own, these tables (1-4) suggest the expression of the range of models from *conflict* through *concordat* to a weak *consonance*.

However, it is instructive to examine the results of tables 1 to 4 in conjunction with the results of tables 5 and 6 (*potential for collaboration*). The respondents were asked to indicate areas for most potential collaboration and 97% (table 5) were able to identify specific topics. Similarly, when asked to comment on potential collaboration (table 6) the vast majority of respondents were enthusiastic about collaboration as it would be beneficial for teaching and the pupil experience and would enable pupils to be more informed, open and tolerant. Examining tables 1-6 in conjunction suggests a disjuncture between current practice and aspiration. Current practice, as represented in tables 1-4, appears to be characterized by the *conflict/concordat* and weak *consonance* models. Tables 5-6 represent the aspirations of the majority of the two sets of teachers to collaboration that would enrich the pupil experience and, hence, a clear move to an aspiration for a more robust *consonance* model.

There is a small minority of negative voices that are dismissive of the possibility of collaboration. These appear to be Science teachers who are unwilling to accept claims for the epistemological validity of religion and Religious Education. There are, however, many positive voices that aspire to greater collaboration, an aspiration that concurs with the aims of the *CfE* documents. These positive voices are tempered by very practical considerations of the conditions that are required for effective collaboration. Commitment is required from leadership and teaching staff to forge the changes that would enable collaboration. This suggests a learning-centred leadership, motivated staff and the existence or creation of a school culture that is conducive to change (Leithwood et al., 2000; Das, 2008; Rhodes and Brundrett, 2010). There would need to be a greater mutual understanding between the two curricular areas that would include an acknowledgement of the nuances of the rights to claims of truth and knowledge in both curricular areas and an understanding that collaboration can contribute to the coherence of the overall educational experience of the pupils (Bell, 2001). Watson and Thompson (2007) argue that the discussion between science and religion in schools should be initiated very early to avoid false dichotomies. Planning, operational issues, time, timetabling, resource and workload issues would all have to be addressed (Hepburn et al., 2012). These are important aspects of the context for change; equally important are the teachers' belief and confidence that these aspects would be addressed effectively by the school leadership (Leithwood et al., 2000).

Concluding Remarks

There are a number of interesting findings in this research. Within a large sample of secondary schools in Scotland, there is evidence of a strong desire for greater understanding and collaboration between Science and Religious Education teachers. This potential move to a *consonance* model would enhance pupil learning and enrich the pupil experience and would be coherent with the aims and, importantly, the implementation of *CfE*. As has been stated above, this potential move is dependent on a number of essential practical and procedural conditions: commitment of both leadership and teaching staff; opening up or extending dialogue between the two curricular areas; joint planning and operation; timetabling of collaborative planning and activity; adequate resources and just allocation to workload. Perhaps one of the most significant findings is the perception of pupils in secondary school that there is no relationship between science and religion - unless they are studying at an advanced level. Some of the Religious Education teachers suggest that the pupils arrive in secondary schools with firm views of a polarization between science and religion. There is potential for this to be addressed in the secondary school, and not just at the senior level, but by the aspirations identified in this research for greater understanding and collaboration between Science and Religious Education teachers. It would be highly advantageous for the research to be replicated in the same Local Authorities with teachers in the associated primary schools. This could provide some insights into the factors that contribute to the formation of the polarized views that are held by the children in the primary school, and provide some ideas about possible modes of intervention.

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[1] Roman Catholic schools have been fully state-funded since the 1918 Education (Scotland) Act.

Table 1 – Significant differences in professional relationships with colleagues

Colleagues who…? %	**Formally collaborated on curricular developments**	**Have taught together**	**Have shared ideas for teaching**
teach science subjects	**Sci 90** **RE 4**	**Sci 47** **RE 9**	**Sci 67** **RE 37**
teach RE	**Sci 2** **RE 63**	Sci 6 RE 15	Sci 24 RE 20
teach humanities or social subjects	***Sci 16** **RE 44**	***Sci 6** **RE 22**	Sci 35 RE 41
teach mathematics	***Sci 16** **RE -**	Sci 4 RE 2	**Sci 61** **RE 22**
teach languages (including English)	Sci 16 RE 17	Sci 4 RE 4	Sci 51 RE 39
teach IT subjects	Sci 8 RE 7	Sci 6 RE 2	Sci 30 RE 24

Figures in bold represent significant differences at 1%(0.01) level
** significant difference at 5%(0.05) level*

Table 2 – Teachers indicating 'very confident' in addressing certain questions

RE teachers	**%**	**Science teachers**	**%**
How can there be a God and science?	83	Is preserving the Planet's resources an issue for science?	71
Did God die in the big bang?	74	Should DNA be used to profile people?	54
If stem cell research can save lives then why is it an ethical issue?	70	Is stem cell research ethical?	52
Should science and medicine allow parents to select embryos which are free from a particular disease?	65	Is it morally wrong to let parents have IVF treatment and then choose embryos which are free from a disease?	50
Is preserving the Planet's resources a faith issue?	61	Should scientists have invented the atom bomb?	47
Will scientific progress feed the world and end poverty?	35	Should religious views affect science?	38
Can science solve our environmental problems?	33	Did God make the world?	27
N=46		N=48	

Table 3 – How do pupils regard religious and scientific views?

%	Completely unrelated	Offering conflicting perspectives	Offering complementary perspectives	Don't know
RE teachers (N=43)	16	70	14	0
Science teachers (N=49)	14	51	10	25

Table 4 – Working with Religious Education or Science colleagues

Activities %	Frequently or sometimes		Rarely or Never	
	RE	Science	RE	Science
We are involved in cross-curricular initiatives	27	13	73	87
We team teach	2	-	98	100
We share teaching resources	27	10	73	90
We discuss issues of common interest	48	26	52	74
I have supported RE teachers when they seek help with science facts or issues	N/A	28	N/A	72
I have supported Science teachers when they seek help with religious and moral issues	14	N/A	86	N/A
We have worked together in other ways	26	27	74	73
N = (RE=44 Science=47)				

Table 5 – Curricular areas and topics offering most potential for collaboration between Science and Religious Education teachers

Science teachers	RE teachers
IVF, artificial fertilization, embryonic development, 'Designer babies'	Big Bang theory/origins of the Universe/Creation stories/Cosmology in relation to 'first causes' argument [i.e. that something caused the Universe to exist] S2 Creation Unit
Evolution/ Natural selection	Medical Issues/Medical ethics including Stem cell research, cloning
Bio ethics/ Ethical considerations of GM foods	Evolution
Ethical considerations of, medicine, Genetic engineering, gene therapy, cloning	Environmental issues (e.g. global warming)/ Environmental ethics
Moral and ethical dimensions of science research	Christianity: Belief and Science Unit at Higher/ Intermediate 2 level. Religious Moral and Philosophical Studies (RMPS)
Stem cell research	Abortion
DNA, Genetic profiling	Existence of God
Big Bang theory/ Astronomy	Euthanasia
God and science/ Metaphysical implications of some Physics, Chemistry and Biology	Genetic engineering
Discoveries and advances (Curriculum for Excellence (CfE) topical science)	Origins of life/ the human condition
Origin of life	God vs. Science, Revelation or scientific method
Animal welfare	Higher - Morality in the modern world
Ideas behind faith and belief	Scientific Methodology
	Organ transplants
	Methods used for seeking truth
	Miracles
	Animal testing

Table 6 – The potential impact of closer links between Science and Religious Education

Closer links between Science and RE would…..? **%**	**Teachers**	**Agree or strongly agree**	**Disagree or strongly disagree**	**Don't know or unsure**
improve the teaching of pupils in the school (N= Science 51, RE 46)	Science	79	10	12
	RE	96	-	4
increase my workload (N= Science 51, RE 44)	Science	68	16	16
	RE	64	32	5
increase support for my teaching (N= Science 49, RE 43)	Science	57	23	20
	RE	81	5	14
improve the coherence of the curriculum (N= Science 51, RE 45)	Science	71	20	10
	RE	93	-	7
have no impact at all (N= Science 48, RE 45)	Science	4	79	17
	RE	-	91	9
promote the development of more informed opinions among pupils (N= Science 49, RE 44)	Science	89	8	2
	RE	91	2	7
contribute to the implementation of Curriculum for Excellence (N= Science 50, RE 44)	Science	86	6	8
	RE	98	-	2
support the development of more open and tolerant attitudes among pupils (N= Science 51, RE 46)	Science	82	11	7
	RE	79	2	19

Table 7 – Priorities for supporting collaboration between Science and Religious Education

Support priorities **%**	**Teachers**	**Medium or high priority**	**Low priority or not required**
Joint in-school meetings (N= Science 49, RE 45)	Science	63	37
	RE	80	20
Joint CPD/ inservice (N= Science 50, RE 46)	Science	70	30
	RE	74	26
Greater knowledge and understanding of the other subject (N= Science 50, RE 45)	Science	88	12
	RE	89	11
Planned collaboration (N= Science 49, RE 46)	Science	84	16
	RE	96	4
Production of joint resource materials (N= Science 51, RE 46)	Science	69	31
	RE	78	22