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3 Vlasta Ilišin & Furio Radin (eds.): **Youth and Transition in Croatia.** Authors: F. Radin, V. Ilišin, B. Baranović, H. Štimac Radin, D. Marinović Jerolimov. Coeditor: State Institute for the Protection of Family, Maternity and Youth.
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5 Nikola Skledar: **O igri, ljubavi i smrti. Antropološki ogledi i razgovori.**
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7 **Izabrana djela Blaženke Despot.** Urednica Gordana Bosanac. Autori: B. Brujić, G. Škorić, Z. Žugić, G. Bosanac, V. Ilišin, J. Kodrnja, N. Skledar, S. Bartoluci. Suizdavač: Ženska infoteka.
8 **Institut za društvena istraživanja u Zagrebu: 1964 – 2004.** Urednik Antun Petak.
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10 Katarina Prpić: **Sociološki portret mladih znanstvenika.**
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15 Vlasta Vizek Vidović (ur.): **Cjeloživotno obrazovanje učitelja i nastavnika: višestruke perspektive.**
16 Vesna Vlahović-Štetić (ur.): **Daroviti učenici: teorijski pristup i primjena u školi.**
17 Alija Hodžić: **Selo kao izbor?**
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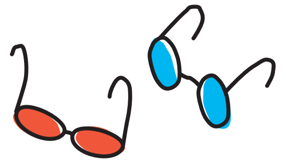
23 Vlasta Ilišin i Furio Radin (ur.): **Mladi: problem ili resurs.**
24 Katarina Prpić (ur.): **Onkraj mitova o prirodnim i društvenim znanostima: sociološki pogled.**
25 Jasenka Kodrnja: **Žene zmije – rodna dekonstrukcija.**
26 Alija Hodžić: **Tragovi pored puta.**
27 Vesna Vlahović-Štetić (ur.): **Daroviti učenici: teorijski pristup i primjena u školi.** 2. dopunjeno i izmijenjeno izdanje.
28 Katarina Prpić (ed.): **Beyond the myths about the natural and social sciences: a sociological view.**
29 Vlasta Vizek Vidović (ur.): **Učitelji i njihovi mentori: uloga mentora u profesionalnom razvoju učitelja.**
30 Nikola Pastuović: **Obrazovanje i razvoj: Kako obrazovanje razvija ljude i mijenja društvo, a kako društvo djeluje na obrazovanje.**
31 Anđelina Svirčić-Gotovac i Jelena Zlatar (ur.): **Akteri društvenih promjena u prostoru; transformacija prostora i kvaliteta života u Hrvatskoj.**
32 Maja Jokić; Krešimir Zauder i Srebrenka Letina: **Karakteristike hrvatske nacionalne i međunarodne znanstvene produkcije u društveno-humanističkim znanostima i umjetničkom području za razdoblje 1991-2005.**
33 Mladen Labus: **Kultura i društvo. Onto-antropološka i sociološka perspektiva.**



I am delighted to see publication of this book. Dr Jokić has produced an important study that tackles an interesting and potentially contentious issue and one that is under-researched not just in Croatia but in any country. I find his findings to be significant and of very considerable value. The implications for educational policy and practice are considerable.

Professor Michael Reiss,
Institute of Education, University of London

One of the most fundamental educational challenges stems from the divergent perspectives of science and religion. This excellent book reports one of the most comprehensive investigations ever attempted of pupils' thinking about the issue. It offers what is, quite simply, an unmissable resource for policy and practice.

Professor Christine Howe,
Faculty of Education, University of Cambridge

Throughout his work, it is clearly evident that dr. Boris Jokić aims to objectively expose and analyse each individual issue and research problem. I consider this characteristic, alongside an openness in dialogue, to be the most exceptional merits of this book. I am confident that the presented results can be used for the advancement of teaching plans and programmes and the manner in which these are communicated and taught in specific school subjects, particularly in Chemistry, Biology, Physics and Religious Education.

Professor Ružica Razum,
Catholic Faculty of Theology, University of Zagreb

One of the most important and valuable features of both Dr. Jokić's research and this book is the placement of the pupil's voice as a central focus. Throughout this book, these different voices are respected and promoted as a crucial element that should inform both policy and practice. As a unique feature in Croatian educational research, this focus on the pupils' perspectives should serve as a model for future research.

Professor Ines Radanović
Faculty of Science, University of Zagreb

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34

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Boris Jokić (1976) is a Scientific Associate at the Centre for Educational Research and Development, Institute for Social Research in Zagreb, Croatia. He holds a B.Sc. in Psychology from the University of Zagreb, and an MPhil and PhD in Education from the University of Cambridge. He has previously co-authored several books and published scientific articles in national and international journals. His other research interests include educational assessment and the examination of private tutoring phenomenon. More importantly, Boris is the proud father of Masha and Nikola, whose influence on his views concerning education and child development is greater than any reference source he has ever read.

IDIZ
Institut za društvena istraživanja u Zagrebu
Institute for Social Research in Zagreb

Boris Jokić

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Institute for Social Research in Zagreb
Zagreb, 2013

TABLE OF CONTENTS

PREFACE

In current educational circles, the claim that the individual pupil is at the centre of one's thinking, policymaking and research resonates nearly everywhere. However, despite positive intentions and bold policy statements, the voices of those for which education principally exists are rarely heard, some would say even neglected. It seems that, as a society, we do not consider the perspectives and opinions of pupils as equal, valid or important. I hope that this book will demonstrate that in this we could not be more wrong.

The book, a slightly revised version of a doctoral dissertation completed at the University of Cambridge, examines pupils' attitudes and self-expressed experience of the study of two contrasting intellectual domains, science and religion, in Croatian elementary education. Undoubtedly, science and religion have a history of an ambiguous relationship that is often portrayed, somewhat naively, as an exclusively conflicting one. In most systems of education, their instruction serves different, but ultimately important roles to society and each individual. In the work presented in this book, pupils' attitudes, perspectives and experiences have been explored at three levels. At the first level, the investigation aimed to determine the nature of, and underlying factors influencing, attitudes towards science subjects and confessional Catholic RE in Croatian education. Secondly, the research aimed to explore pupils' conceptualisations, understandings and attitudes towards the general concepts of science and religion. At the third and final level, this work aimed to probe pupils' understanding and attitudes towards the concurrent teaching of explanations for the origin of life derived from science subjects, through the teaching of evolutionary theory, and Catholic RE, through the teaching of Creation.

The publication of this book marks more than five years since the book was first completed. While the reasons for this delay are various, they largely stem from a lack of publishing opportunity and my own uncertainty about how the book and its results would be received. However, when an opportunity for sharing this work more widely did come, I thought it would be scientific cowardice not to publish it. Since 2008, when my dissertation was originally completed, there has been research activity with regards to both science and religious education in Croatia as well as some important writings by Croatian theologians on the relationship between science and religion. Because I wanted to preserve the integrity of the original text, this recent and important work is sadly not included in the literature review of this book. While the work is published in its original English, I do wish there had been opportunity and time to prepare this work for publication in Croatian, not only because of the potential for reaching a wider readership in Croatia but also because the words of pupils and teachers would have more effectively resonated with their original richness and strength.

If nothing else, this book calls for a dialogue between worldviews and professions in all spheres of education and society. It is my own firm belief that, without such dialogue, this country and its education system are doing a great disservice to pupils and, ultimately, will be unable to progress forwards.

Boris Jokić, Zagreb, November 2013

ACKNOWLEDGEMENTS

First and foremost, I would like to thank the pupils, teachers and school staff who devoted their time and consideration to the research presented here. This book would not have been possible without them.

My gratitude also goes to my doctoral supervisor, Professor Linda Hargreaves, for her kindness, tireless efforts and belief in the value of this endeavour. I would also like to thank the book's reviewers, Professor Ružica Razum, Professor Ines Radanović, Professor Christine Howe and Professor Michael Reiss, for their valuable comments that directly contributed to improving this book. I would like to thank my institution, the Institute for Social Research in Zagreb, and especially Professor Nikola Pastuović, for financially supporting this publication. My gratitude also goes to Lidija Novosel for her cover design and Stjepan Tribuson for the book layout.

Several individuals deserve a special mention: Nikos Bamiedakis and Damjan Pfajfar, with whom I shared Cambridge days from the beginning to the end, and Zrinka Ristić Dedić, for her patience and camaraderie during 11 years of collaboration.

I would like to thank my family, and most particularly my parents, whose high standards and unconditional support gave me the courage and will to embark on and complete this work.

Finally, I would like to thank Claire Sangster Jokić for being who she is, Masha for becoming a smart and playful little girl so gracefully and little Nikola for his funny faces and caring personality. I dedicate this work to the three of them.

CHAPTER ONE: INTRODUCTION

1.1. INTRODUCTION

Religion and science, as two of the grandest achievements of the human mind, have a history of an ambiguous relationship, often portrayed, somewhat naively, as an exclusively conflicting one (Brooke, 1991). Both have been, and still are, linked to and clearly reflected in most forms of education, where their instruction serves different, but ultimately important roles to both society and each individual. The nature, forms and relative relevance of scientific and religious education has varied at different historical points in different societies (Hull, 1994). Ultimately, however, if not in dialogue, to use Ian Barbour's (1997) classification of the relationship between science and religion, they have retained a mutual independence within the educational context. Due to their differing nature and the concurrent overlap in their areas of interest, science and religion have offered discrepant explanations and incompatible knowledge claims on certain issues presented in educational curricula. Thus, it might be argued that such educational systems expose pupils to knowledge claims from both domains which can at times be different, contrasting or even contradictory.

While education systems might encompass such contradictions, individuals may be less accommodating to such inconsistencies and incompatible knowledge claims. John Polkinghorne (1994) points out that many scientists, himself included, have successfully adapted and co-housed their religious belief and scientific worldview. This seems plausible since scientists typically are educated, experienced, and mature individuals able to conceptualise divergent claims, but is the same to be expected of elementary school pupils? The question of how well individual pupils might face this problem gains greater relevance in light of the mutual independence and low levels of dialogue between these two domains in education. This question is a point of initiation for the present research; its tentative answer forms the conclusion.

This brief introduction presents a schematic overview of the research reported here, showing the vast range of potential areas for exploration invoked by the general research problem illustrated in Figure 1.1, and, in Figure 1.2, the focal areas that are examined empirically in depth in the course of the book.

1.2. OVERVIEW AND CONCEPTUAL FRAMEWORK

Figure 1.1 is a simple representation of the links between science and religion at the philosophical, societal and educational levels. It serves as a starting point for the development of the conceptual framework of the present study (Miles & Huberman, 1994).

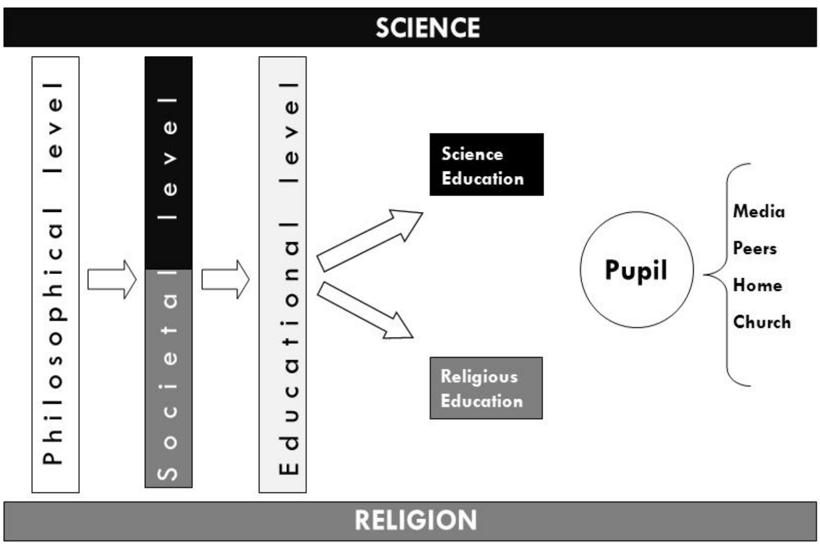

Figure 1.1. Contextual framework informing the present study

While the philosophical relationship predominantly informs the present study, the specific interaction between the two intellectual domains on societal, educational and individual levels is similarly vital for the conceptualisation of the research and is delimited by two fundamental elements: the Croatian social and educational context and an exploration of elementary pupils' perspectives.

Croatian society emphasises the development of scientific and technological competence as a force behind economic progress and competitiveness in global markets. Simultaneously, Croatia is characterised by a strong and traditional relationship with the Catholicism and Catholic Church, placing itself among the most religious countries in Europe alongside Poland, Italy, Ireland and Portugal (Davie, 2000). This is evident in the fact that, according to the 2011 census, 86.3 percent of Croatian citizens declared themselves Catholics. This duality is clearly mirrored in the educational system. Pupils are taught science extensively throughout education, where the aim is to develop scientific thinking and an appreciation for the scientific enterprise and to foster the adoption of a correspondent worldview. At the same time, 87.7 percent of elementary pupils attend a confessional form of Catholic RE in a subject called 'vjeronauk' (school catechesis) which at the outset is elective but, once chosen, becomes obligatory (Razum, 2008). The aim of this subject is the induction of pupils into the Catholicism and the development of a religious worldview. Both scientific and RE subjects are taught as independent 'magisteria', presenting content from their domains that at times offer discrepant knowledge claims to pupils, as in the case of the teaching of human origin and sexuality.

While this dual existence of science and religious education in the Croatian context is interesting on many levels, it has been the aim of the present research to channel and amplify the pupils' voice in order to explore and understand some of these facets within the Croatian educational system. Although it falls at the centre of the educational process, pupils' perspectives have rarely been probed in Croatian educational research and there has been little opportunity for pupils' voices to be heard. Therefore, the elicitation of the pupil perspective (used here as a singular generic term to indicate multiple pupil views) is a focal point of the present study. This is shown in a diagrammatic conceptual framework (Figure 1.2) as a starting point for the design and implementation of the study.

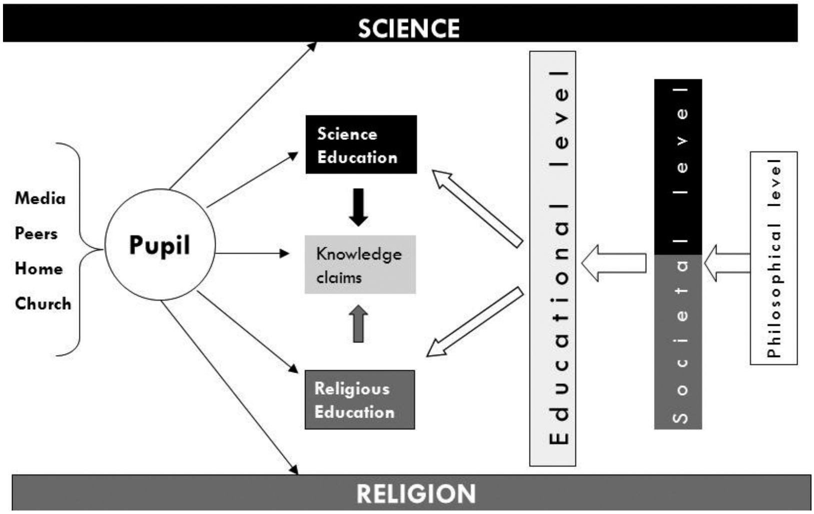

Figure 1.2. Conceptual framework of the present study

An important element of the pupil perspective is the attitudes pupils hold towards the subjects they encounter in school. Indeed, the development of positive attitudes towards specific subjects and their impact on the educational experience can have serious consequences for pupils' present lives and their choice of future educational and professional paths (e.g. Gardner, 1975; Osborne, Simon & Collins, 2003). Pupils' choices, in turn, will ultimately have an impact on the economical and educational level and variety of a specific society (e.g. Osborne & Collins, 2001). Additionally, pupils' attitudes offer valuable insight into actual educational practice and curricular content.

Further, as both science education and RE aim to develop positive attitudes towards their respective enterprises and an appreciation for a scientific or religious way of exploring and understanding the world and human nature, it becomes important to determine whether and, if so, in what manner this is reflected in the pupils' perspective.

Finally, it seems likely that there are issues on which the two intellectual domains offer knowledge claims to pupils that may seem opposed or contradictory. Therefore, it is of central importance to explore pupils' understandings of and attitudes towards these knowledge claims both separately and in interaction.

1.3. AIMS OF THE STUDY

The present research, then, aims to explore pupils' attitudes to, and self-expressed experience of, the study of two contrasting intellectual domains, namely science and religion, in Croatian elementary education. In response to this complex and overarching aim, pupils' attitudes and experiences have been explored at three levels. First, the study aims to determine the nature of, and underlying factors influencing, Croatian elementary pupils' attitudes towards science subjects and confessional Catholic RE. Secondly, the study aims to explore pupils' conceptualisations, understandings and attitudes towards the general concepts of science and religion. Finally, it aims to probe pupils' understanding and attitude towards the concurrent teaching of explanations for the origin of life derived from science subjects, through the teaching of evolutionary theory, and confessional RE, through the teaching of creation. In order to fulfil these aims, the research employed a mixed model design using both quantitative and qualitative methodologies to collect the necessary data. In addition, the design incorporated a cross sectional element by probing the attitudes and experiences of pupils from two elementary age cohorts: a $5^{th}/6^{th}$ grade cohort (aged 11 to 12 years) and a $7^{th}/8^{th}$ grade cohort (aged 13 to 14 years) chosen because the science curriculum becomes more differentiated at these points. Finally, the research probed if and in what manner pupils' affinity towards either a religious or scientific worldview influences the understandings, attitudes and experiences of the other intellectual domain.

1.4. THE RELEVANCE OF THE STUDY

The present study aims to contribute to a number of currently under-developed research areas. In the following paragraphs, the relevance of the study in both the Croatian and international context will be discussed. In Croatia, there are few empirical educational research efforts examining elementary education in general and there is almost none probing the pupils' perspective (Jokić, 2007). Furthermore, pupils' attitudes towards school subjects have not gained adequate research interest, with very little research conducted on this topic (Marušić, 2006) in the fields of both science and religious education. Razum (2008) reports that *'thus far there has not been a single systematic and holistic research on the reaction to RE in public schools' (p.230).* Similarly, there has been very little research on the religious experiences and religiosity of children of elementary school age. Živković (2007) reports that topics in the psychology of religion, and the development of religious concepts in particular, are scientific themes almost nonexistent in Croatian psychology.

Internationally, research into pupils' attitudes towards both science and science education and religion and RE has been a prominent field of investigation in educational research for decades (reviewing research in science education: Collins, Reiss & Simon, 2006; Koballa & Glynn, 2007; Osborne at al., 2003; and in RE: Francis, 1982; Hyde, 1990; Kay and Francis, 1996; Ormerod, 1971; Taminnen, 1996). By employing multiple methods and by investigating not only the quantification but also the formation and development of pupils' attitudes, the present study aims to overcome some of the shortcomings of previous research into pupils' attitudes towards science and religion (Koballa & Glynn, 2007; Osborne & Collins, 2001). Furthermore, the study aims to eliminate the existing ambiguity in current research between pupil attitudes towards school subjects and the general concepts of science and religion by purposely distinguishing between them (e.g. Gardner, 1975, 1995; Greer, 1982; Kind, Jones & Barmby, 2007; Ramsden, 1998). The intention here is to differentiate the two concepts by looking at them separately and seeking the connecting and divergent points between them.

Further, a limited number of studies have explored the interaction between pupils' understanding of evolutionary theory and creation (e.g. Lawson & Worsnop, 1992; Vehey, 2005). Once again, the present research design allows a more complete exploration of this topic than in some of the previous purely quantitative research (e.g. Francis, Gibson & Fulljames, 1990, 1991; Francis & Greer, 2001; Fulljames & Francis, 1987, 1988).

Finally, there is a very limited amount of research (e.g. Roth & Alexander, 1997) exploring the influence of the religious values, attitudes and beliefs of pupils on their understanding of scientific knowledge (Evans & Evans, 2008). The Croatian case additionally offers a mirrored picture of how scientific values, attitudes and beliefs influence the adoption and understanding of catechetic contents. By profiling research participants according to their religious and scientific interests, this study aims to make a contribution to this still developing field of research.

1.5. BOOK OUTLINE

This book is divided into eight chapters. Following this introductory chapter, the Croatian educational and social context will be described in Chapter Two. Chapter Three offers a review of the theoretical and empirical literature relevant to the topic of research and is coarsely divided into two parts. In the first part, which roughly follows the contextual framework presented in Figure 1.1, elements of the relationship between science and religion on general, societal, educational and individual levels will be presented. The second part, following the conceptual framework presented in Figure 1.2, begins with a review of the empirical literature investigating pupils' attitudes towards science education and RE. This is followed by an exploration of the limited but very important research into the interaction of these two domains from a pupils' perspective. Chapter Four offers a thorough discussion of the methodological design, starting with a consideration of the mixed methods approach followed by a detailed description of the research design. In Chapter Five, findings regarding pupils' attitudes towards and experiences with school subjects are presented and discussed. Chapter Six examines pupils' conceptualisations and attitudes towards science as a general concept, as well as their conceptualisations, adoption of and attitudes towards religious teachings stemming from Catholic RE. In a specific investigation of pupils' perspectives on a potentially contradictory topic for science and religious education, Chapter Seven offers insight into pupils' understandings and attitudes towards the scientific and religious teaching of the origin of life. Finally, in Chapter Eight conclusions, limitations and implications of the study are presented.

CHAPTER TWO: CONTEXT OF CROATIAN EDUCATION AND SOCIETY

2.1. INTRODUCTION

In order to adequately contextualise and interpret the findings, as well as some of the methodological and analytical issues, a consideration of the educational, social and cultural context of Croatia is necessary. This discussion will be divided into three parts. A brief outline of the Croatian educational system will first be presented, followed by a consideration of elementary science education, which in many ways resembles that in the wider European context. Finally, significant attention will be devoted to a consideration of the nature and role of RE, a subject deeply rooted in the national, historical and social context of Croatia.

2.2. DESCRIBING THE CROATIAN EDUCATION SYSTEM

The Croatian educational system is divided into preschool, elementary (primary and lower secondary), upper secondary and higher education (Figure 2.1). Lasting eight years and catering to pupils between the ages of 6 and 15, elementary education represents the only compulsory educational level (Law on Primary Education, 2003).[1] According to data from the Ministry of Science, Education and Sports (2004) (hereafter referred to as the Ministry), the percentage of pupils enrolled in elementary schools amounts to 96.5 percent of children of official age in the country as a whole.[2]

Elementary education is divided into two key parts that are implemented in separate manners. The curricular content in primary education (grades one through four) is divided into seven subjects: Croatian language, mathematics, nature and society, foreign language, music, art and physical education. With

[1] Children who reach the age of six by April 1st of the current year would enroll in the first grade of elementary school in that year (Law on Primary Education, 2003). This implies that at the start of the school year in September, pupils are between six and a half and seven and a half years old.

[2] Data on the number of schools, pupils and periods taught were taken from the Education Sector Development Plan 2005-2010 (MZOS, 2005).

the exception of foreign language, subjects are taught by one class teacher, hence this form of organization in the first four grades is called *class teaching*. The second part of the elementary education (grades five through eight – lower secondary education) is discipline-based and, in essence, reflects the scientific division of knowledge (Jokić, 2007). Here, pupils are taught in approximately twelve compulsory and two elective subjects and the teaching is carried out by subject specialist teachers and is thus labelled *subject teaching*. The compulsory subjects in the 8th grade are: Croatian language, mathemathics, foreign language, music, arts, physical education, history, geography, biology, physics, chemistry, and technical education. The elective subjects are: RE, ICT and a second foreign language. In both key parts, pupils are grouped into mixed ability classes of between 17 and 30 pupils and they progress through elementary education in the same class.

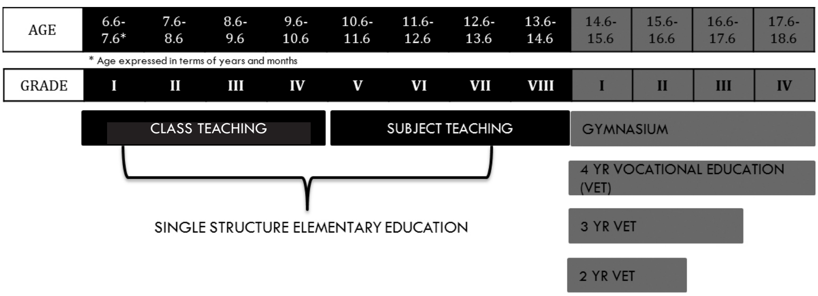

Figure 2.1. The system of education in Croatia

Previous research has demonstrated that, according to teachers, the subject curricula and its implementation have numerous shortcomings (Baranović, 2006). These problems included the extensiveness of the required subject content, its lack of relevance and out-datedness, the insufficient correlations between various subjects and a dominance of traditional teaching methods (ibid). The need for significant reform and improvement in the educational system has also been recognized by educational authorities. In June 2005, the Croatian government adopted the *Education Sector Development Plan 2005-2010* (MZOS, 2005) which set strategic goals, priorities and activities aimed at securing the development of a more efficient system of education '*in order* *to create intellectual and operational human capital as a key treasure of the Croatian state' (p. 1*). The plan especially emphasises the development of flexible educational solutions which place the pupil in the centre of the educational process, implying the need for both modern and individualized teaching methods. Here, it was stated that the *Croatian National Educational Standards (HNOS)*, along with the new curricula, would be introduced into elementary schools as of the 2006-2007 school year. Teaching Plan and Programme for Elementary Education, representing an updated version of present subject curricula was developed and implemented in Croatian elementary schools as of the 2006/07 school year (MZOS, 2006). It represents the foundational document for elementary education, incorporating Teaching Plans and Programmes for each subject in elementary education, often colloquially called 'subject curricula'. No system of standardized external assessment is currently applied at this educational level, although the Ministry has been announcing its development and implementation for several years. The rationale for this supposed introduction has been the inflation of good grades and the perceived unfairness and subjectivity of the present system of assessment. Currently, pupils in elementary schools are assessed by the individual teacher of each subject, whereas their overall achievement is expressed as a grade point average (GPA) from all subject grades.

2.3. TEACHING OF SCIENCE IN CROATIAN ELEMENTARY EDUCATION

In light of attempts at accession into the European Union (one of Croatia's main strategic goals), special emphasis has been placed on the development of science education in education policy documents (MZOS, 2005; MZOS, 2006). The policy rhetoric of these documents connected the concepts of knowledge and risk societies and rapid economic and demographic changes with the need for the development of higher quality science pedagogy. In addition, the role of science and technology in education has been further emphasised in the context of Croatia's attempts to feature competitively on globalised markets.

From the first grade, pupils are taught some form of natural science in Croatian schools. The main subjects covering the natural sciences through all grades are presented in Table 2.1.

Table 2.1: Teaching of science in Croatian elementary education

Grade							
1	2	3	4	5	6	7	8
Nature and Society				Nature		Biology	
						Chemistry	
						Physics	

The gradual diversification of the scientific disciplines, evident in the table, starts from the holistic subject of ‘nature and society ’and ends with a clear distinction between the three natural science disciplines in the 7th and 8th grade. In addition to these subjects, content stemming from the wider body of natural scientific knowledge are presented in the subjects of geography and technical education, which are taught from the 5th grade. In addition, topics on the history of science are covered as part of the history curriculum, also taught from the introduction of subject teaching in the 5th grade. In the following paragraphs, the three different forms of science teaching will be briefly described.

Nature and Society

As its name suggests, this is an all-encompassing subject covering various topics related to pupils’ personal, social and physical environment and considering themes from various scientific fields and disciplines (chemistry, physics, biology, geography, Croatian language, ICT) (MZOS, 2006). This subject is taught by non-specialist teachers and is awarded 70 teaching hours per school year in the first and second grades and 105 teaching hours in the third and fourth grades. In general, the scientific complexity of the covered themes increases in each grade so that, by the third grade, pupils are presented with content clearly indicative of the development of scientific thinking and the diversification of knowledge into separate scientific disciplines. This is particularly evident in the elaboration of the subject aims, where the presented themes are envisaged as a foundation for the development of a scientific worldview. This nurturing of a scientific worldview is further fostered in nature in the fifth and the sixth grade.

Nature

Nature is taught by specialist teachers and is awarded 52.5 teaching hours per year in the fifth grade and 70 hours in the sixth grade. At the outset of the subject curricula for this subject, it is stated:

'The idiosyncrasy of the subject nature in the 5th and the 6th grade of elementary school stems from the large possibilities for the assimilation, connection and consideration of natural concepts coming from various elements of nature and the world at large. For this reason, nature, unlike most subjects in Croatian education, contributes to the development of pupils' holistic picture of the complexities surrounding us in the modern world.' (MZOS, 2006, p. 261)

Amongst its main goals, this subject lists the development of a scientific worldview and scientific thinking. The curriculum document further suggests that the subject adopts a holistic picture of the natural sciences, thus preparing pupils for the diversification of sciences that will come in the 7th grade. However, the core of the content remains connected with the biological sciences, as evident in the following excerpt from the policy document:

'The present subject curricula, in which dominance is given to biological content, are suited to the age of pupils in the 5th and the 6th grade.' (ibid: p.261)

It is later added that the physical and chemical sciences would also be taken into account in order to prepare pupils for a '*holistic manner of understanding and solving problems*' and as conceptual preparation for the upcoming subjects of chemistry and physics. The themes covered in this subject reveal a strong scientific, although mainly biological, orientation as well as a highly detailed level of presented content.

Biology, physics and chemistry

In the 7th grade, pupils are introduced to three new subjects corresponding to the scientific disciplines of biology, physics and chemistry, which are taught by subject specialists. In the case of biology, this introduction could be most accurately described as a gradual transition in light of pupils' previous experience in nature. Another connecting point between nature and biology is the fact that, in most cases, both subjects are taught by the same teacher in a single school. In contrast, pupils are faced with completely new content in both physics and chemistry. All three subjects are given 70 teaching hours in both the seventh and eighth grade, and have very similar aims, as evident in Table 2.2.

Table 2.2: Aims of biology, chemistry and physics subjects

Subject	Aim
Biology	'The aim is for pupils to acquire a knowledge of basic biological fundaments and structure and functions of life forms, to develop a natural-scientific way of thinking, to understand methods of exploration of nature, and to develop a readiness and adequate responsibility for the application of acquired knowledge in life.' (p. 266)
Chemistry	'The aim is the introduction of pupils to a scientific way of thinking, educating them in a sensible relationship with nature and the environment, acquiring useful knowledge from chemistry and equipping pupils for the use of acquired knowledge in everyday life, technology and production.' (p. 272)
Physics	'The teaching of physics should enable pupils to understand natural phenomena and to develop a basic understanding of methods and techniques in the scientific exploration of nature and in the use of acquired knowledge in everyday life, technology and production as well as to develop the ability for scientific thinking and independent problem solving.' (p.279)

MZOS (2006)

The aims of all three subjects include the development of scientific thinking, the acquisition of knowledge and an understanding of the process of scientific enquiry and the practical application of acquired knowledge. In addition, all subjects stress the importance of the learning process and the involvement of pupils in experimentation. These general learning aims seem in stark contrast to the thematic content of the subject curricula which suggest a highly detailed and specific content heavily focused on the acquisition of factual knowledge.

In the next section, the discussion of Croatian RE will adopt a slightly dissimilar approach than was the case with science education in light of the fact that the nature, position and function of Catholic RE are deeply seated in the historical, political and cultural elements of the Croatian context.

2.4. RE IN THE CONTEXT OF CROATIAN EDUCATION AND SOCIETY

The existence of concurrent definitions as well as differing social and political contexts, religions and their roles in society and educational systems are but a few of the problems that make defining RE, and placing Croatian RE in the existing typologies, extremely difficult. For these reasons, a consideration of the theoretical approaches to defining RE in general will first be presented. This will be followed by a more detailed description of the social and political context of Catholic RE in Croatia. Finally, the form, nature and position of RE in Croatian education will be discussed.

2.4.1. Approaches to defining RE

There are various approaches to arriving at a definition of RE. According to Hull (2001), models of RE consider 'education *into* religion', 'education *about* religion' or 'education *from* religion'. *'Education into religion'* is defined as a form of RE that acts as an introduction to one specific confession. *'Education about religion'* is concerned with religious knowledge and religious studies, concentrating on the meaning of religion to followers of a certain faith. This model is primarily concerned with developing an understanding of the interaction between religious beliefs and actions, the individual's behaviour, and the role of religion in society (Schreiner, 2002). Finally, *'education from religion'* gives an overview of different religions. Being eclectic and 'free of indoctrination', it gives pupils the opportunity to seek out answers for themselves, placing personal experience at the centre of the teaching process (ibid, 2002).

Schreiner (2002) offers another typology by dividing RE models in Europe into two categories: the religious studies approach and a denominational or confessional approach. The difference between these two approaches is in the divisions of responsibility for the contents of RE, teacher training and the development of teaching materials and RE curricula. In a denominational approach, the state takes a neutral role with respect to set issues and guarantees freedom and neutrality in conceptualising and executing RE to the major, and often to all other, faith traditions in the country. The religious studies approach implies that the state (and not different denominations) has the authority in planning and implementing RE. Here, teaching does not remain neutral with respect to values, but to different faith traditions. The state serves as a guarantee that this approach to RE will be acceptable to all in a sense that it will not act against the values and beliefs of members of any faith tradition.

Ashton (2000) has an altogether different conceptualisation of the approaches to RE. She makes a distinction between 'explicit' and 'implicit' RE, a division based on teaching methods and the levels of disclosure of religious materials to pupils. She further divides RE approaches into four categories, as seen in Table 2.3.

Table 2.3: Classification of religious education approaches in primary education (Ashton, 2000)

Approach	**Motto**
Confessional	'We are right'
Phenomenological	'No one is right; we are just different'
Experiential	'We are all right, but only for ourselves'
Evaluative	'We have to work towards being right, trusting in what we think we know'

Source: Adapted from Ashton, 2000 (box 2.9, p. 21-22)

In her classification, Ashton (2000) attempts to make a qualitative distinction between these four approaches, concluding that 'the evaluative approach' is the most appropriate and most stimulating for children's development. While Ashton's attempt at ranking approaches may be applicable and appropriate for a specific country (mainly multi-ethnic societies such as England), it might be less informative for an international understanding of RE.

In considering the various educational systems in Europe, it is easy to conclude that a universal European model of RE in public schools does not exist. The religious and educational variety of 'the old continent' is replicated in the case of RE. Kodelja and Bassler (2004) suggest that most European countries have some form of RE in public schools, be it compulsory or optional. RE and its complex system of origins and influences make it necessary for research into RE to be aware of all of the complexity surrounding the subject in particular social, educational, cultural and political contexts. Schreiner (2002) states: *'RE in Europe is grounded in factors like: the religious landscape in the country, the role and value of religion in society, the structure of the education system, history, and politics'* (p. 87). Looking through the lenses of the aforementioned factors, it is easy to conclude that any study of RE in a certain country requires the adoption of a local perspective.

2.4.2. Historical, social and political context of State-Church relations in Croatia

Before considering the role of RE in Croatian education, a brief consideration of the specific context of relations between Croatian statehood and the Catholic Church in Croatia is necessary to fully appreciate the wider historical, social and political frameworks in which RE in Croatia exists.

The Croatian case can be contextualised in the wider Central and Eastern European context with which it shares a somewhat similar history.[3] While these countries have experienced different levels of developmental statehood, with the relationship between churches and states in this region on a different level even from a historical point of view, all countries in the region share two historical facts:

[3] However, it needs to be pointed out that this context is by no means religiously homogenous, as it incorporates both the most religious and non-religious countries in Europe (Borowik, 1999).

- All countries were under communist rule in the latter part of the 20th century.
- All countries, to some extent, experienced a 'religious revival' after the fall of communist rule. (Borowik, 1999)

An analysis of the role and actions of the communist regimes towards religion and church and the Church's responses represents a complex scientific problem that has thus far not yielded a satisfying and unambiguous conclusion (Barker, 1999). Religious feelings, although not completely oppressed during the communist era, presented something that needed (re)discovery. As a result, all countries in the region experienced considerable shifts in religious movements after communism (Tomka, 1999). It might be argued that the Church was the victor in the communist struggle, as it has survived one of the most unfavourable regimes in its history and, as Tomka (1999) points out, was the only organised body that survived centralist, communist powers. This hardship was not only experienced through the obstruction of the Church's mission, but also on a more concrete economical and infrastructural level (Beyer, 1999). Another vital limitation imposed on the Church during the era was the possible recruitment of new members. This was amplified and illustrated by two facts:

- Religious education was rarely present.
- In order to progress in society, it was very unlikely, if not impossible, to succeed if one was overtly religious. (Beyer, 1999)

As such, it was no surprise that the Church welcomed the fall of communism in the region[4]. When it became obvious that a change was about to come, the Church rightfully saw this as an opportunity to regain lost property

[4] In fact, although beyond the scope of the present work, it might be argued that the Church was, among others, one of the instigators of this fall. By appointing John Paul the 2nd as the Pope in 1978, the Catholic Church made a choice that signalled a change, as the attitude towards religion and the Church also changed (Tomka, 1999). On many occasions during his pontificate, Pope John Paul the 2nd emphasised the danger of communism, proclaiming it as one of the biggest dangers in the modern world. (Pope John Paul the 2nd, 2002).

and economical goods and re-establish itself on the social, political and, most significantly for the present work, educational scene (Tomka, 1999).

Although instructive, a regional framework can inform, but not fully provide, an explanation of the State-Church relationship in Croatia[5]. Due to both past historical relationships and more recent conflicts, countries of Ex-Yugoslavia provide a specific discourse on the academic considerations of this relationship. Complex historical, social and political circumstances led to a rise in the interest and popularity of the Catholicism in Croatia. Throughout history, Croatia was a constant stronghold of Catholicism nested beside other confessions in the region. This resulted in a strong historical bond between the Croatian nation and the Catholic Church (Dugandžija, 1986). In the 20th century, Croatia, along with other nations in the region, formed the multi-national state of Yugoslavia, which became the Socialist Federative Republic of Yugoslavia (SFRY) after World War II. SFRY was a socialist country ruled by the Communist Party in which religious expression was contained and restricted to the private sphere (Zrinšćak, 1999b)[6]. There was no religious instruction in formalised education in any form and, although the constitution guaranteed religious rights and freedoms, the desirable conformity patterns were those of non-religiosity and atheism (Marinović Bobinac & Marinović Jerolimov, 2006). In 1991, the Croatian parliament proclaimed independence from Yugoslavia, and later that year, Croatian citizens voted in a referendum to separate from Yugoslavia and to form the Republic of Croatia. These decisions were followed by a tragic war with the Yugoslav army and the international recognition of the Republic of Croatia alongside other wars in the Balkans fought along the lines of ethnicity and religion. The Holy See played a vital role in Croatia's independence movement in the 1990s, being among the first countries to recognise Croatia as an independent state. Vrcan (1998) speaks

5 Vrcan (2001) states that, unlike the wider development of the revitalization of religion in the region, the Croatian case was specific in a sense that it was more oriented towards the traditional, collective spirit and a strong connection to the idea of nation. This movement lacked the plurality and modernity of religious expression characteristic of the wider region, expressed by Tomka (1999) as 'religion a la carte'

6 It needs to be said that, while religious expression was not prohibited, it was not favourable. A person could not have been a member of a church and the communist party at the same time (Dugandžija, 1986).

about the role of the Catholic Church in Croatia's independence movement as not only ecumenical and humanistic, but as an instigator and a guardian of the Croatian national ethos. After the fall of the communist system at the beginning of the 1990s, the Catholic Church regained their lost influence and role in society (Vrcan, 2001) and, as Zrinšćak (1999a) states: *'The Catholic Church did not have many doubts about the concept of omnipresence. The first element of proof was the introduction of religious education in public schools'* (p.130).

2.4.3. RE in Croatia

Based on the models of RE described in the previous sections, it might be argued that RE in elementary education in Croatia is 'education into religion' (Hull, 2001), denominational in its approach (Schreiner, 2002) or explicit and confessional (Ashton, 2000). Razum (2008), coming from a Catholic theological stance, defines RE in Croatia as a strictly confessional model or 'school catechesis'. From the first grade onwards, RE is one of the elective subjects offered to pupils in elementary education that, once chosen, becomes obligatory (Razum, 2008). In 2006, 87.7 percent of elementary education pupils attended RE (ibid). Indeed, both the very high percentage of pupils attending the subject and its 'obligatory' character makes its 'electiveness' somewhat relative. In each grade, 70 teaching hours are devoted to RE per year. Teachers of the subject are both lay theologians approved by the Catholic Church and members of the clergy (ibid). While further consideration of Croatian RE will be explored in the next sections, the legal framework in which Catholic RE exists will first be considered. This will be followed by an analysis of the particular aims and form of RE in elementary education.

2.4.3.1. The legal framework of RE in Croatia

Catholic RE was formally introduced into the Croatian educational system in the 1991/1992 school year, nearly coinciding with the formation of an independent Republic of Croatia. In her report of discussions carried out in Church circles concerning the name and nature of the subject prior to its introduction, Razum (2008) expresses surprise at the sudden change from the name *'religious culture',* which was a dominant option amongst the discussants, to *'school catechesis'*. Here, the Church decided to use the name 'catechesis', previously used for 'parish catechesis', and added the prefix 'school'. This was particularly dangerous for the nature and existence of 'parish catechesis', and thus it seemed surprising that, in their message on the matter, Croatian Bishops stressed that school and parish catechesis are not two forms of religious education that are exclusive but two instances of catechesis that are instead complimentary (Razum, 2008).[7]

Catholic RE is formulated on the basis of the *'Contract between the Holy See and the Republic of Croatia regarding Cooperation in the Fields of Education and Culture'* from 1996.[8] This special contract was based upon three premises. First, both the Croatian constitution and the laws of the Holy See grant a formal legislative right for a contract of this kind. The second premise expresses the view that a contract is needed because of the historical and current role of the Catholic Church in Croatia in the area of education. The third premise is based on the factum that a majority of the population belongs to the Catholic Church.

The form and nature of Catholic RE in Croatian elementary schools is clearly explicated in the *'Contract on Catholic Religious Education in Public Schools and Religious Education in Public Preschools'* from 1999. This document includes statements of the subject's aim, allocations for teaching time, and qualifications of those eligible to teach RE. On the basis of these two documents, the Croatian Bishops Conference (CBC), on behalf of the Catholic Church, developed precise 'plans and programmes' for RE in each grade of elementary education. Among other things, the Contract states the following:

- Catholic RE becomes obligatory for those pupils who choose to attend it. A written statement from parents declaring the choice of pupils' attendance is given to the head of school. The teaching of RE is

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7 This same author argues that this formulation and the newly established nature of RE has contributed to lower levels of attendance in parish catechesis in the years to follow.

8 In 2003, similar contracts were signed with other major religious communities (Orthodox, Islamic, and Jewish).

conducted under the same conditions as any other obligatory subject, especially with respect to its place in the daily schedule (art. 1).
- It must be taught through two teaching hours per week (art 3).
- Teaching plans and programmes are developed by the CBC and confirmed by the Ministry (art. 3).
- Textbooks must be approved by the CBC (art. 4).
- Article 5.1 states that: *'Catholic Religious Education is taught by persons who have received a proof of 'missio canonica' from the diocese Bishop...'* which is followed by the statement in Article 5.4: *'The diocese Bishop has the right to issue a decree of withdrawal of 'missio cannonica'...in cases of incorrectness of teaching or personal morality'*.
- The CBC, through its National Catechetic Office (NCO), is responsible for Catholic RE (art. 10).

From the above, it is evident that the role of the state in issues concerning decisions on the development of subject curriculum and selection of the teaching staff is secondary. Zrinšćak (1999a) emphasises the significance of these bilateral agreements in the State's recognition of the legal entity of the Catholic Church and the provision of absolute freedom to the activities of the Church, including its access to schools. Although this might be indicative of the place of the Catholic Church in Croatian society, some of the characteristics present at the time the agreements were negotiated and signed serve to illustrate its powerful role further (Zrinšćak, 1999a).[9] In particular, Zrinšćak noted that there was very little discussion about the consequences of the signed agreements and even less discussion about their educational consequences in particular. However, several factors create a strong argument in defence of these documents, and need to be taken into consideration. Specifically, in ratifying these agreements, both the Catholic Church and the Government

9 First, Zrinšćak suggests that the documents were prepared in secrecy, while the public remained completely uninformed about the process. Secondly, even when they were expressed, critical objections about the documents were largely ignored and failed to stir public debate. Thirdly, the mutual signing of the Agreements took place in the Vatican in the week prior to the local elections in April 1997. Zrinšćak states: *'Both sides showed a strong interest in a quick approval without 'unnecessary' public debates, and before the local elections in April as well as the presidential elections in June'* (p. 127).

satisfied their interests, whilst managing to avoid violating the constitution or any other State law[10].

2.4.3.2. Aims, form and position of RE in the Croatian educational system

In establishing a subject at the level of a bilateral contract between Holy See and Croatia, and consequently making this contract a law, it is clear that Catholic RE has both a special place and a special set of regulatory mechanisms unlike any other subject in Croatian education. Further, by specifying the number of teaching hours, the State, with both intention and willingness, has legally secured the amount of teaching time devoted to RE. This means that, in order to change these teaching hours, the State would have to negotiate revisions to the Agreement with the Holy See, which would be an unlikely and unprecedented event[11].

Beside this legal framework, the introduction of RE was also based on its foundation in theological – ecclesial, anthropological – pedagogic, historical and social perspectives (Razum, 2008). The first and most central perspective implies that the methods and contents of the subject are based on the Church's evangelical and catechetic role, as Razum states:

'…it is clear that the aims, contents and methods will be almost identical to those characteristic of the Church catechesis aimed at members of the Church: in this case it is a simple move of Church catechesis into a school space.' (ibid, 203)

The dominance of this perspective is also evident in the subject themes which strongly follow Catholic catechesis, as well as in the subject's aim:

'The aim is the systematic and harmonious theological – ecclesial and anthropological – pedagogic connection of God's announcement and the Church's tradition

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10 Further, such agreements are not an exception in the European context, with other countries like Spain and Italy having signed similar contracts with the Catholic Church (Zrinšćak, 1999b).

11 In contrast, while teaching hours devoted to RE cannot be changed even at the level of Parliament, the Government can reduce the number of hours dedicated to any other subject with a simple decision by the Ministry.

with pupils' life experience in order to establish a systematic and holistic, ecumenical and dialectically open introduction to the Catholic faith on an informative, knowledge, experiential and practical level…' (MZOS, 2006: 336)

Together, these elements suggest that the subject is strongly characterised with catechetic elements and that it is, like its name suggests, a school form of catechesis (Razum, 2008: 279). Furthermore, one important element of the dominance of the theological-ecclesial and evangelical role of this subject is the fact that participation in school RE is a precondition for the receiving of the sacraments. In other words, pupils who attend parish catechesis, but do not attend RE in school, cannot receive sacraments (NCO, CBC, 2000).

In this chapter, the Croatian educational and social context with respect to the two domains of interest was described. The discussion was framed in the contents and aims of science education and RE, but also in the wider context of the duality between modernity and tradition characteristic for Croatian society. The discussion clearly illustrated RE's unique position in Croatian education and presents an interesting point of comparison and contrast with the more traditional form of science education, as viewed from the pupils' perspective. Having painted a picture of the local context within which the present study has been carried out, the research must be further placed in the greater context of the research literature before turning to a discussion of the research aims and design itself.

CHAPTER THREE: SETTING THE SCENE - A LITERATURE REVIEW

3.1. INTRODUCTION

In the first part of this chapter, an examination of the complex relationships between science, religion and psychology will be discussed. This discussion will start at a general, philosophical level, moving to a discussion of this relationship in the social, and particularly educational, sphere and, finally, a consideration of the relationship at the personal level.

In the second part of this chapter, a more specific review of empirical work informing the present study will be provided. In the first instance, the concept of attitudes will be discussed, which will be followed by a more focused discussion on pupils' attitudes towards science and RE. Finally, an overview of the limited but important literature on the interaction of the two worldviews from pupils' perspectives will be presented. This will be followed by a statement of the project's aims and research questions.

3.2. EXAMINING THE RELATIONSHIP BETWEEN SCIENCE AND RELIGION

It could be argued, as Thomas Huxley did in Victorian England, that the history of modern thought is but a reflection of an ongoing conflict between science and religion (Brooke, 1991). Therefore, an attempt to describe the association between these two constructs in a study of this size and scope might be classified as an overambitious and immature venture. However, because the present research deals with and is informed by some of the aspects of this relationship, especially by those evident in modern day educational practice, it is necessary to explore, at least partially, some of the issues and ideas surrounding the topic. For centuries, philosophers, theologians, historians, scientists and others have tried to conceptualise the relationship between the two domains by emphasising the commonalities and differences between them. For example, Barbour (1997) and Polkinghorne (1998), based on their own examples and those of many other scientists, proposed that religion and science should engage in a sincere and meaningful dialogue. In contrast, Stephen Jay Gould (1999) proposed the concept of 'non-overlapping magisteria' where the manner of thinking and purpose of science and religion are separate and so between them there is no meaningful interaction and subsequently no possibility for conflict. Finally, Richard Dawkins (2007) argues that the two are in conflict and science is superior to religion. Dixon (2005) suggests that, in fact, both concepts have more in common with each other than is often thought. He emphasizes the common interest in and efforts dedicated to deciphering fundamental problems about the origins and nature of the physical world, and about human beings especially. This common interest towards deciphering the unknown has been both a main connecting point and divisive issue at the core of the historical and present-day divergence between science and religion. Before explaining the nature of this relationship, the manner of exploring and describing the world and human activity from the perspectives of science and religion will be briefly discussed.

3.2.1. How do religion and science go about understanding the world?

One of the primary divisive characteristics between religion and science is a question of method, or the manner in which the natural world and human activity is explored and described (Hood, Spilka, Hunsberger & Gorsuch 1996). In order to investigate, describe and explain the world and human existence, the scientific approach uses an inductive method relying on the collection of evidence that can then be generalised to an overall phenomenon (Polkinghorne, 1994). However, as Karl Popper (1969) suggested, knowledge in science should not be considered as fixed, and every knowledge claim necessarily needs to be prone to falsification. It is this characteristic of constant openness to rejection that, arguably, enables science to be open and a-dogmatic. The Christian religion, on the other hand, relies on a highly developed system of thinking regarding the natural and social worlds established through the Holy Scriptures (Scott, 2003). Through discovery and theory building, science, and the fields of astronomy, geology and evolutionary theory in particular, have posed serious threats to the literal understanding of religion (Argyle, 2000). This has particularly challenged concepts in religion such as biblical chronology, mind-body dualism and the possibility of miracles (Dixon, 2005). As such, religion is not so welcoming to the idea of falsification in the face of new scientific discoveries, relying more on a literal and metaphorical understanding of the scriptures. These differences in method paint a contrasting picture of religion, on the one hand, as unchanging scripture engraved in stone, and science, on the other hand, as modifiable text printed tentatively on a word processor.

However, there exists a problem in this claim. Murphy (1990) suggests that this simplified position undermines the rationality of religion while overstating that of science. Lakatos (1981) and Kuhn (1970), in an extension of Popper's thinking, have suggested that, even in the case of negative evidence, the core of some scientific theories is rarely falsified, much like the literal interpretation of religious texts. Lakatos claims that while the core is hardly ever rejected, the auxiliary belt of theory is more likely to be modified or discarded. On the other hand, from both distant and recent historical perspectives, various religious organisations have indeed reinterpreted and modified the postulates and codes of their confessions. This suggests that the difference between science and religion as hierarchical systems of different quality may be overstated.

Arguably, however, the problem of method is intrinsically connected with an underlying, but more fundamental, issue between science and religion: that of the debate regarding the observable vs. the unobservable, or the inner world, in the case of religion, and science's interest in the physical world (Argyle 2000). In other words, the difference in the methodological approach of the two disciplines may be connected with the divergence of their foci of investigation. This position is arguably fallible on a few accounts. First, both science and religion share their interest in understanding what is still unknown, which occupies both physical and inner worlds. Secondly, the division between science's interest in the observable and religion's interest in the unobservable proves too restricted if we take into account the branching of scientific disciplines and exploration of areas such as cosmology and Bohr's research in quantum physics, which suggests that much of science is 'irrational' and unpredictable, whilst even more of it unobservable (Argyle, 2000). Thirdly, as argued above, both religion and science give an account of the emergence and development of the physical world and of the inner world of the individual.

A specific consideration of the differing methodological approaches adopted to describe and understand the world and human nature proves to be complex and multi-faceted. While in many ways divergent, science and religion's dual examination of both the physical, observable world and the inner world of the individual makes their relationship increasingly one of overlap and mutual interest. In the next section, the nature of this relationship will be described.

3.2.2. What is the nature of this relationship?

Although it might seem logical, at first, to envisage the relationship between science and religion as one characterised exclusively by conflict, such a narrow view would be a grave mistake. Both Brooke (1991) and Dixon (2005) argue that the association between religion and science should not be exclusively traced to recent times (i.e. from modern times and the Enlightenment era to the present). Indeed, it could be argued that the relationship between science and religion is not only ancient and enduring in its nature, but, more so, ambiguous in its character, at times divergent and at others harmonious (Bowler, 2001). For example, over the course of history, the three major monotheist religions (Christianity, Islam and Judaism) have all contributed to the development of scientific thought at certain periods of history, which has been followed by periods of religious reaction towards that same scientific development (Barbour, 1997). More recent historical work sheds interesting light on this intriguing association by demonstrating that the suggested schism between religion and science is dependent on the context, often defined by the particular religion, the particular science and the specific geographical and historical location in which this relationship is grounded (Brooke, 1991). A consideration of such contexts has shifted the focus from grand theories of conflict to more highly specified theories concerning specific events in history, such as the disputes between Galileo and the Church, darwinism vs. creationism, or Bible vs. Science. Modern historical analysis has also pointed out that the reasons behind and circumstances surrounding such conflicts have not been exclusively intellectual (nor, one might suggest, even philosophical or metaphysical), but have often been fraught with political and practical influences (Cantor, 1991; Harrison, 2003).

Ian Barbour (1997) postulated how this liaison might be characterized in one of a number of ways, namely one of:

- conflict,
- mutual independence,
- dialogue, or
- integration.

As both a physicist and religious believer, Barbour (1997) strongly rejected the idea of an irreconcilable conflict between science and religion, promoting both a dialogue between and a possible integration of the two, a perspective shared by many other scientists and theologians writing about this relationship. Dixon (2005) reviews the analyses and criticisms mounted in response to Barbour's work. This review of existing arguments will form the structure for further discussing the nature of the religion-science relationship in the following paragraphs.

1) *It has been argued that the dialogue between science and religion advocated by Barbour (1997) has become one-sided. According to this view, it is science that dictates the conversation and demands responses from religion and theology.*

Scientific enterprise, through its constant modification, has posed a serious threat to a religious understanding of nature and humankind (Argyle, 2000). This has resulted in a peculiar situation for religion that has been described as an intellectual position known as the 'God of gaps' (Astley, 2001), or one in which religious explanation is needed only in situations in which science has not yet provided rational explanations (Drees, 2003). As such, critics argue, it is religion that becomes troubled by the role and position of the ever-changing and modernizing worlds of science and technology.

Arguably, this position over-simplifies the issues by undermining the present-day position of religion whilst overemphasising the role of science. The position arguing for the depiction of religion as simply a ‘God of gaps’ implies a power equilibrium largely in favour of science. However, as recent history and a multitude of social and religious contexts indicate, religion, through cultural foundations and its social and political ties, has been able to pose questions and threats to science to which the latter feels obliged to answer. For example, in debates concerning the initiatives of fundamentalist Christian groups in the USA to include theories of intelligent design in high school science curricula, it is clear that science needs indeed be concerned with the position and role of religion in the modern world (Ruse, 2005).

So, although science, through ongoing empirical research and advancement, has and continues to indirectly question a religious understanding of the physical world and human nature, it would be simplistic to envisage the position of religion as one of a boxer on the ropes, only able to strike a lucky punch. Arguably, religion, mostly through its cultural importance, social position and connection with political structures, still plays a vital role in almost all societies. Furthermore, through exercising this role, it is capable of posing a threat to scientific understanding (Scott, 1997). As such, the relationship between science and religion is perhaps more accurately envisaged as a symmetrical one than the one-sided relationship advocated by the intellectually and theologically false position of the ‘God of gaps’.

2*) It has also been argued, in response to Barbour’s (1997) work, that it is, in fact, impossible to refer to the terms science and religion, and the relationship between the two, in the singular form because both expressions imply extensive plurality.*

The main idea behind this criticism is that one cannot describe a general relationship between science and religion, as both concepts entail a plurality of forms. It is through the interaction of these plural forms, further amplified by the plurality of the social settings in which the relationship is realised, that creates a need for consideration of this relationship to be more specific (Dixon, 2005).

The plurality of the views of religion towards science is not only evident in the existence of various confessions, but even more so in the differences between them. The relationships of different faiths, such as Buddhism or Catholicism, to science are qualitatively different, and are represented through a diverse range of conflicting messages regarding the role of science in the teachings of the Church (Brooke, 1991). In short, it seems as though, in religion, there exists no unified standpoint towards or relationship with science (Drees, 1996). It becomes even more difficult to speak about 'science' as a general term, where what would be considered *science* by most, or the so-called 'core scientific disciplines', could be easily expanded. For example, one could quite readily pose the question: 'Are psychology, anthropology or even educational research scientific disciplines and do they have a uniform relationship to religion and religious phenomena?' The plurality of scientific disciplines further emphasizes the need for a non-singular response to the issues contained within the religion-science relationship (Haught, 1995).

3) *Finally, Barbour's (1997) work has been criticized by writers who argue that the debate concerning the relationship between religion and science is limited in its sole adoption of Christianity as its starting point.*

Extending on the second account, critics have further argued that the problems evident in describing the relationship between concepts of religion and science have been a product of the specific intellectual, political and social milieu of the developed countries of the Western world (Dixon, 2005). This adds further complexity to the problem of the plurality of forms involved in the science-religion relationship, and implies that the problem might not exist outside the perspective of the Western world, or of the Judeo-Christian tradition specifically. Although a thorough exploration of this argument is beyond the scope of this book, it is an important issue to bear in mind when considering the relationship between religion and science in the context of the proposed research.

In general, the above arguments expose the complexities surrounding the issue of the relationship between religion and science. There exist multi-layered, multi-influenced, and multi-faceted intricacies within this relationship, with both science and religion holding a vested interest in the actions and influences of the other (Scott, 2003). Further, while the above arguments might apply in a consideration of the science-religion relationship in general, they are less helpful for depicting this relationship within a context of a specific social or political system where it, arguably, gains further complexity (Strassberg, 2005). Hefner (2008) points out that researchers in the science-religion field often postulate that the conversation between the two occupies an empty room, whereas in reality there are multiple other influences modulating it. Religion, as a social phenomenon, has a cohesive power, which may serve as a connection to the tradition, history and ethnic structure of a specific society (Reich, 1996). On the other side, the close connection between science and technology and the forces of economy and politics dictates the importance of the role played by science in modern societies, with scientific and technological advancement increasing a society's competitiveness on the globalised market (Roth & Alexander, 1997). Indeed, it might be argued that both serve an important, although different role, making their individual interaction with political structures firm. It might be further argued that the importance and significance awarded to these concepts in a certain society should be represented through their position in the education system and the decisions of educational policy structures in relation to their nature, form and prevalence in educational curricula. In light of their mutual importance and the case for their inclusion in any educational system, the assumed conflicts could be problematic for political structures forced to accommodate both positions.

3.2.3. Science and religion in education

Jerome Bruner's instrumentalism tenet of his psycho-cultural approach to education emphasises that, apart from the consequences education holds for the future lives of individuals, the wider culture and its various institutions are also affected from this educational endeavour (Bruner, 1999). It is the interaction amongst these multiple consequences that is instrumental for the preservation and development of a culture. Thus, it might be argued that the diversity and plurality of epistemological approaches in the overall curriculum might have effects for culture and society itself. Societies typically introduce scientific subjects into their national curricula from the early years, gradually increasing their emphasis and complexity as children grow older. Indeed, given the potential contribution of science to society, it is of vital importance to encourage pupils' interest in science in an effort to consequently improve societies' economic achievement and competitiveness through the engagement of their citizens in scientific enterprise (Osborne & Collins, 2001). Historically, religious instruction also has been a fundamental feature in educational systems (Hull, 1984). However, unlike scientific study, the role, importance and prevalence of RE has diminished over time, much in the manner of the disputed deterioration of the importance of religion in modern societies (Hull, 1984).[12] Despite this observation, it might be argued that religion, through a firm connection with the historical and cultural traditions of a society, can still hold an important role in the education of a specific society, namely that of establishing this connection between religion and societal tradition in the minds of young people, through which the confessional and ethnic patterns of societal life reinvent themselves (Argyle, 2000).[13]

A specific society might develop educational designs that include both instruction of confessional RE and elaborated science instruction, postulating their relationship, using Barbour's typology, as one of mutual independence, dialogue or even integration. It is somewhat unlikely that an educational design would purposely posit a relationship of conflict between the domains or subjects. From an educational perspective, problems arise when one considers the contradictory knowledge claims offered by religion and science. In the case of a mutually independent relationship, contradictory knowledge claims are presented in separate subjects and pupils are often left alone to make sense of

12 This might be true of Great Britain, but, as evidenced in the description of the Croatian context, Hull's statement becomes questionable here.

13 It is this critical interaction between the Catholic faith and the Croatian nation that is cited as the first reason for the establishment of Catholic RE in public schools in Croatia.

the connection between them. Open dialogue offers the possibility of meaningful presentation and discussion of these claims, a situation which presumes that both disciplines are willing and able to accept and understand the other perspective. If we accept Michael Apple's (1990) notions of the interplay between knowledge and various forms of power, it becomes extremely difficult for educational policy structures to decide which of the two, or whether both, divergent worldviews should be represented in education. In the face of such divergence, it is plausible to speculate that institutions representing such claims will compete for their presence in the curriculum. As such, the assumed conflict between religion and science becomes very apparent in the spheres of education. Although there are various topics in education where science and religion could potentially offer contrasting claims, the teaching of evolutionary theory and creation is one prominent illustration of the complex relationship between these two concepts in the educational context. This potential for discrepancy will now be explored as a prelude to a discussion of findings from the present research on pupils' perspectives on this topic.

3.2.3.1. Teaching of evolution and creation[14]

Regardless of its nature, all educational systems incorporating some form of RE introduce the central religious concept of creation at some point, theologically defined as 'bringing-into-being-of-everything-by-God' (Poole, 1998). This does not mean that these systems teach creationism, a movement which tends to specify time-scales and processes of creation more recently associated with fundamentalist Christian groups (Poole, 2007).[15] Similarly, the theory of evolution as a framework that unifies all aspects of life into a coherent system is a part of science lessons in almost all educational systems. Because, for most of the last century, both of these concepts have been taught side by side in

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14 The history of the relationship between the story of creation and evolutionary theory is compelling and multifarious. However, it is not central to this thesis, where the interest is rather in the existence of these two concepts in education.

15 It is important to note that all believers are, in some sense, creationists due to their belief in the 'bringing-into-being-of-everything-by-God', but this does not mean that they believe in creation in a literal understanding of the time-scales and processes depicted in the Bible.

many societies, questions arise as to the reasons and means for the reignited controversy of teaching evolution in science classes. Recent controversies have mostly occurred in the USA, where fundamentalist Christian groups have used various political, legal and media instruments in order to promote creation science and, more recently, intelligent design theories and to weaken the instruction of evolution in educational institutions (Moore, 2001). Pennock (1999) attributes a lot of the fervour of these groups to their wider political agendas. Tracing the conflict in the USA from the early 1990s to the present day, Moore (2007) states that, after losing all court challenges related to evolution and creationism instruction in public schools, these groups have turned to more subtle ways of challenging evolution by attempting to embed anti-evolutionary policies in educational documents and rearranging creationism as intelligent design and presenting it as a scientific alternative to evolutionary theory. But is this only a problem in the USA and is it confined only to fundamentalist religious groups? In fact, Jones and Reiss (2007) write that dislike of and disagreement with evolutionary theory is globally widespread and crosses denominational boundaries.

The Catholic Church has a particular stance towards this issue in its nominal acceptance of evolutionary theory. Arguably, the often quoted words of Pope John Paul II, who stated that emerging discoveries and knowledge have led to the conclusion that the theory of evolution is more than just a hypothesis, signals this acceptance (Bižaca, 2007). Dawkins (2003) is sceptical about such statements, regarding them as nominal and superficial. According to him, they are typically coupled by clear statements which emphasise the existence and central significance of some supernatural form that has an active and cognisant role in either the origin of life or the first appearance of humans. Bižaca (2007), coming from a Croatian theological perspective, notes a change in the attitude of the Pope Benedict XVI towards evolution. Based on the collection of presentations and discussions the Pope held with his disciples in 2006, he concludes that this Pope is much more reserved than his predecessor and is cautious of premature harmonisations between theological teachings and evolutionary theory (Bižaca 2007). Jones (2007), in her personal account of teaching evolution in southern USA, notes that, regardless of the official stance of the Catholic Church and the apparent lack of any theological schism between Catholic doctrine and evolutionary theory, her Catholic students expressed some of the strongest anti-evolutionary views she had experienced, views that had been acquired from priests and in their catechetic classes.

By now, it is clear that the relationship between science and religion is infinitely complex, even within the more specific considerations of the methodological approaches taken by these constructs and their relationship to the realms of politics, society, and education and even in consideration of the specific topic of teaching creation and evolution. It is also clear that any examination of this relationship is context specific, and should be undertaken with the influences of political, social, historical, and cultural contexts firmly in mind. Although no clear resolution as to the nature of the connection between science and religion can be made, the issues highlighted here are relevant to the forthcoming examination of student attitudes and understandings within science and religious education.

3.2.4. Science and religion at the individual level

While simplistic ideas of 'eternal conflicts', 'raging wars', and 'complete integration' might be meaningful on social, political and even educational levels, do they retain meaning at the individual level? Are the lines between religion and science among individuals really delineated? Many individuals have managed to successfully combine their religious belief and scientific worldview, but can the same be expected of elementary school pupils?

Reich (1991) has proposed a stage theory to examine pupils' understanding of apparently contrasting and competing explanatory theories, and states that a student's ability to achieve complementarity between such theories develops with age. Indeed, complementary reasoning is of critical value for pupils' religious development (Reich, 1991). Reich argues that, in order to reduce pupils' cognitive dissonance between science education and religion, educational policy should:

- Assist pupils to acknowledge different kinds of truth and different levels of symbolism and transcendence in both fields.

- Encourage pupils to face apparent conflicts as being a vital part of the complex reality of both society and human existence.

Reich's work becomes especially appropriate for developed societies in its depiction of some of the main streams of development in RE in the EU. Problems do arise, however, when one attempts to transform his model and apply his recommendations to the case of confessional RE within the Croatian context. His findings impose serious consequences for the present research, as they suggest that the majority of younger pupils may be unable to envisage the complementarity of religious and scientific ideas.[16] As previously explained, Croatian pupils are exposed to different and sometimes contrasting world-views and knowledge claims from an early age. This raises the question of how this situation might affect their attitudes towards specific subject curricula and whether such attitudes play a role in the adoption or rejection of the associated worldviews.

To further position this investigation in the context of the theoretical and empirical literature, the relationship between psychology and religion will be explored in the following section. Like science and religion, they represent another set of concepts that have not always enjoyed a fruitful and consonant coexistence.

3.3. EXAMINING THE RELATIONSHIP BETWEEN PSYCHOLOGY AND RELIGION

Religion is essentially linked with the inner world of the individual, which is, of course, also a focus of investigation in any psychological enterprise (Argyle, 2000). Therefore, the distinction between science's interest in the physical world and the inner world of humans as an exclusively religious realm

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16 Reich's final stage of complementarity is similar to the 5th, and highest, stage of Fowler's theory of faith development (Fowler, 1987). This stage is characterised by a dialectic and inclusive style of faith in which the individual is willing and able to hold contrasting views about religion. In this respect, Fowler argues, the individual will use either view depending on its utility in understanding a particular situation and particular circumstances. Arguably, this is how individuals function when faced with the cognitive dissonance caused by a conceptual conflict between religion and science.

proves incompatible in a discussion of religion and the science of psychology. As Argyle suggested, psychology's alternative account of mental processes represents a field in which science seriously trespasses into the religious field. However, Argyle (2002) later suggests that religion is positioned somewhat outside of the fields typically considered to be those studied by psychologists. Thus, Argyle argues, psychology fails to offer a complete psychological explanation of religious phenomena. Harris (2000) suggests that psychology has been negligent of religion. However, religion is an omnipresent concept in the lives of individuals, cultures and societies throughout the world and throughout history (Merkur, 2005). Furthermore, a substantial part of human behaviour is or has been initiated, determined and affected by religion. Therefore, a valid question arises: How can a scientific discipline aimed at understanding human behaviour neglect the existence of such an important phenomenon and how can it fall outside the realms of it?

It would be a mistake to assume, from Argyle's (2002) argument, that psychologists have not been interested in the study of religion. Although the relationship might be a tentative one, there have been serious attempts to understand religion and religious phenomena throughout psychological history (Wulff, 1997). Prominent psychologists, such as Freud, Eriksson, James, Bandura, Maslow and Allport, have devoted substantial parts of their work to the consideration of religion in the personal world of individuals (Merkur, 2005), but this stops short of establishing religion as one of psychology's central interests. Merkur (2005), in an argument driven by a psychoanalytical and theological perspective, criticizes the fact that psychological considerations of religion have been limited to those that can be most readily understood from an experimental, quantitative perspective.[17]

As was the case for religion and science, it might be argued that the contrasts between religion and psychology are exaggerated. However, although psychology has provided substantial empirical evidence for various religious phenomena, these explanations do not seem to satisfy religious institutions,

[17] In contrast, Argyle (2002) acknowledges that psychology cannot explain vital religious concepts such as sacrifice, religious experience and sudden conversion, but recognises its considerable success in explaining some of the phenomena related to religious behaviour.

theologians and religious studies circles. In fact, the fundamental reason for the friction between religion and psychology could be attributed to the differing perspectives taken by the two. Psychology, as it has developed over time, has aimed for a higher level of specification of the unit of examination through careful analysis. Furthermore, it has developed its methods much in the same light, striving mostly towards the quantification of various phenomena. Religion, on the other hand, is a holistic phenomenon, one that demands and works best in the synthesis of ideas and concepts that may seem almost banal when looked upon analytically.[18] Argyle (2002) offers a modest conclusion in his overview of the interactions between psychology and religion:

'Perhaps the best psychology can hope for is to study the causes, correlates and effects of religion, but may not be able to explain it.' (26)

Argyle's words might usefully serve as a guide to the potential of psychology in making a contribution to the study of religion.

One of the fields in which psychology has significantly contributed to the exploration of religion is the development of pupils' religious thinking. Theories in this field have significantly affected RE practice in the western world. In the Croatian case, where RE aims to educate pupils into the Catholicism, the development of religious thinking includes not only the development of positive attitudes towards Christianity or Catholicism, but even more so the adoption of the correspondent worldview. The mixed model, cross-sectional design used in the present research allowed for valuable, albeit indirect, insight into pupils' understanding and conceptualisations about the curricular content presented to them. Existing psychological conceptualisations of the development of religious thinking served as a foundational framework for this exploration. In order to place such examination in the context of the wider theoretical literature, the following section will review the psychological conceptualisations of children's religious thinking with respect to the age of pupils participating in the present research.

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18 Bakan (1996) states that psychology has modelled humans like machines regulated by causal determinism. If Bakan's views are valid, it is not surprising that scholars of religion seem so resistant to psychology.

3.3.1. Religious thinking

A considerable body of research has been devoted to exploring the development of children's religious thinking.[19] Many of the ideas emerging from these research attempts have informed the educational practice and design of RE. In a brief, albeit simplistic, classification, previous psychological research efforts on religious thinking can be clustered into three distinct conceptual and chronological categories:
Piagetian, Neo-Piagetian and Theory-Theory (Gottlieb, 2006). These three research streams imply and use differing conceptualisations and methods and, not surprisingly, have reached different conclusions, thus failing to allow firm conclusions about the development of children's religious thinking to be drawn. In the following paragraphs, each of the three research streams will be briefly explained.

Elkind (Long, Elkind & Spilka, 1967) and Goldman (1964), the pioneers of research into children's religious thinking, formulated stage developmental models of religious thinking through an extension of the ideas proposed by Piaget. Both researchers, although at variance in their descriptions of the ages and pace of key changes in religious thinking, proposed a three stage developmental model.[20] Much like Piaget's work, their models soon became a topic of critique which, among other features, centred on the fact that these theoretical models largely ignored and distorted the affective and existential aspects of religious thinking (Francis, 1976; Slee 1986).

According to Elkind and Goldman, prior to the age of 10 years, religious thinking is in a concrete phase where religious identity is related to specific behaviours, dressing patterns, prayers and other concrete activities. This is also a period where children interpret Bible narratives 'correctly', describing God as a man or a threatening force (Gottlieb, 2006). Between the ages of 10 and

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19 Gotlieb (2006) points out that use of the phrase *religious thinking* in itself may indeed be problematic for RE educators and curriculum designers as it strongly focuses on cognitive processes, while religious experience and RE itself arguably function on more than just a cognitive level.

20 While Elkind focused on the development of conceptions of religious identity and prayer, Goldman was most interested in the understanding of Biblical texts (Hyde, 1990).

14 years, the age at which the participants in the present research fall, children enter a phase of more abstract religious thinking. Here, private characteristics of prayer, knowledge and the differentiation of various beliefs increases and the previously concrete understanding of biblical accounts moves to a more abstract and systematic one. At the time of their conception, both theories had an immense effect on the approach to teaching RE in Britain and the rest of Europe. This was especially the case for Goldman's suggestion that young children should not be exposed to the Bible in light of the chance that children's undeveloped, material interpretations of biblical stories would become so firmly established that they would be difficult to change later (Hyde, 1990). It was further argued that, as cognitive processes become more complex and elaborated in adolescence, these individuals might reject religion as something immature and unimportant. This proposition provided rationale for the distancing of RE from biblical texts, and was criticised for its inclination towards liberal theological frameworks over those more conservative approaches linked to the literal truth of the Bible (Gorsuch, 1988). Although severely criticised, this conclusion is interesting in the case of confessional RE in Croatia whose catechetic nature is based on biblical accounts and teaching relies heavily on biblical narratives from the very first grade.

The second stream of research placed its focus on the existential and affective aspects of religious thinking and was mostly associated with Kohlberg's research in the field of moral development. Once again, the work of two researchers came to fore, with complex multidimensional six-stage models of religious development proposed by Fowler (1981) and Oser (Oser & Gmunder, 1991). Fowler's model focuses on faith development, whilst at the centre of Oser's model is the development of religious judgement. Of interest for the present research are the second and third stages of both Fowler's and Oser's models, where research participants would be placed according to their age. Stage 2 of Fowler's model (mythic-literal stage) is characteristic of children between 7 and 11 years and is typified by literal interpretations of stories, beliefs and religious practices. Although these can be meaningful for children of this age, they are unable to disengage themselves from narratives and formulate more reflective, conceptual meanings. The third stage (synthetic-conventional faith) is characteristic for adolescents but becomes an endpoint for the religious development of some adults. Here, faith becomes conformist as it is tuned to the expectations and judgements of significant others. Arguably, the individual begins to relate to a specific value and belief framework and is often unaware of other existing and competing frameworks.

In Oser's model, the second stage, most commonly emerging between the ages of 11 and 12 years, is characterised by an orientation of giving in order to be able to receive (Hyde, 1990). While God is still viewed as an omnipotent being that punishes and rewards, one can influence him by doing good deeds, promising and vowing (Gottlieb, 2006). The third stage, according to Oser, is most commonly achieved by individuals in their early 20s and is characterised by an orientation of absolute autonomy or deism. Here, the role of God in human life diminishes and the individual perceives himself as responsible for his life. The rejection of religious authority is characteristic for this stage.

The educational effect of this research stream did not result in such tectonic movements as the first one, with no systematic effort to devise clear educational implications and designs arising from the models and subsequent empirical research. Both models agreed with previous Piagetian models that preadolescent religious thinking is mostly concrete and literalistic and that it moves from transcendence to immanence (Harris, 2000). Gottlieb (2006) argues that this imposes grave constraints on RE and the materials presented to pupils in that children are not only cognitively unable to comprehend religious concepts, as suggested by Piagetians, but are unable to experience mature religious feelings and obligations. Once again, the critique from theological circles was that both models are biased towards more liberal theological streams. From this point of view, it would be interesting to consider how the concepts of these theorists would fare in the case of Croatian society and the 'school catechesis' form of confessional RE.

The third, more recent stream of research, falling under the name 'theory-theory' (Gopnik & Wellman, 1994), is clearly post-Piagetian in its rejection of stage theory but even more importantly in its implied development in religious thinking.[21] Here, it is suggested that young children are able to develop and test hypotheses about observed phenomena and, based on the outcome, progress to further and even more elaborated theories (Gopnik, Meltzoff & Paticia, 1999). As such, children's thinking is not qualitatively different from that of adults and existing observable differences are more a result of quantitative deficits in children's experiences and cultural knowledge (Woolley, 2000). This research paradigm has reignited interest in children's religious beliefs in light of its successful explanations in the fields of children's understanding of causation in physical, psychological and biological spheres (Rosengren, Johnson & Harris, 2000). Important to this stream of research is the work of anthropologist Pascal Boyer, who proposed that religious beliefs are a by-product of human cognitive evolution (Boyer, 2004). Central to his argument is the concept of intuitive ontology, defined as 'a set of broad categories about the types of things to be found in the world, together with quasi-theoretical assumptions about their causal powers' (Boyer & Walker, 2000; 135). Boyer argues that humans tend to over-attribute agency on one side and be fascinated by intuitive ontology on the other and that religious representations are counterintuitive and tend to violate intuitive principles. These religious representations include attention grabbing features which are socially transmitted (Boyer & Walker, 2000). Boyer further states that the religious conceptualisations of adults and children are largely continuous and do not have stages. What differs is the amount of cultural knowledge children have in comparison with adults. As with the acquisition of more complex cultural knowledge, the difference between religious conceptualisations becomes smaller with age.

Although, unlike the two previous streams of research, 'theory-theorists' reaffirm the abilities of young children for religious understanding and thinking, this work poses even greater challenges for RE. First, according to this line of research, religious thinking is not domain specific in any substantial way but integrates conceptual repertoires from physical, biological and psychological domains (Boyer & Walker, 2000). Furthermore, proponents argue that re-

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21 For example, theorists here state that the emergence of immanence in adolescence may actually result from an ability to provide more 'theologically correct' answers while the belief in transcendence still remains (Boyer & Walker, 2000).

ligious thinking is not culture specific, where underlying ontological assumptions are basically the same even though cultural patterns differ significantly (ibid). There has been strong criticism of Boyer's work, mainly focusing on its negligence of the plethora of evidence for cultural and religious differences. This line of research has had relatively limited impact on RE, which Gottlieb (2006) attributes to an ideological distance between researchers and RE educators created by the impression that Boyer's work resembles the anti-religious reductionism of Freud and Marx.

Based on the previous discussion, it seems there is still much to be understood about children's religious thinking, with no clear conclusions on its nature and development emerging. While the present research does not have as its sole focus the development of pupils' religious thinking, it does aim to provide some insight into this topic that might prompt more concentrated research efforts in the future. It additionally incorporates an examination into the function of education on the development of religious thinking, a notion that Gottlieb (2006) argued had not been awarded enough attention.

Before moving to a discussion of the present study, this examination of previous work will now shift to a more empirical consideration of several topics housed within the research aims. Namely, specific attention will be devoted to an exploration of the literature examining pupils' attitudes towards subjects in elementary education, with a special focus on science and RE. Finally, a review of the research investigating pupils' understanding of the discrepant knowledge claims that arise in these subjects will be presented.

3.4. STUDYING PUPIL ATTITUDES

The discussion thus far has been grounded in a somewhat intangible consideration of the relationship, in both general and academic terms, between the spheres of religion, science, and psychology. Here, the intent was to review the empirical literature on the ways pupils perceive these elements. This section mainly focuses on pupils' experiences and attitudes towards science and RE, which will be considered mainly through a discussion of existing research in the international context. As previously stated, the attitudes and experiences of Croatian pupils towards school subjects are a field of study yet to be adequately investigated. Indeed, the only insights into pupils' perspectives known to the researcher are those from the aforementioned 2003 study (Marušić, 2006). Since the author was a main methodologist and a member of the research team that designed the research instruments on this project, significant elements of the present work are informed by the design and results of the 2003 study. Therefore, discussion will first be devoted to a brief presentation of the previously only partially published 2003 results. This will be followed by a thorough consideration of international research on attitudes towards science and religious education. However, a consideration of attitudes as a concept and its delineation in the present research is first necessary.

3.4.1. Defining a concept: Attitudes

One of the more common definitions of attitudes is offered by Eagly and Chaiken (1993), who state that: *'An attitude is a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour'(1)*. Petty and Cacioppo (1991) define attitude as *'a general and enduring positive and negative feeling about some person, object or issue' (27).* Perloff (2003) offers the definition that an attitude is a *'learned, global valuation of an object (person, place, or issue) that influences thought and action'* (39). Arguably, all three definitions can be further scrutinised for certain elements. The first definition implies favourable or unfavourable evaluations, thus opting for a definition of attitudes as constructs with positive or negative tendencies. This approach fails to recognize that a personal stance to an attitudinal object may indeed be bi-valent or, in other cases, ambivalent. This may be especially relevant in the case of coexisting but differing attitudes towards concepts such as science and religion. The second definition mentions feelings, a concept that could be easily distinguished from attitudes as a shorter and more contextualised reaction, while attitudes are more enduring valuations (dos Santos & Mortimer, 2003). The third definition includes two important implications for the present work. First, it mentions the learned nature of attitudes, which implies that education is capable of cultivating and influencing pupils' attitudes towards certain constructs. It is important to note that this influence can function in various directions resulting in positive, negative or ambivalent evaluations of attitudinal objects. However, the learned nature of attitudes should not be considered in absolute terms in light of research with newborns suggesting that some attitudes might be more genetically oriented (Rosenstein & Oster, 1997). The second important element arising from Perloff's (2003) definition is the implication of influence on behaviour and action. The connection between attitudes and behaviour has been disputed in the field for decades, warranting the suggestion that, rather than propagating a direct relationship between these two concepts, a more indirect connection might be more suitable. Using all three definitions, attitudes might best be defined as mostly learned, relatively constant evaluations of an object.

As previously stated, a review of the literature on attitudes towards science and RE will start with a description of the only research effort probing elementary pupils' attitudes towards school subjects in Croatia.

3.4.2. The 2003 survey: Laying a foundation

In 2003, a large-scale project was carried out in which a specially designed questionnaire was administered to one randomly selected 8th grade class in each of 121 participating schools. [22] Overall, 2674 pupils from all regions of Croatia, with an average age of 13.6 years and equal gender representation, participated in the research. The questionnaire focused on pupils' attitudes towards subject curricula, perceptions of school activities and teaching methods and their interests in and outside of school. Although the questionnaire examined a wealth of themes, the focus here will be given to pupils' reported attitudes towards specific subjects, operationalised as their estimations, on a seven-point semantic differential scale, on each of the following dimensions:

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22 One of the primary phases of the project was a needs assessment survey, conducted on a representative sample of 15% of Croatian elementary schools. Sampling at the school level was stratified according to the regional location of the school, followed by the random selection of schools for participation in the survey within each of the stratums.

- Interest
- Comprehensibility
- Difficulty
- Usefulness for present life
- Importance to future life

Although the analysis conducted for all subjects depicted an interesting picture of pupils' perceptions of Croatian elementary education, attention will be directed towards chemistry, physics, biology and RE here.

3.4.2.1. Survey findings

The findings, expressed as means of pupils' estimations for science subjects and RE on all five dimensions, are presented in Figure 3.1[23]

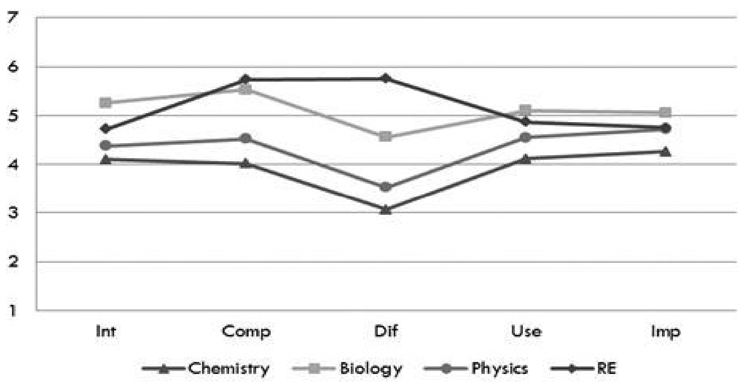

Figure 3.1: Pupils' ratings of science subjects and RE on five attitudinal dimensions – 2003 study

From these results, some noteworthy features regarding pupils' attitudes towards science subjects and RE can be highlighted. Perhaps the most striking feature is the low ratings for chemistry and physics on all dimensions, especially the low estimations of the comprehensibility and interest for both

23 Results are expressed as means. Higher estimations indicate elevated levels of interest, comprehensibility, easiness, usefulness and relevance of the respective subjects

subjects. Conversely, pupils regarded biology most positively. Interestingly, while pupils did not perceive it as an easy subject, it remained generally comprehensible and interesting. This combination suggests that both the content and implementation of the biology curriculum are more suitable for pupils than is the case for both chemistry and physics.

RE was regarded as the easiest and most comprehensible subject in elementary education, while at the same time falling within the middle range of subjects in terms of interest level. This presents an interesting paradox. In the first instance, it could be argued that the RE curriculum houses some of the most challenging and difficult concepts and ideas in elementary education, due to the abstract nature of its ideas and their interaction with pupils' personal preconceptions and beliefs regarding matters of religious faith. However, pupils' responses suggest just the opposite, thus demanding an acceptance of a more complex analytical framework for considering these issues. This framework needs to be informed, on one side, by the confessional nature and 'school catechesis' form of the subject and by concerns related to the educational elements of the subject on the other.

The patterns of results in the first three dimensions were similarly revealed in the analysis of the dimensions of perceived usefulness for present life and importance to future life. Here, the estimations were highest for biology and lowest for chemistry, with RE and physics falling in between. The position of these subjects in the overall classification once again repeats a similar pattern, with chemistry positioned near the bottom, RE and physics in the middle and biology in the upper half of all subjects taught in Croatian elementary education. While the results for science subjects were concordant with previous analyses, highlighting the lower status of chemistry and physics and the relatively high status of biology, there existed a relative drop in the estimations of RE on these two dimensions compared to the dimensions of perceived difficulty and comprehensibility.

Gender differences

Analysis of gender differences in the 2003 data painted an interesting picture of a gender split in the case of chemistry and physics. While the former was more highly rated by girls, the latter subject was more appreciated by boys. However, the results also suggested that it would be premature to conclude that girls enjoy chemistry more than boys. In fact, while girls provided higher estimates in almost all subjects and on all dimensions than boys, they still regarded chemistry as the most difficult and least interesting subject in elementary education. Physics, on the other hand, despite its perceived difficulty, was one of the most highly estimated subjects by boys, whereas chemistry was the lowest ranked subject. Girls gave higher estimates for biology, placing it high in the overall ranking of all subjects. This was especially evident on the dimensions of usefulness for present life and importance to future life. Interestingly, boys perceived physics as more important to future life than biology. Girls also gave higher estimates of RE than boys. However, while girls rated RE as more interesting, important and useful than both chemistry and physics, the highest ranking in all these dimensions is awarded to biology. Boys, in contrast, perceived both biology and physics as more interesting, useful and important than RE.

This preliminary analysis of the raw quantitative data collected several years ago offers more questions than possible answers. While the results pointed to some trends in pupils' attitudes, the research design did not allow for an exploration of the reasons for such attitudinal patterns both within and between school subjects, nor did it provide any explanation for the nature of the differences, on all dimensions, between boys' and girls' ratings. These issues clearly required further investigation, and were thus incorporated into the aims of the present research. Next, a consideration of the existing literature on pupil attitudes towards science and RE will place the present research in further context.

3.4.3. Studying pupil attitudes: Justification and challenges

The presented results are in many ways consistent with findings in the existing literature on pupils' attitudes towards science and RE. At present, such arguments come primarily from literature on science education. Reviews of the literature on pupils' attitudes towards science education indicate that this topic has been of primary interest in the field over the last four decades (e.g. Collins et al., 2006; Koballa & Glynn, 2007; Osborne et al. 2003). A review of the literature on attitudes towards science education and science will be succeeded by a consideration of pupils' attitudes towards RE and religion. Finally, an overview of the limited, yet significant, literature connecting science education and RE will be provided.

3.4.3.1. Why study pupil attitudes?

Various studies have demonstrated the importance of the role of attitudes in pupils' attainment, and in the consistency and quality of their classroom work. Furthermore, underlying the study of pupils' attitudes is a wish to understand their experience of the educational process and the curricular content they encounter. By offering rare insight into pupils' preferences and perceptions, attitudes may serve as a means for ameliorating the present teaching context. It has been suggested that pupils' attitudes affect their views about science education in general and, as students' progress through educational study and enter the workforce, towards scientific occupations. Osborne and Collins (2001) suggest that interest in the study of pupils' attitudes towards science is amplified by a public awareness of the difficulties evident in British science education. They argue that a large proportion of pupils are alienated from scientific disciplines, while such disciplines are having an ever-increasing significance in their personal, economic and social lives. This sentiment is seconded by other researchers who consider the devastating economic consequences of the lack of pupils' interest in scientific disciplines (e.g. Haste, 2004; Jenkins, 1994; 2005; Lepkowska, 1996; Simpson, Koballa, Oliver & Crawley, 1994; Sjoberg, 2006). Osborne et al. (2003) state that the competitiveness of a nation is largely based on a highly educated, well-trained and adaptable workforce. This is in line with many educational policy documents from the USA, UK, EU and Australia, which emphasise the importance of pursuing science in education in order to achieve economic prosperity. Whereas the contextual framework of the aforementioned work is rooted in the post-industrial worlds of Great Britain, USA and the EU, the question arises whether the same patterns are valid for developing countries like Croatia. Arguably, if such societies wish to be competitive on globalised markets, the importance of sound science education and the resulting flexibility of the workforce become even greater. As such, negative pupil attitudes towards science could have an even greater devastating influence on the future personal choices of individuals and the overall development of Croatian society.

While this argument may be true of science education, how does it apply to a need for studying pupil attitudes concerning RE? In the opinion of this researcher, there is no reason why analogous thinking could not be applied to RE or any other subject. Namely, it seems appropriate to argue that the valence of pupils' attitudes towards RE will have consequences for everyday school practice and the acceptance of the worldviews offered through RE curriculum. Clearly, denominational RE holds very different goals from science education and, as previously elaborated, a special position and role in Croatian elementary education. Pupils' attitudes towards RE might be used as an indicator of the educational systems' success at fulfilling these goals and justifying this special role and position. On this basis, investigation of pupils' attitudes is both relevant and important in the field of educational research.

However, the process of probing pupils' attitudes towards school subjects has been marred by the ambiguities regarding the definition of the term attitude (Francis & Greer, 1999b; Germann, 1988; Kind et al., 2007). Osborne et al. (2003) reiterated the need for a commonly agreed definition, pointing to an overlap of terms used in the existing literature such as 'beliefs', 'attitudes', 'opinions', and 'values'[24]. An even more salient and equally disputed point in research exploring attitudes towards science and religious education is ambiguity in the definition of the object of attitudes. Reid (2006) appropriately emphasises the lack of clarity of the concept of pupil attitudes towards science. Koballa and Glynn (2007) emphasise that research into science attitudes usually explores such attitudes within the context of school science but that this is usually not made clear. The same might be said about attitudes towards religion, where difference between attitudes towards religion and RE seem

[24] Koballa and Glynn (2007) state that, in relation to attitudes, values are more complex, broader and enduring concepts (Trenholm, 1998), beliefs are the cognitive foundation of attitudes (Ajzen & Fishbein, 1980), and opinions are verbal expressions of attitudes (Shrigley, Koballa & Simpson, 1988).

inadequately articulated and ambiguously understood (Francis & Kay, 1984; Greer 1983).

Gardner (1975) was one of the first researchers to note the difference between attitudes towards science and scientific attitudes suggesting that attitudes towards science are those affective perceptions which incorporate the feelings, beliefs and values held by a student about science or any of its derivatives, such as science education. Alternatively, a scientific attitude is conceptualised as a longing to know and understand, to question what is presented, to collect and analyse data, to search for verification and to logically connect premises and consequences[25]. In other words, although these concepts have a common theme they are actually different constructs. In relation to the present study, Gardner's dichotomy seems to be easily transferred to the field of attitudes towards religion and religious thinking, while the description of them is necessarily different (Greer, 1983).

However, Gardner's dichotomy soon becomes insufficient in light of the suggestion from several authors that the concepts of attitudes towards science are multifaceted (e.g. Bennet, 2001; Jarvis & Pell, 2005; Kind et al., 2007). In the present research, the actual problem seems to be three-fold as in the context of education: an exploration of attitudes towards curricular subjects might uncover pupils' attitudes towards (i) the general concept, namely science and religion; (ii) the concept as it relates to school, that is to say science education and RE or; (iii) the specific way of thinking and behaving, or a religious or scientific attitude. Although it is very plausible to expect different evaluations of separate objects, such as the educational elements of RE and the doctrine of the Catholic Church, educational and general concepts often seem blurred in research into attitudes.

In their comprehensive review of instruments measuring science attitudes, Blalock, Lichtenstein, Owen, Prusky & Marshall (2008) point out that, alongside conceptual ambiguity, attitude research has been and still is associated with measurement problems. They especially emphasise issues of questionable psychometric characteristics, single study usage and limited ecological validity.

25 This might be said to be similar to what Kuhn (2004) calls 'scientific thinking', and can be conceptualised as a cognitive endeavour.

Some of the more often used instruments are: the unidimensional 'Attitudes Towards Science Scale' (Francis & Greer, 1999b), 'The Attitudes towards Science Inventory' (Gogolin & Swartz, 1992), 'Changes in Attitudes about the Relevance of Science' scale (Siegel & Raneey, 2003) and multidimensional instruments developed by Pell and Jarvis (2001) and Kind et al. (2007). One of the more interesting recent developments in the use of self-report instruments is the Relevance of Science Education project (ROSE), an international comparative project investigating factors influencing the importance attributed to the learning of science and technology in over 40 countries (Schreiner & Sjoberg, 2004).

The problems of probing pupils' attitudes are connected not only with issues of psychometric characteristics and limited ecological validity, but include the centrality of quantitative methods in the exploration of pupils' attitudes towards school subjects. Potter and Wetheral (1987) state that quantitative methods are useful in revealing the crudest estimates of attitudes but fail to expose and explain the imbedded complexity of feelings and views. This is seconded by Ryan and Aikenhead (1992), who state that questionnaires do not accurately measure pupils' attitudes because the closed nature of the items and forced-choice response typically reflect researchers' ideas and ideologies rather than those of participants. Furthermore, the most commonly used methods of Likert-type and semantic differential scales, used also in the present research, are prone to the well-known problems of quantitative self-report measures in attitude research, such as response styles, response sets and social desirability (Perloff, 2003). The results from a limited number of studies employing qualitative methods have indicated the beneficial elements of such designs (e.g. Ebenezer & Zoller, 1993; Osborne & Collins, 2000; Palmer, 1997; Piburn & Baker, 1993).

In order to address some of the aforementioned deficiencies, the present research employed both quantitative and qualitative methods in order to gain a more holistic view of pupils' attitudes and their formation. This decision is in line with the view of several researchers in the field that a shift from purely quantitative measures of attitudes to a more contextualised and thorough consideration is needed (e.g. Jenkins, 2006; Koballa & Glynn, 2007; Osborne et al., 2003). Such a design will also enable a reduction of the conceptual ambiguity related to the exploration of attitudes towards science and religious education and towards science and religion as more general concepts.

Before speaking to the relationship between pupils' perceptions and understandings in scientific and religious study, a review of the literature examining attitudes in each discipline separately will be considered.

3.4.3.2. Pupils' attitudes towards science

The development of positive attitudes towards science in school becomes significant when one considers them as a main contributing factor to the decision to pursue a scientific career (Haste, 2004; Jenkins, 2005; 2006; Osborne et al., 2003). However, reviews of research in the field suggest that formal education is not doing enough to provoke pupils' interest and develop scientific curiosity (Braund & Reiss, 2006; Collins et al., 2006; Osborne et al., 2003). As mentioned, previous research suggests that, in general, pupils' attitudes towards science education cannot be described as positive (e.g. Ormerod, 1971; Osborne & Collins, 2000). The worrying results derived from the 2003 survey regarding pupils' attitudes towards science are consistent with those in other research. Indeed, research on pupil' attitudes towards science education has resulted in a multitude of evidence that would be very difficult to review fully in this book. Collins et al. (2006) suggest that researchers have usually focused on several strictly delineated variables of the multifaceted issue of pupils' attitudes. As the present work is not informed by, nor does it attempt to probe, all of them, only those elements of the literature related to the present work will be presented here. First, in light of the cross-sectional nature of the present research, the issue of differences in attitudes over time will be addressed, followed by a discussion of research on the variance in pupils' attitudes towards different scientific disciplines. Next, a consideration of research into the relationship between attitudes and gender and academic achievement, two variables that feature prominently in the present design, will be presented. A discussion of the limited research exploring the relationship between religion, as both a personal and cultural element, and attitudes towards science education will be considered in a separate section.

Attitudes over time

Research has demonstrated a decline in enthusiasm for science with age (e.g. Barmby, Kind & Jones, 2008; George, 2006; Hadden & Johnstone, 1983b; Piburn & Baker, 1993; Simpson & Oliver, 1990), which has also been supported in research on primary school pupils' attitudes towards science (Galton, Gray & Rudduck, 2003; Galton, Hargreaves & Pell, 2003; Hargreaves & Galton, 2002; Pell & Jarvis, 2001). These are intriguing and critical results which highlight serious questions regarding the nature and purpose of science education in pupils' development, especially considered alongside the findings of Kahle and Lakes (1983), who demonstrated that pupils enter education with very favourable views of science. It was this kind of evidence that led Hadden and Johnstone (1983) to suggest that science education in schools may actually do more harm than good in nurturing pupils' interest and positive attitudes towards science and science education.

With most research designs investigating attitudinal change with a cross-sectional design, there are very few longitudinal studies of pupils' attitudes towards science (Osborne et al., 2003). Furthermore, while qualitative efforts devoted to researching this problem might illuminate personal perspectives on this decline, there exists very little of such research. Reiss (2004) is one exception, employing a longitudinal qualitative design in order to research pupils' attitudes towards science. His conclusions on the erosion of pupil enthusiasm serve to complement the aforementioned research efforts. Both Osborne et al. (2003) and Collins et al. (2006) appropriately suggest that, while previous research has been useful in identifying patterns of attitudinal decline, it provides limited knowledge of the processes involved in these phenomena. As such, these researchers call for the use of both longitudinal designs and complimentary methods in order to get a holistic picture of these issues.

Attitudes towards scientific disciplines

Various studies have demonstrated that pupils' attitudes towards science education vary amongst the specific science subjects (e.g. Havard, 1996; Hendley, Stables & Stables, 1996; Osborne & Collins, 2000; Parkinson, Henley, Tanner and Stables, 1998). Namely, the results from Osborne and Collins' (2000) study established a distinction between biology, which was found to be both relevant and pertinent for pupils by addressing issues with which they were concerned, and the physical sciences, with which pupils had difficulty in identifying. This is in line with the earlier findings of Whitfield (1980) and Ormerod (1971), which suggested that physics and chemistry are the two least popular subjects in secondary education. Havard (1996) further established the distinction between biology on one side and physics and chemistry on the other. Osborne and Collins (2000) were somewhat surprised to find chemistry less appealing than physics, a result also suggested in the analysis of the 2003 study. Osborne et al. (2003) hypothesise that negative attitudes towards chemistry may be a result of the abstract nature of the subject and its remoteness from the everyday experiences of pupils, a suggestion confirmed by Reiss (2000). Similar findings emerged from research in international settings. Lannes, Rumjanek, Veloso and de Meis (2002) found that Brazilian pupils find biology more relevant than physical sciences, a conclusion similar to that of Lamanauskas (2004) in the case of Latvian secondary pupils. Even though the educational contexts are highly different, these findings were confirmed in the results of the 2003 study, which similarly demonstrated diverse estimations for different subject curricula.

Gender differences in attitudes towards science

Harding and Parker (1995) state that women seem to be poorly represented in professions requiring science-related qualifications, with the exception of the medical profession. Many researchers have made the link between this problematic situation and statistical data concerning pupils' attitudes towards school sciences. This has resulted in a substantial body of empirical work devoted to the exploration of gender differences in attitudes towards science and the wider implications of such differences. One of the most quoted arguments in this field is Gardner's (1975) notion that gender is the most important variable associated with pupils' attitudes towards science. This has been confirmed through the meta-analyses of Becker (1989) and Weinburgh (1995) and in various individual research efforts afterwards (Andre, Whigham, Hendrikson & Chambers, 1999; Dawson, 2000; Jones, Howe & Rua, 2000; Pell, Galton, Steward, Page & Hargreaves, 2007), in which it was demonstrated that boys have consistently more highly positive attitudes towards school science than girls. When bracketed down to scientific disciplines, research results generally indicate that boys are more interested in physical studies whereas girls generally prefer topics in the biological and social sciences (e.g. Clarke, 1972; Colley et al., 1994; Kelly, 1986; Kelly, White & Smail, 1987; Lamanauskas, 2004; Osborne & Collins, 2001). Salta and Tzougraki (2004), in an examination of the gender differences in Greek secondary pupils' attitudes towards chemistry, found that there were no significant gender differences except in the perceived difficulty of the subject, where girls gave higher estimations. The 2003 study mostly confirmed these results, with boys indicating significantly more positive attitudes towards physics and girls towards biology.

There is a plethora of hypotheses for explaining these gender differences. An attempt at such an explanation was made by Smithers and Hill (1987) in a somewhat stereotypical description of personality differences and gender concepts in which girls are more person oriented, responsible and cooperative while boys are more independent, achievement oriented and dominant. Other studies have argued that classroom organisation, materials and computer applications that inherit gender bias are more appealing to boys (Bazler & Simonis, 1991; Jones & Wheatley, 1989; Jones et al., 2000). Qualter (1993) argued that it is teaching through concrete examples related to personal activity and experience which girls favour, thus making biology a preferred subject. Similarly, Reid and Skryabina (2003) argue that physics has traditionally been presented in an abstract and rule dominated form typically preferred by boys.[26]

Academic achievement

While the 2003 study did not consider pupils' achievement in relation to attitudes towards science subjects, the larger body of literature on this topic is quite extensive. Collins et al. (2006) report that the nature of this relationship remains ambivalent while other studies reporting this relationship often describe it as one relatively moderate in strength (Jovanovic & King, 1998; Oliver & Simpson, 1998; Osborne & Collins, 2000; Weinburgh, 1995). Os-

[26] Besides those already mentioned, the gender debate has various other streams that are too numerous to be pursued at length in this thesis.

bourne et al. (2003) report that the rationale for the complex relationship between academic achievement and attitudes towards science is yet to be successfully formulated. Collins et al. (2006) reiterate this by stating a lack of conclusive evidence for this relationship signals a need for further research.

So, how do the results of the 2003 study fit into the wider literature framework? In general, it seems that the 2003 survey results are a confirmation of the results from the existing literature, through its clear distinction between biology, which was established as a positively estimated subject, and chemistry and physics, which did not receive high estimations. The high correspondence of the 2003 study with the existing body of knowledge is even more evident when the variable of gender is taken into account. First, the 2003 results seem in line with evidence from the literature suggesting that boys show more highly positive attitudes towards physics. Secondly, there exists a difference in attitudes towards biology between girls and boys in the 2003 study. Chemistry, as a subject with the most negative estimations from both boys and girls, signifies a special problem that needs a thorough, contextualised analysis. These topics will be explored further in a discussion of the results from the present research.

3.4.4. Attitudes towards RE

Schweitzer (2006) started his overview of the future perspectives for research into RE with a rhetorical question: '*Is religious education an academic discipline really doing research?*' He continues by saying that neither theology nor education had really taken RE seriously in terms of research investigation. Similarly, Grace (2003) points out the general neglect of the dimension of faith on any major issue under investigation of educational research. Indeed, while there exists a wealth of literature on pupil attitudes towards science worldwide, there has been considerably less research exploring pupils' attitudes towards RE. Furthermore, alongside the previously mentioned problems associated with research into attitudes towards science, such research is additionally faced with at least two further problems that make conducting and comparing it more complicated. The first issue lies in the strongly emotional nature of the subject of religion, as compared to science, in the individual lives of pupils. This makes distinguishing between attitudes towards RE and religion and a religious attitude, similar to the distinction that has been suggested for science, significantly more difficult. The second problem that arises is one outlined by Greer (1972), one of Britain's pioneers in the field of quantitative research on RE. He emphasised that the differences in pupils' attitudes towards religion and RE is related to different denominations, the cultural context and geographical location. While Greer's notion might be valid for Britain alone, it arguably gains even more significance if international research is considered. Thus, it seems the problem faced by researchers investigating pupils' attitudes towards RE lies in the complexity posed by the notion that each religion presents with a particular historical, political and social position within a specific society, by the existence of various forms of educational systems existing within that society, and by the specific forms of RE in particular.

These considerations make the comparability of findings from research conducted within the context of a non-denominational RE in liberally-oriented England to the context of a denominational RE in semi-traditional Croatia more limited than was the case for the scientific disciplines. As it was argued in the outset of this book, in order to understand RE and religion in a specific society, a deeply rooted local perspective needs to be adopted. This is similarly true for research into pupils' attitudes towards RE. Such a perspective would not only take into account the circumstances surrounding specific confessions in Croatian society, but, more importantly, would also acknowledge the specific educational practices expressed within the special role, position and form held by RE in the Croatian elementary educational system. However, despite this assumed limitation in the compatibility and transferability of the results from different educational systems, confessions and forms of RE, it remains important to consider the existing body of knowledge in order to inform the present study.

In Britain, research into pupils' attitudes towards RE has demonstrated that the subject is generally not perceived positively (Francis, 1987 1996; Harvey, 1984; Ormerod, 1975). In fact, in all of the referenced studies, RE has been ranked as one of the least popular subjects amongst pupils. This seems in contrast with the results of the 2003 study suggesting a generally positive attitudinal pattern of RE amongst Croatian pupils. However, Lewis and Francis (1996) raise an important issue by reporting that various groups of students hold differing attitudes towards the subject of RE. Specifically, the researchers demonstrated that girls held more positive attitudes towards RE then boys. This finding conforms with the empirical data from the work of Greer (1972), as well as to the results from the 2003 study in Croatia. This is also in line with the more general finding, in regards to religion and religious behaviour, that boys and men are less religious than women and girls on all dimensions of religiosity and across all ages (Argyle & Beit Hallahmi, 1975; Batson & Ventis, 1982; Hyde, 1990). A second distinction that can be made amongst pupils' differing attitudes towards RE comes from the work of Francis (1987; 1989), which suggests that pupils who are more closely affiliated with religious institutions have more positive attitudes towards RE. This and other research (e.g. Tamminen's (1996) thorough longitudinal exploration of pupil attitudes towards RE in Finnish education) suggests that, with age, attitudes towards RE tend to become less positive for both boys and girls, while the difference between genders remains. However, Tamminen suggests that such gender differences should be observed in relation to the more highly positive attitudes amongst girls towards school in general.

In sum, a consideration of pupils' attitudes towards RE demonstrates a significant overlap between the findings from the literature and the 2003 study. However, there is one notable exception: Croatian pupils, in a relative ranking of all subjects, seem to perceive RE more positively than is the case with British pupils. As explained, the differentiation of the attitudinal object between RE as a school subject and the more general concept of religion is an important one to make. Francis and colleagues, from a perspective of practical theology, developed a set of instruments probing pupils' attitudes towards Christianity (Francis, 1987) that were used in the present research. However, due to its elective, confessional nature and 'catechetic' form, the implementation of attitudinal measures alone to probe pupils' reaction to Croatian RE and their confession seems insufficient. Instead, a deep-seeded contextual approach that embodies both quantitative measures and qualitative techniques was implemented to explore pupils' experiences, thoughts and attitudes towards religious teachings.

3.4.5. The link between RE and science education and the role of pupil attitudes

While attention has previously been devoted to a consideration of the relationship between science and religion, a review of the literature investigating the liaison between religious and science education more specifically, and the role played by research into pupil attitudes towards both subjects in examining this relationship, will now be presented. At the outset, it is significant to mention that, although such research represents an intriguing topic for investigation, there exists a limited number of research attempts focused on developing an understanding of the relationship between these two fields of the curriculum. One possible obstacle to conducting such research might be due to the specific relationship between these two concepts within various confessions, societies, educational systems and forms of RE. Astley (2001) emphasises that, within educational institutions, there often exists a certain lack of trust and communication between those who teach in these two subject areas. Astley's (2001) reflections raise some important issues regarding the form of the relationship between religion and science in the field of education. His conceptualisation of a lack of trust and communication between educationalists from the two disciplines seems largely removed from Barbour's (1997; 2000) discussion of integration, dialogue and coexistence between science and religion. Instead, Barbour's ideas would suggest that knowledge developed in science and religion could complement, or at least coexist with, each other and that this should be supported by educationalists from both fields. However, as Greer (1972) correctly emphasises, the complexity of the educational context within which both subjects exist is a significant obstacle to developing and explaining this relationship.[27]

Thus, it seems that developing an understanding of the relationship between science and RE is similarly complex to the study of the connection between science and religion in general. In the present research, an attempt

[27] In their analysis of the Agreed Syllabuses for RE in England, Bausor and Poole (2003) found that two thirds of these documents had materials on science and religion, but missing were comparisons of language use, the nature of the explanations in religion and science as well as the history of the 'conflict thesis'.

at analysing this relationship will focus specifically on the nature of pupils' attitudes towards each discipline. Previously, some researchers have similarly tried to establish a connection between RE and science education through attitudinal measurements. In his work, Francis (1996) states that positive interest in science education is expressed by approximately two thirds of 12-16 year old students, a figure that is significantly greater than the mere one third of students who express a positive attitude towards religion and RE. Francis, in a confirmation of Greer's (1972) findings, demonstrates further that girls are more interested in RE than boys, whereas boys show more interest in science subjects. Additionally, he adds that both boys and girls report progressively less interest in religion with age and more interest in science.

Various research efforts have further probed the interaction between pupils' attitudes towards science and religion. Francis (1996) suggests that being male and of greater age positively correlates with an opinion that science is superior to the religious and biblical interpretations of creation and history. Astley (2001) further argues that, when asked about the science-religion relationship, students often express their attitudes in terms of an assumed conflict. Reiss (2007) is likely correct when he attributes that such findings are probably due to quantitative data collection techniques and the typically dichotomous formulation of questionnaire items. Further research from Francis (1992b) points to the uncertainty held by pupils about the relationship between science and religion. In this study, 51 percent of pupils answered 'not certain' when asked if they agree with the statement 'Science has disapproved of religion'. Although a critique could be addressed to the author due to the fact that his analysis is based on a single attitudinal item, this finding might suggest that a significant proportion of pupils do not perceive a connection between the concepts of religion and science at all. Furthermore, and more plausibly, these results might suggest that pupils have difficulty with the acceptance of the coexisting, yet rival, understandings derived from each discipline. This seems in line with the seminal work of Greer (1972), who demonstrated that pupils experienced difficulty in combining a religious understanding of the biblical story of creation and a scientific understanding of earth and human origin. Research from Kay and Francis (1996) and Fulljames (1996) follow this line of enquiry and investigates the influence of the extreme positions of creationism and scientism on pupils' attitudes towards Christianity. This research has demonstrated the difficulty, experienced by students adopting either position, in being positively oriented or interested in the opposing position. Kay and Francis (1996) conclude that scientism and creationism cannot be complementary and that there is no philosophical ground for a dialogue between the two.

Arguably, however, such crude statistical indicators on which the former studies are founded are insufficient to explain the subtle interplay between the two subject areas. Indeed, such results might become more robust were they to be taken into consideration alongside an examination of pupils' personal experience of both religion and science. It is the aim of the present research to engage in such an investigation.

3.4.6. How does adopting a specific worldview influence the acquisition of knowledge from an opposing position?

Roth (2007) explicates that a sound theory of knowing relating religious belief and scientific knowledge is yet to be provided. He states that tacit conceptualisations and intuitions of how the world works influence pupils' learning and development in school as they serve as a foundation upon which new education-based experiences become salient. Francis (1996) has suggested that much educational research has failed to acknowledge the role of religion and RE in shaping pupils' values, attitudes and beliefs. This was rationalised by the presumed marginalisation of religion in modern society, which, according to Francis, has reached a point at which information about a young persons' religious beliefs becomes irrelevant in understanding their educational, social and public worldviews, a view inapplicable to the Croatian situation. However, a very limited amount of research has explored the influence of the religious values, attitudes and beliefs of pupils on their understanding of scientific knowledge (Evans & Evans, 2008). Among these studies is the seminal work conducted by Roth and Alexander (1997), which explored the interaction of students' scientific and religious discourses. In a co-authorship effort between the researcher (teacher) and the researched (pupil), the authors found that religious discourse can negatively influence pupils' understanding of science. The qualitative research design used by Roth and Alexander (1997) is a welcome novelty in the field of investigating the interaction between scientific and religious preconceptions and informed the present design. Justification of their work came from a thorough review of the science education literature, which led the authors to suggest that, while considerable attention had been devoted to the influence of conceptual change and pupils' preconceptions on the understanding of scientific ideas, there existed a lack of research on the influence of other sources of influence on science instruction. The authors concluded that the interference of such influences, including religious values and beliefs, can be even more detrimental to scientific understanding than other more highly recognized factors, such as pupils' conceptions of natural phenomena. By recognising the potential conflict between science and religion, the authors pose the legitimate question regarding the representation of this conflict at the individual level. Their results indicate that pupils' conflicting discourses can have a negative influence on the deeper understanding of each one of them. Furthermore, the authors suggest that teachers and education staff should direct students in their attempt to successfully manage such discrepant knowledge claims. Their suggestion is in line with the work of Cobern (1993), who points out that science classroom learning can be ameliorated, especially with respect to students with lower interest or attainment in science, if teachers are aware and respectful of their potentially incompatible worldviews. There is, however, a serious obstacle in transferring the findings from Roth and Alexander's study (1997) to the present work, which emerges from the fact that the participants in their research were 18 year old high school students with advanced knowledge in physics from a private religious school in Canada. Whereas their research design justifies their sampling procedures, the present study differs in its attempt to look at the average elementary school pupil. While the advanced scientific thinking of high achieving physics pupils might make them more suitable for a consideration of the relationship between science and religion, which would, after all, be in line with the uncertainty of quantum physics, it is this researcher's opinion that an even bigger internal battle of discrepant discourses is being fought in elementary school.

As previously stated, one of the most contested issues in education is the teaching of evolution and creation. Poole (2007) states that pupils may have difficulty accepting and understanding the scientific account of origin if it contradicts their religious understanding. Lawson and Worsnop (1992) found that pupils with strong religious commitments are less likely to switch their belief after being exposed to theories of evolution and natural selection in the classroom, Verhey (2005) found that students with creationistic beliefs became more sympathetic to evolutionary theory after being exposed to explanations of both evolution and intelligent design in the classroom.

In this chapter, a review of the contextual framework informing the present study has been discussed. This was followed by a consideration of the literature with regards to the conceptual framework. Findings from the 2003 survey were presented, offering lone insight into Croatian pupils' attitudinal schemata with regards to school subjects. Additionally, through a review of the corresponding literature, the importance and relevance of studying pupil attitudes, and those towards science and RE in particular, has been demonstrated. Finally, the role of pupil attitudes in the development of pupils' understanding of scientific and religious worldviews, and their subsequent rejection or adoption, has been considered. Prior to a discussion of the methodological issues of the present design, a return to both contextual and conceptual frameworks and research aims is needed in order to formulate research questions.

3.5. REVISITING FRAMEWORKS AND AIMS AND STATING RESEARCH QUESTIONS

Based on the previous discussion of the Croatian educational and social context and a review of the literature, the initial contextual and conceptual frameworks (Figures 1.1, 1.2) presented in the introductory chapter can be further elaborated. The contextual framework, applied to the case of Croatia, presented in Figure 3.2 reveals the duality of the roles of science and religion in Croatian society. It also identifies the school subjects relevant to each domain as well as the likely sources of influence on pupils' attitudes and perspectives from outside education.

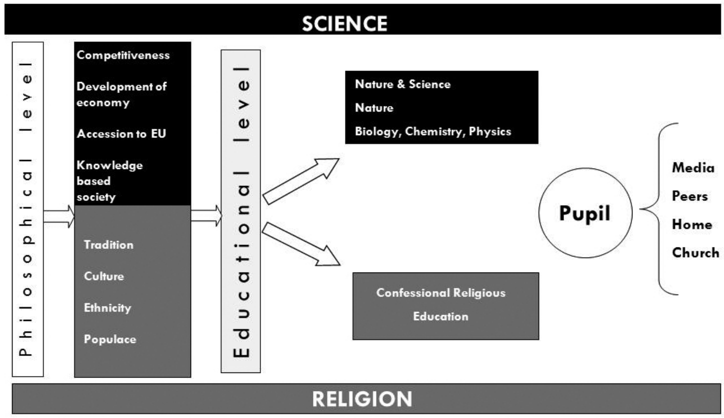

Figure 3.2 Contextual framework – The Croatian case

This change is also evident in the case of the conceptual framework representing Croatian elementary education, presented in Figure 3.3.

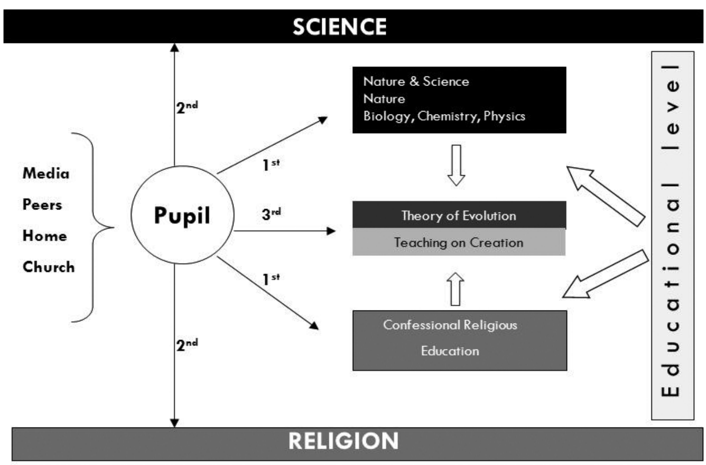

Figure 3.3. Conceptual framework representing Croatian elementary education and potential influences on, and problems for, development of pupils' attitudes and perspectives

Here, it might be suggested that the present study is informed by three seemingly distinct, yet intrinsically connected, sets of problems. First, the present study is involved with the exploration of pupil attitudes towards science subjects and RE, following the findings of the 2003 study of pupils' attitudes towards different subject curricula in Croatian elementary education. This study aims to replicate the 2003 procedures for comparative purposes, but more importantly it aims to extend the understanding of these expressed attitudes. Thus, one of the underlying aims of the present research becomes the exploration of factors likely to shape and influence pupils' attitudes towards the respective subject curricula and the ways in which their experience develops. More specifically, the present study aims to gain insight into the nature and development of pupils' affective and cognitive reactions towards the content covered in scientific subjects and RE in Croatian elementary education.

Secondly, the present study aims to explore pupils' conceptualisations, understandings and attitudes towards the more general concepts of science and religion. The science subjects' curricula aim to foster positive attitudes towards scientific enterprise and an appreciation for a scientific way of exploring and understanding the world and human nature. This study seeks to determine if and in what manner these aims are reflected in pupils' perspectives. In the case of RE, the specific form of teaching into the Catholicism goes beyond the affirmation of attitudes and appreciation of a religious worldview, to encouraging the adoption of this worldview and acceptance of religious teachings. Therefore, in addition to attitudinal measures of pupils' religious conceptualisations, pupils' adoption of this worldview and acceptance of religious teachings will be at the focus of this investigation.

The third stream of issues housed within the present research is founded on the coexistence of opposing knowledge claims offered by confessional 'catechetic' teaching of RE and the teaching of science, established through various subjects across elementary education. Although there are several topics through which these two educational streams expose pupils to opposing knowledge claims, the focus of the present research is on pupils' attitudes and understanding of the origin of life in the context of the concurrent teaching of creation and evolutionary theory.

The following research questions have been formulated to address these issues and guide the design of the research project, and are accompanied with schematic diagrams illustrating the corresponding conceptual frameworks informing each question.

Overarching research question:

What is the nature of pupils' attitudes to, and self-expressed experience of, the study of two contrasting intellectual domains, namely science and RE, in Croatian Elementary Education?

Research questions:

1) What are pupils' attitudes towards and self-expressed experiences of science education and religious education? To what extent and in what ways do they differ with respect to these domains? According to pupils, what factors influence these attitudes? (Figure 3.4)

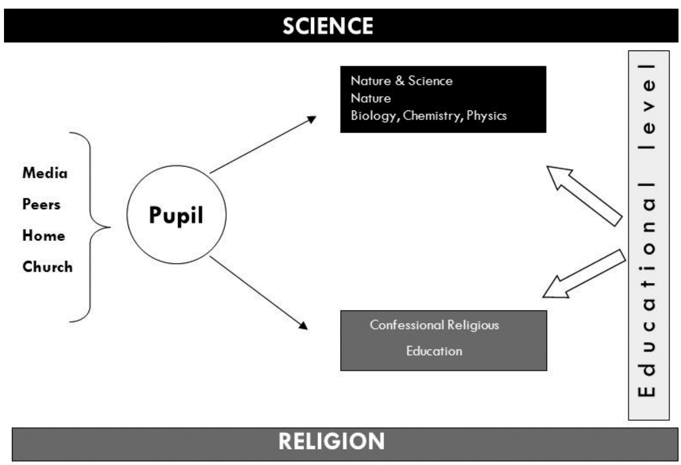

Figure 3.4 Conceptual framework to illustrate the first research question

2) What is the nature of pupils' attitudes towards and conceptualisations of the more general concepts of science and religion and to what extent do these attitudes and conceptualisations correspond to the aims of the respective subject curricula? (Figure 3.5)

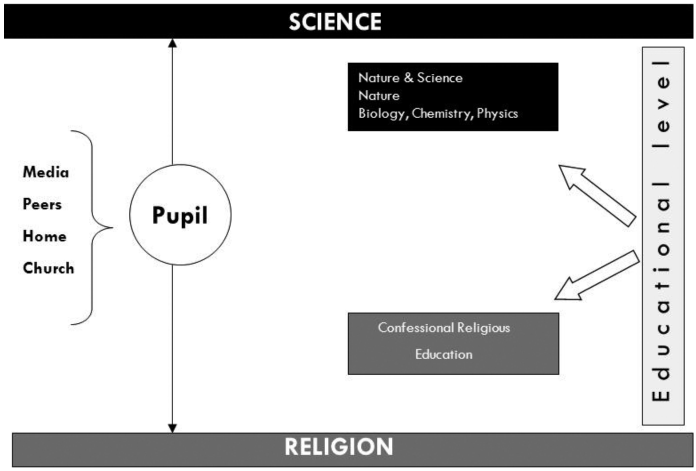

Figure 3.5 Conceptual framework to illustrate the second research question

3) How do pupils conceptualise and understand the issue of the origin of the species stemming from the concurrent teaching of creation and evolutionary theory and in what ways do pupils adhere to a particular teaching? (Figure 3.6)

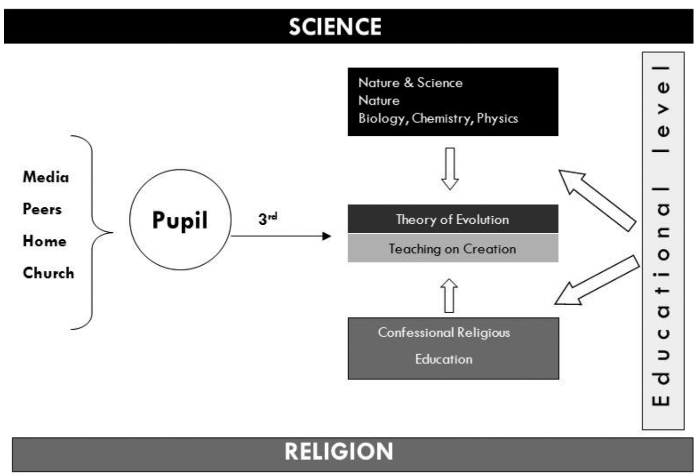

Figure 3.6 Conceptual framework to illustrate the third research question

All three sets of problems and the three research questions will be further considered using the variables of gender, academic attainment and stage of learning. The inclusion of two cohorts at two key points in the elementary education system, where the science curriculum changes from 'nature and society' to 'nature', and then 'nature' to 'physics, chemistry and biology', allows for a developmental perspective. Finally, the present research also aims to investigate how the tendency to adopt religious or scientific views affects the development of the attitudes and understandings housed within the three research questions.

CHAPTER FOUR: METHODOLOGY

4.1. A BRIEF OVERVIEW OF THE RESEARCH

In order to answer the research questions most effectively, the present project used both quantitative and qualitative methodologies to gather the necessary data. The data were collected between March and December 2006, thus following the same pupils from one school year to the next. The qualitative portion of the research preceded the quantitative element, but continued into the second part of the research to occur concurrently with the quantitative phase. Both phases of the research addressed three main themes: pupils' attitudes and experiences with science subjects and RE in the present curriculum; pupils' attitudes, conceptions and understandings of science and religion as wider concepts; and pupils' views on the questions arising from the interaction between science and religion, in education and in general. Table 4.1 illustrates the data collection programme.

The qualitative data were collected in one elementary school in central Zagreb. In total, 30 pupils participated and completed the qualitative research. Pupils were selected by their teachers, in collaboration with the researcher, through pre-established selection criteria based on gender and pupil interest in science and religion. Participating pupils came from two age cohorts: a 5th grade cohort (approx. 11 years of age) and a 7th grade cohort (approx. 13 years of age). At the termination of the project, these two cohorts had progressed to the 6th and 8th grades, respectively. The primary data collection method in this part of the research was individual semi-structured interviews with pupils. In addition to interviews, pupils were asked to keep a research diary which served as a space where they carried out 'research homework', but also as a medium where they could express their thoughts and feelings regarding the research process and covered themes. Each participant was involved in approximately eight interviews. In addition, five teachers from the same school (one each from the subjects of chemistry, physics, and biology and two from RE) participated in the research. Beside their role in the selection of participants, teachers also became active research participants themselves as the research progressed.

Two semi-structured interviews, one in each phase of the qualitative research, were conducted with each of the participating teachers. For biology and RE, two class periods conducted by the participating teachers were observed. These observations were qualitative and impressionistic in their nature, and thus served to develop an understanding of everyday classroom practice.

Table 4.1: Data collection programme for PhD study

Month	Activity
February – March 2006	• Letter to the Ministry of Education regarding permission to conduct the research. • Contacting the head master of the elementary school in Zagreb for his permission to conduct a study • Contacting the teachers of RE, biology, physics and chemistry regarding the initial sample selection • Contacting the pupils regarding their own wish to participate in the research • Writing and sending parental informed consent letters explaining the research to prospective participants' parents.
March – June, 2006	• Commencement of the qualitative part of the study – piloting of the procedure, interviews with pupils and with teachers, distributing and establishing pupils' diaries, qualitative observations, initial piloting of the questionnaire.
September – December, 2006	• Commencement of the second phase of the qualitative part of the study –interviews with pupils and teachers, continuation of pupils' diaries, qualitative observations.
October, 2006	• Determining the sample for the quantitative part of the research • Contacting the schools regarding their willingness to participate in the research. • Quantitative piloting of the questionnaire
November – December, 2006	• Administering questionnaires in schools

The quantitative phase was carried out in 11 schools in the central and greater Zagreb area. Schools were selected using random stratification as a sampling procedure, with school location serving as a selection stratum. In each school, one 6th and one 8th grade class were randomly selected to participate. In total, responses from 216 6th and 203 8th grade pupils were included for subsequent statistical analyses. Separate versions of the questionnaire were developed for each of the two age cohorts due to the different curricula in the separate grades and different developmental levels.

In the following sections, the research design, including all methods used in both participant sampling and data collection, will be described and justified in full detail. Firstly, however, a consideration of the methodological and paradigmatic frameworks informing the present work will be provided, with special emphasis on the mixed methods approach.

4.2. METHODOLOGICAL AND PARADIGMATIC APPROACH

As a study in which both quantitative and qualitative data were used in order to answer a wide array of research questions, the present research seems best positioned under a framework of a mixed methods approach. More specifically, this research might best be described as employing a multiple method design, defined by Tashakkori & Teddlie (2003) as *'research where more than one method or more than one worldview is used'* (10).

The present effort sets a dual task much in line with the argument derived from Gorard and Taylor (2004), who propose that, in mixing methods, quantitative work should provide answers to questions of 'what' and 'how many', while qualitative work should answer 'how' and 'why'. The research aimed to determine pupils' attitudinal patterns towards topics of interest, and adopted quantitative research methods as most appropriate for determining the scope and size of these phenomena. On the other side, the research questions imply an intention to explore, in depth, the foundations and formational factors behind pupils' attitudes, conceptions and understandings of certain phenomena. In order to gain such an understanding, a qualitative perspective was deemed more appropriate. It should be noted that the mixing of methods was envisaged not only as a way of conducting two smaller, yet still separate, studies housed within one overarching endeavour, but as complementary phases across the stages of a singular research process. Finally, the choice of mixed methods was carried out in line with the researcher's overarching philosophy of holism as a core characteristic of any research endeavour in the field of education.

In the following sections, a brief consideration of the mixed methods approach in educational research, and of pragmatism as its philosophical foundation, will be followed by a discussion of these methodological choices in the present research.

4.2.1. The mixed methods approach

Recently, growing interest and recognition of mixed methods approaches has generated many definitions for this methodological stream and its development. Johnson and Onwuegbuzie (2004) call the mixed methods approach *'a research paradigm whose time has come'* (14), whereas Tashakkori and Teddlie (2003) describe it as a *'third methodological movement'* (9). Similarly, Creswell (2003) states:

'Mixed methods research has come of age. To include only quantitative and qualitative methods falls short of the major approaches being used today in the social and human sciences.' (4)

Growing numbers of research journals and fields have been accepting mixed methods as a rigorous form of conducting research, and multiple books covering mixed methods research as a unique, stand-alone paradigm have recently been published (Tashakorri & Teddlie, 2003; Creswell, 2003; Creswell & Plano Clark, 2007). Although these actions would suggest that mixed methods research is a recent trend, most methodologists in this field would agree that the mixing of research methods has been present long before a formal formulation of the approach occurred[28]. Arguably the mixing of methods,

28 The evolution of mixed methods can be traced back to the multitrait-multimethod studies of Campbell and Fiske from the late 1950s and early 1960s, further strengthened by an interest for triangulation from different data sources in the late 1970s, and finally characterized by recent attempts at the parsimonious classification of what is currently known as mixed methods (Creswell, 2003).

techniques and even paradigms has always been a matter of 'praxis', a practice not affected by the ongoing philosophical and methodological debates occurring in academic circles.

The question might be posed 'Why mixed methods now?', or perhaps more accurately, 'Why not before?' Tashakkori and Teddlie (2003) offer a succinct, albeit somewhat simplistic, answer to these questions in arguing that the 'practical orientation' of mixed methods, in an age of strong theoretical debate, might explain why mixed methods research has not become the 'third methodological movement' sooner. One of the main reasons for the opening of a methodological space for mixed methods in social and behavioural sciences is the current state and recent history of the two major methodological approaches. In 1998, Tashakkori and Teddlie declared that the 'paradigm war', a term coined to depict irresolvable differences between the two major social science paradigms - positivism and interpretivism, was over. According to them, such conflicts over the supposed superiority of one paradigm over another have been present for decades, generating an 'incompatibility thesis' that argued that any dialogue between these two models was unproductive and that shared compatibility between quantitative and qualitative methods was impossible. This suggested incompatibility is the result of the nature of philosophies on which these methods are based (ibid, 1998). Indeed, even in the mid-1990s, Guba and Lincoln (1994) stated that the combination of paradigms is impossible and claimed that fundamental ontological differences are at the core of the incompatibility thesis[29]. However, it soon became evident that this radicalization of relationships between the two camps was not productive and that reconciliation between methods was needed.

Indeed, mixed methods approaches might be best positioned as a continuation of the two major paradigms, or more precisely as a reconciliation of the two. In the words of Johnson and Onwuegbuzie (2004): '*…mixed methods sits in a new third chair, with qualitative research sitting on the left side and quan-*

29 It should be noted that, at the same time, several authors (House, 1994; Datta, 1994) argued that these differences are overdrawn and unnecessarily dramatic, and that the schism between paradigms is too big. Some went so far as to maintain that the 'paradigm war' was an academic, methodological, and artificial conflict that had little to do with what was practised in reality.

titative research sitting on the right side.' (15) This notion is even more evident in the argument presented by Gorard and Taylor (2004), stating that competing qualitative and quantitative approaches would more appropriately be considered on a continuum rather than as exclusive and completely separate entities. They rightly state that quantitative social sciences typically deal, to some extent, with qualities, even when these observed qualities are counted. On the other hand, much qualitative analysis relies on the use of some form of numerical data, even through the use of words like 'most', 'some' or 'none'. Tashakkori and Teddlie (1998) claim that the end of the 'paradigm wars' and the emergence of mixed methods approaches had a positive impact for research in diverse fields, in that researchers were now able to apply whichever method is appropriate in order to answer the research questions. In the following section, attention will be devoted to pragmatism, which serves as a philosophical foundation of the mixed methods approach.

Pragmatism

Howe (1988) suggests pragmatism as an appropriate and useful philosophical paradigm for mixed methods[30]. At its foundation is the work of classical pragmatists including Charles Sanders Pierce, William James and John Dewey, who developed the ideas behind pragmatism as a way to reconcile the philosophical dualism promoted by purist positions (Morse, 2006). In the case of social research, pragmatism comes very close to the words of William James (1995, 1907 original) from the beginning of the last century: 'The pragmatic method is primarily a method of settling metaphysical disputes that otherwise might be interminable…The pragmatic method in such cases is to try to interpret each notion by tracing its respective practical consequences' (p.18).

By rejecting dualism, pragmatism seeks to offer a more moderate and commonsense perspective on the issues of paradigms in social research. It seeks ways of finding the most efficient way of solving problems, or in this case, answering research questions. Furthermore, by insisting on the rule of the re-

30 Pragmatism is not the only philosophical idea proposed to serve as a paradigm for mixed methods. Some researchers take advocacy/participatory perspectives as a paradigm. Indeed, proponents of this approach are the biggest critics of the choice of pragmatism (Tashakkori & Teddlie, 2003).

search question over paradigm, pragmatism offers the most suitable platform for achieving practical consequences implied and derived from the research questions. Flick (2006) stresses that the quantitative-qualitative debate has moved from a consideration of epistemology towards a consideration of the fitness of each approach for addressing research questions or studied issues. As such, it becomes possible to argue that debate regarding the 'true' nature of reality and knowledge construction becomes less relevant than the selection of methods appropriate for addressing a specific research problem.

Gorard and Taylor (2004) state that the pragmatic researcher should accept arguments from both philosophical stances, recognizing the value of searching for an understanding of a universally 'true' reality, while also accepting that part of this reality is constructed and co-constructed amongst individuals and in the context of their environment. Furthermore, the pragmatic researcher should have a notion that knowledge is fallible and facts are inherently theory laden. This is consistent with an argument formulated by Robson (2002), who states that mixing methods requires the researcher to be innovative and eclectic whilst not rigidly following traditions that do not fit the research purposes.

Regardless of the evident advantages of positioning the mixed methods approach as a middle point between two paradigms, the choice of pragmatism as a philosophical foundation also draws considerable criticism. Several of these critiques need to be addressed in light of the present research. First, it seems that the adoption of a pragmatic lens can lead to an inclination towards applied, rather than basic, research, thus looking more for immediate and practical, rather than structural and fundamental, findings. The present research effort has an ambitious goal for deriving solid research results that would be transferable to other contexts and phases of education in Croatia, and therefore, the choice of pragmatism may be inadequate. Secondly, by offering an a-paradigmatic and even 'anti-philosophical' stance, pragmatism does not offer a philosophical solution to the paradigmatic dispute, but more a way around many traditional philosophical and ethical discrepancies (Johnson & Onwuegbuzie, 2004). Acknowledging these criticisms, the present research effort has applied a mixed methods approach by accepting the contents and philosophies of both qualitative and quantitative approaches, and, by doing so, engaging in, rather than evading, paradigmatic dialogue.

4.2.2. Mixed methods in the present research

The emphasis, in mixed methods approaches, placed on the research questions as the primary force driving any research study is especially important for the present study. This position might best be described through the words of Tashakkori and Teddlie (1998):

'For most researchers committed to the thorough study of a research problem, method is secondary to the research question itself, and the underlying worldview hardly enters the picture, except in the most abstract sense.' (21)

Although there are valid arguments against the above statement, focusing on the research question rather than on paradigmatic issues alone is extremely useful in the present research, where the complexity of the topics covered by the research questions would be further amplified by the inclusion of paradigmatic notions.

Several features of the present project further justify the decision of mixed methods and will be considered in turn in the following paragraph:

- conducting research with children,
- conducting research into attitude formation,
- investigating religion and science as wider concepts,
- investigating questions arising from their interaction.

First, conducting research with children demands considerable flexibility on behalf of the researcher, as well as the pluralistic use of research methods in order to ensure that those most suitable for eliciting data from young participants will be applied (Christensen & James, 2003). This implies that, at times, the choice of method is almost under the influence of children's preferences, rather than a predetermined and fixed research schedule (ibid.). Secondly, although the measurement of pupils' attitudes entails, in most cases, the use of quantitative methods, the additional aim of the present project to investigate the factors influencing this attitudinal formation demands the inclusion of qualitative methods. Further, the complex concepts of science and religion gain further complexity when considered amongst young pupils. Finally, researching young children's conceptions of some even metaphysical questions arising in the intersection between science and religion represents a complex task that the inclusive and pragmatic orientation of mixed methods seems most suited to address.

However, while multiple method designs might provide a greater variety of data, do they really offer, as Johnson and Onwuegbuzie (2004) suggest, superiority over mono-methods? Tashakorri and Teddlie (2003) state three reasons why using mixed methods is superior to mono-methods. Specifically, they advocate that mixed methods designs can answer research questions that could not be answered by the exclusive use of just one method, that mixed methods provide stronger inferences, and that mixed methods offer a medium for presenting a greater variety of conflicting views. These reasons form another rationale for the choice of mixed methods in the present research. Research questions based on determining the scope of attitudes towards school subjects amongst elementary pupils could not have been effectively answered by qualitative methods, in that the type of data that would have been collected would not have been adequate to answer research questions searching to uncover questions of *'how many'*. An even greater mismatch is apparent in the application of quantitative methods to those research questions regarding the formation of attitudes, experiences and understandings of two separate worldviews, where the collection of numerical data alone would prevent the researcher from examining the foundations of pupils' attitudes and understandings of the researched topics. Together, these arguments imply that inferences arising from data collected using multiple methods are stronger than if only one method was used.

A different classification for considering the rationale for conducting mixed methods research is proposed by Greene, Caracelli & Graham. (1989).

They offer five situations in which using mixed methods is both desirable and justified, where the aim of the research is to achieve:

a) triangulation
b) complementarity[31]
c) initiation[32]
d) development[33] and
e) expansion[34].

It might be argued that the aims and methods of the present research house all five suggested purposes. Specifically, the research aims to triangulate the findings on a single issue gathered from different perspectives and through different methods. Secondly, it uses the results gained through one method to serve as clarification and elaboration of the findings gained by the use of a differing set of methods. Thirdly, the research design allows for paradoxes discovered in the first phase of the research to assist in the formulation and operationalisation of the second research phase. The present research also encompassed the 'development' quality by using the results from the qualitative phase in order to directly inform the quantitative phase. Finally, as argued before, the present research was conceived in this form in order to achieve a broader view of the complex phenomenon of the coexistence of science and religion in elementary education curricula in Croatia and the implications of this coexistence on pupil' attitude formation and understanding.

From the above discussion, it seems clear that a mixed methods approach is a reasonable and appropriate choice for achieving the aims of the present research. As such, avoiding the strict use of a singular research method, and

31 Defined by Johnson and Onwuegbuzie (2004), as 'seeking elaboration, enhancement, illustration and clarification of the results from one method with the results from the other method'. (ibid, 22)

32 Defined as 'discovering paradoxes and contradictions that lead to a re-framing of the research questions'. (ibid, 22)

33 Defined as 'using the findings from one method to help inform the other method'. (ibid, 22)

34 Defined as 'seeking to expand the breadth and range of research by using different methods for different inquiry components'. (ibid, 22) using multiple methods for developing a thorough understanding of pupil attitudes and perspectives on the researched topics instead, seems most adequate and beneficiary. In the following section, the present study will be located within a typology of mixed methods studies, followed by a consideration of the sequence of the design and method dominance.

Positioning the present study within a typology of mixed methods research

While locating the present research within the wider framework of mixed methods research is a relatively straightforward task, it becomes somewhat more challenging to explicitly define the specific type of research design employed. According to Tashakkori and Teddlie (2003), one of the major shortcomings of mixed methods approaches is the lack of consensual typology and basic definitions. A review of the literature demonstrates that nearly every methodologist in this field has proposed their own classification of mixed methods research designs. Indeed, describing all of the existing classifications of mixed methods is far beyond the scope of the present discussion. Although it is understandable that, in an attempt at establishing mixed methods research as a third methodological movement, proponents of this approach might strive for the parsimonious classification of its designs, more important to the present research than its position in any existing typology is the fact that the mixed methods approach allows the freedom to combine approaches in a manner most suitable for answering research questions. Indeed, this freedom, and the consequent creativity allowed in mixed methods research design, implies that the classification of a particular design in a wider typology is possible only in general terms, and not as a precise and fixed measure.

Although existing typologies might seem unsatisfactory, the proposed research could be classified as a sequential mixed model design, as defined by Tashakkori and Teddlie (1998). The authors' distinction between 'mixed methods' and a 'mixed model' design is an important one and deserves mention here. While the former implies mixing only at the level of the methodology, 'mixed model' designs also incorporate mixing at various other stages of the research process. As such, Tashakorri and Teddlie (1998) state that mixed model designs are superior to 'mixed methods' ones, because they are truer to the foundations of the mixed methods approach. As previously argued, the present research incorporates mixing at almost all levels of the research process. Specifically, in the development of the research design, aims and research questions, the present effort includes both exploratory and confirmatory elements. At the level of methodology and measurements, it employs both qualitative and quantitative methods and data collection techniques. Finally, methodological mixing is also present and fundamental at the level of analysis and interpretation, where both data sets were used in order to answer the research questions and achieve common interpretations.

4.3. THE RESEARCH DESIGN

As a sequential mixed model design, special attention was given to the temporal sequence of research phases. The qualitative phase preceded a revised and more focused quantitative phase, offering a thorough indication of what might underlie pupils' experience and attitudes towards the researched topics. This, in turn, served as a more precise foundation for the formation and piloting of questionnaire items. As such, using Creswell's (2003) typology, the sequence was:

QUAL (spring 2006) ----- ***QUAN*** (autumn/winter 2006)
QUAL (spring 2006) ----- ***QUAL*** (autumn/winter 2006)

The qualitative portion of the research, occurring both before and concurrently with the quantitative phase, also served as a tool with which to achieve an in-depth perspective into pupils' explanations for their attitudes and experience towards the research themes. Regardless of the sequencing of the quantitative and qualitative phases, both parts were considered equally important to addressing the research questions. Furthermore, each phase was aimed at answering differing aspects of the research questions, and without their coexistence, a complete examination of the issues outlined in the questions would not be possible. Not attributing superiority to any of the research phases is in line with a suggestion from Tashakkorri and Teddlie (1998), who state that such an equivalent status design is especially appropriate for educational research.

In the following sections, the methodological decisions made in preparing for each phase of the research design will be described and justified in detail. This will include a consideration of the sampling strategy and procedure, the selected methodological techniques and instruments, and the methods used in data analysis. This will be followed by a section dedicated to a discussion of how the two components of the research design were integrated.

4.3.1. The qualitative phase

The approach adopted in the qualitative phase was largely phenomenological due primarily to the intent to describe and understand the reasons behind pupils' experiences and attitudes. Through this phase, the study aimed to explore the various factors informing pupils' attitudes towards science and RE and how these attitudes develop over time, as well as to gain insight into pupils' understandings and conceptualisations of science and religion and their interaction.

4.3.1.1. Sequence of the qualitative phase

The qualitative phase of the study was carried out in two parts taking place in the spring and autumn of 2006. At the beginning, participants were in the 5th and 7th grades, and were already accustomed to the newly established context of their educational setting. Thus, 5th grade students would have become familiarized with subject teaching as a new model for classroom instruction and 7th grade students would be accustomed to the newly-introduced subjects of chemistry, physics and biology. With this structure in mind, the data collection targeted the transitional periods during which the scientific subject curricula are expanded, since such transitions might stimulate specific insight into pupils' attitudes towards and thoughts about these subject areas. Thus, the focus of the qualitative phase was on the subjects of nature and RE for pupils moving from the 5th to the 6th grade and the subjects of chemistry, physics, biology and RE for pupils progressing from the 7th to the 8th grade. The quantitative investigation was carried out with pupils in the 6th and 8th grade. While this allowed for questionnaire administration to coincide with the latter part of the qualitative phase, it further allowed the researcher to probe the expectations of younger pupils towards the upcoming diversification of science subjects in the 7th grade and to compare these with the attitudes of 8th grade pupils, who already possessed experience in this diversification.

4.3.1.2. Sampling strategy and sample description

Multiple sampling techniques were incorporated in both qualitative and quantitative phases. This is in line with Kamper, Stringfield and Teddlie (2004), who suggest that any complex research question requires more than one sole sampling technique. Indeed, it seems obvious that sampling should be directly related to the formulation of the research questions in a way that the quality and appropriateness of the sampling techniques directly influences the degree to which the research questions might be validly and effectively addressed. Additionally, the sampling techniques used here were developed in order to gain understanding that would be potentially transferable to other settings and populations. Therefore, both probability and purposive sampling procedures were incorporated. In the qualitative phase of the study, sampling decisions were made at both the school and pupil level.

Sampling at the level of the school

The qualitative phase was carried out in a single school in central Zagreb. The decision to work in a single school was intrinsic to the attempt to explore the learning experience of a small number of pupils and the ethos of a specific school. In such a manner, the researcher was able to develop a '*partial ethnographic account*' (Siraj-Blatchford & Siraj-Blatchford, 2001) of the phenomena of interest by devoting the maximum amount of investigative time and focus to a specific educational setting. Arguably, the inclusion of a larger number of schools might have reduced the risk of an effect of the specificity of the school, thus increasing the generalisability of the findings. However, the present methodological decision was taken from a constructivist epistemological position aiming to describe and examine in depth the personal perspective of a specific group of students rather than on a need to make generalisations. In an absence of any national statistical indicators which would point to typicality, the centralisation of the educational system in Croatia and the existing consistency across schools with respect to pedagogy and curriculum content and delivery suggests that insights gained in a single school might indeed have elements of wider transferability to other schools in Croatia.

Sampling at the level of pupils

In total, 32 pupils were recruited to participate in the qualitative phase of the research. The desired number of participants was selected in order to allow for an in-depth exploration of pupil attitudes and perspectives, while also allowing for student attrition over the time-span of the project. The sampling strategy used to recruit participants for this phase of the research was purposive. The rationale for this was based on the need to develop a detailed understanding of the formation, nature and development of pupils' attitudes, understandings and conceptions of research topics. The selection of student participants was carried out in collaboration with subject teachers specializing in the subjects of interest. Teachers were informed about the aims of the project and the nature of student participation, and were then asked to collaborate between themselves and suggest pupils who would be suitable to participate in the research project.

Three criteria were established as prerequisites for the selection of these participants:

1) All participants were pupils attending RE classes.

Due to the interest in examining pupils' attitudes and self-expressed experience of the study of science and religion, it was necessary to delimit the research to only pupils who were attending Catholic RE classes. Arguably, only pupils exposed to both worldviews, through scientific and religious curricula, would experience the positive or negative influences of such a relationship between the two. However, the exclusion of pupils not attending RE should not be perceived as additional stigmatisation in a society in which they seem to be already stigmatised.[35]

2) As far as possible, the sample should aim to include equal numbers of boys and girls in each age group and student profile.

In response to findings from the literature and an analysis of the 2003 survey results regarding attitudes towards science and RE, an equal gender distribution amongst both age groups and student profile groups, to be described below, was necessary. This criterion was important if gender differences were to be considered in the analysis of the present research.

3) Students in the sample were selected on the basis of three student profiles, with equal numbers of students in each profile group.

Most importantly, along with the above-mentioned criteria, teachers were asked to consider their selection using three student profiles based on perceived levels of pupil interest in each subject:

- **HIGH RE – low science**

The students with this profile were characterised by a heightened interest in RE and the adoption of a religious worldview. At the same time, participants fitting this profile were expected to have a lower expressed interest in scientific subjects.

- **low RE – HIGH SCIENCE**

This profile was characterised by a stronger interest in science and the adoption of a scientific worldview. At the same time, the participants were expected to be relatively less interested in contents of RE.

- **Medium RE – Medium science**

The students fitting this profile were characterised by equal interest in both areas of study and a tendency to adopt both worldviews.

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35 It has been previously argued, in both the MPhil thesis and in the introduction to this thesis, that the problems of pupils who do not follow RE lessons is one of the most pressing issues of concern in regards to RE in Croatian elementary education.

It is important to note that the assignment of students to high or low profiles did not necessarily correlate with academic achievement in the subjects of interest, with teachers' estimates of pupils' specific interests the sole basis for the assignment of potential participants to profile groups. This was especially the case with regards to low profiles, where low levels of perceived interest in a subject did not necessarily translate to low levels of achievement in that subject. It is also important to note that teachers were further advised not to select pupils who exhibited equally high or low levels of interest in both religion and science. The rationale behind this decision was that it would become difficult to observe the interaction and pre-assigned importance of two differing worldviews amongst pupils for whom interest in science and RE was equally high or equally low.

There were several reasons for assigning the crucial role of participant identification to teachers themselves. First, it was believed that teachers probably possess the most accurate knowledge of pupils' preferences and interests in their respective disciplines. Secondly, the inclusion of teachers in this process facilitated feelings of involvement amongst school staff, thus fostering support for the research process within the school. Thirdly, because pupils were aware that their teachers were given the role of selecting students for participation, the research process was granted certain authority within the school context. These sampling decisions are in line with what Shulha, Wilson and Teddlie (2004) called a 'collaborative mixed methods' approach. Specifically, these authors state that mixed methods research needs to take into account the large possibilities for collaboration in the field at all levels of the research process. In the present research, teachers also played a vitally important role as 'gatekeepers' by holding both an official role as co-creators and participants in the research process, and an unofficial role as research support and the first point of assistance throughout the research process. In this way, teachers assisted the researcher in identifying individuals who would most benefit from the research process, as well as in minimising any problems the researcher might have encountered (Creswell, 2003).

This sampling procedure served to construct a group of what Patton (1990, p.69) calls *'information rich'* participants. This method might further be defined by Miles and Huberman's (1994) technique of 'maximum variation', where the sampling strategy was developed in order to document diverse variations amongst a group of pupils while also identifying common patterns. Further, because the sampling procedure recruited cases that met pre-specified criteria, a 'criterion' based strategy was also incorporated. In general, sampling at the level of pupils in this phase of the research most closely resembles a 'stratified purposive' sampling strategy by employing predetermined criteria to develop a group that is representative of various subgroups within a population and allows for their comparison.

Participants

Initially, teachers were asked to name six pupils per profile per age group, creating a pool of 36 potential participants. Following this selection, these 36 students were invited to participate in the study. Participants were not members of the same class, but came from different classes inside of the cohort. Although the researcher hoped to achieve a final sample of 24 pupils, expecting some would not wish to participate, all 36 expressed an initial willingness to participate. These pupils were given parental informed consent forms in which a thorough explanation of the research and its goals, as well as the expected demands on each participating pupil, was provided. Only those for whom parental consent was granted were included in the final sample, with consent not granted by parents of four pupils. The most commonly stated reason for not granting consent was parents' fear that participation in the project would interfere with pupils' schoolwork. In total, 32 pupils began participation in this phase of the research in March, 2006. The characteristics of this group, according to the pre-established criteria discussed above, are summarized in Table 4.2.

From the initial 32, two boys from the younger group dropped out of the project over the course of the research for different reasons. One student, although expressing enjoyment in participating, had changed schools over the summer break, and the second student chose not to participate following the summer break because his parents were afraid that participation was taking up too much of his school time. All other pupils participated for the full duration of this phase of the research. Five teachers participated in the research, one teacher representing each science subject and two RE teachers.[36]

Table 4.2: Sample of pupil participants – Qualitative phase

	5th grade (2005-06)	7th grade (2005/06)
Profile A: **HIGH RE** + low science	3 girls and 3 boys	2 girls and 3 boys
Profile B: low re + **HIGH SCIENCE**	3 girls and 3 boys	3 girls and 3 boys
Profile C: medium RE and Medium Science	3 girls and 2 boys	1 girl and 3 boys

4.3.1.3. Qualitative data collection techniques and methods

In the qualitative phase, several research methods were used in order to gather multiple sources of data. These included interviews with pupils, pupil reflections as expressed through a personal diary, interviews with teachers regarding personal and pupils' perspectives, documentary analysis and non-participant observation. The use of multiple sources of data enabled a triangulation of the findings regarding pupils' experience. In the following sections, the form and purpose of each of the methods used is described.

Interviews

A series of semi-structured interviews was conducted with each pupil. In order to understand individual perspectives on the researched topics, semi-structured interviews were employed so as to concentrate on specific aspects of the educational process, constrained by the consideration of specific subjects, researched concepts and their interaction. Furthermore, semi-structured interviews offer a reasonable balance between a wish to probe deeply the perspectives and thinking of each participant and the need to respect the limited time which pupils would be willing and capable to offer to each interview

36 While a single teacher taught nature and biology, the first RE teacher was replaced, due to maternity leave, by a second teacher who participated in the second half of the research.

session (Fontana & Frey, 1998). On average, each pupil participated in seven or eight interviews, with approximately four of these carried out in each of the two phases. Interviews differed in length according to the covered themes and the varying levels of pupil motivation to engage in interview discussion. Altogether, the constructive talk carried out in these interviews amounted to approximately 100 minutes of interview time per pupil. In addition, in efforts at establishing and maintaining rapport with the participants throughout the interview process, there is recorded material regarding the pupils' views on school in general, their personal life and other interests.

Piloting of the interview schedules

Although the present research design did not allow for a formal piloting of the interview schedules, a within-sample procedure was used to ensure that the nature and structure of the interview allowed for a smooth and natural discussion generating sufficient responses for addressing the research questions. In the initial block of interviews, two randomly-selected pupils (one per age group) served as a 'pilot' group. Their interviews were used as verification that the interview schedule was an acceptable instrument. These pupils' interviews were included in the final analysis, since only minor modifications to the interview schedule were necessary.

Interview themes

Interviews were built around three main research themes: science and RE as part of the school curricula; the holistic concepts of science and religion and related concepts; and an exploration of their interaction. These themes will be considered below in further detail.

A substantial portion of the interviews was focused on a discussion of pupils' perceptions of the content, teaching process and teaching methods for each subject of interest. Furthermore, pupils were encouraged to offer personal insights into their thoughts and feelings towards the subjects and the ways their attitudes towards each subject have developed. Furthermore, interviews also presented pupils with an opportunity to engage in individual narrative in response to open-ended questions designed to facilitate deeper reflection about a specific subject or item of the subject curriculum (Cortazzi, 1993). For example, pupils were encouraged to reflect on their own experience within the context of a specific subject by talking about a time when they had doubts about the material being presented, when they didn't understand a lesson, or when they truly enjoyed being in the lesson. Such narratives offered an opportunity for further questioning in efforts to more fully engage the student in a discussion of their own attitudes and perspectives about the subject of interest. Finally, interviews also provided an opportunity for pupils to discuss any perceived interactions between science subjects and RE.

A second block of themes structuring the interviews revolved around pupils' understandings and conceptions of the holistic concepts of science and religion, as well as their attitudes towards the role and relevance of religion and science in today's world and Croatian society. In light of the confessional nature of RE, significant time was devoted to an exploration of pupils' religious thinking and feelings. This was done openly and with full respect towards pupils' beliefs and attitudes and the teaching of Catholic Church.

Finally, a third broad theme dealt with somewhat more challenging topics surrounding 'metaphysical' questions relevant to scientific or religious worldviews. For example, the interviews contained questions encouraging pupils' consideration of ideas concerning creation and evolution as part of their curricula, but also wider themes such as the role of humans in the universe, the success of science at explaining the origins of life, questions of freedom as perceived through religious and scientific lenses, cloning and questions on the nature of free will. In this report, only the results and discussion on differing explanations for the origin of life will be presented as there was not enough space to consider all researched topics.

Interview procedure

Once permission for pupils to attend interviews during teaching time was negotiated with teachers, each pupil was interviewed individually within a single school period. The interviews took place during all subject lessons and thus were not restricted to lessons in science and RE. The researcher respected the decision of any teacher not granting permission for a pupil to leave his or her lesson, and adjusted the interview schedule to accommodate these requests. Typically, two interviews were carried out during a single class period. The structure of each interview was similar over all meetings between the researcher and pupil: the researcher would first greet the participant, which was followed by a short discussion on school topics not related to the research itself, including achieved grades, school trips, and sports events. This discussion was carried out in order to allow the pupil to acclimatise to the unique nature of the research process in comparison with familiar school activities. This introductory discussion was followed by a review of the pupils' record in his or her 'research diary', as assigned from the previous meeting. These tasks were analysed together by both the researcher and student and discussed further. Following this, the researcher proceeded by introducing new topics and questions. In instances where pupils indicated some reluctance to directly offer their opinions, this was fully respected and some other probes were used to encourage reflection and open discussion. This technique gradually became less apparent as increasingly positive rapport was established with pupils, where all pupils gradually becoming more willing to offer insights and regularly completed the assigned tasks. Interview sessions in most cases concluded with the assignment of a new task for the pupil's diary.

Participant diaries

All 32 participants were asked to keep a personal diary during the period in which interviews were being carried out. This personal diary served both as a tool aimed to provoke self-reflection regarding the research itself, but also as a source of data concerning the attitudes and perceptions of the pupils about the researched topics. Pupils were asked to make a diary entry once a week in a form most suitable for them. Thus, pupils were free to decide how they would use the journals, and to express themselves in the manner they saw appropriate. Participants were encouraged to be creative in their diaries, in that the precise form of expression was only seldom assigned. On occasion, their expressions were only a few bullet points or words describing their feelings, while at other times, diary entries were pictures or elaborated essays. When assigned tasks for journal entries were given, they were intrinsically connected with the topics of the research and those discussed specifically in the interview during which they were assigned. Pupils were also encouraged to record their thoughts and feelings about the project or other things happening in their lives. While serving as an important source of data in itself, diary entries also served as a stimulus for discussion in the interview sessions.

Non-participant qualitative observations

Non-participant qualitative observations were used as an additional tool to gain insight into the teaching process and the interaction between pupils and teachers in each subject. Observations were carried out during RE and biology lessons, with one lesson for each respective subject observed at each grade level during the 2006-2007 school year. The classroom observations were qualitative and impressionistic in their nature, thus while serving to develop further understanding of everyday classroom practice, they are limited to acting as a source of supporting information and not as a primary source of data.

Interviews with teachers

Semi-structured interviews were additionally carried out with participating teachers. Here, the focus was on teachers' views regarding pupil attitudes, motivation and interest towards their respective subject curricula and on teachers' own views concerning the possible interaction between RE and science subjects. These interviews also explored teachers' views on the coexistence of separate worldviews in the education system and school curricula as well as their own views on science, religion and their interaction. The inclusion of teachers' views was important when considering the crucial role played by teachers in the development of pupil attitudes, as well as their profound knowledge of both the educational system and their own disciplines. Interviews were conducted with teachers during both academic years. Each teacher participated in one or two interviews each, with a total of 8 teacher interviews conducted. The total recorded interview time for each teacher was approximately 90 minutes.

Documentary analysis

In addition to other methods, an analysis of the subject curricula, or Teaching Plans and Programmes, for chemistry, physics, biology and RE was conducted. This was especially vital to a consideration of the teaching of evolution and creation in Croatian elementary education, discussion on which will be presented in a later chapter.

4.3.2. The quantitative phase

The quantitative sample consisted of participants from 11 elementary schools in Zagreb. In total, 216 6^{th} grade and 203 8^{th} grade pupils participated in this phase of the research. In order to accurately depict this phase of the study, a consideration of an important delimitation of the present design will first be presented, followed by a description of the selected sampling techniques, applied instruments and methodological procedures.

4.3.2.1. Delimiting the study

A significant delimitation to the present study is that it confines this quantitative phase to an exploration of the phenomena of interest within the specific context of state-funded elementary schools in the Municipality of Zagreb. The choice of state-funded schools seems natural in that such schools represent 98 percent of all elementary schools in Croatia. However, the choice to conduct the study in the municipality of Zagreb alone demands further explanation. Zagreb is a city with a population close to a million inhabitants, making up around 20 percent of Croatia's total population. As the capital city, it is economically the most highly developed region of the country and, as such, may seem unrepresentative of the rest of Croatia. The decision to conduct research in Zagreb alone was largely a practical one in that, as a sole researcher, any attempt to conduct a study of the scope similar to that of the 2003 study was considered to be both impossible and unwise. Furthermore, the 2003 study was funded with material and human sources completely incomparable to those available for the present effort. The second argument supporting this restriction arises from the previously-described Croatian educational system, which consists of a highly-centralized system of curriculum delivery and consistent pedagogical style. Therefore, findings from this study, although not entirely comparable to those which might be found outside of Zagreb, are, at the very least, suggestive of the general conditions in the Croatian education system.

4.3.2.2. Sampling strategy

As in the qualitative phase of the research, sampling was conducted on several levels. In the first instance, key sampling decisions were made at the level of the school, while secondary selection was also made at the levels of class and pupils.

Sampling at the school level

At the school level, a stratified random sampling technique was applied, with the location of the school serving as a stratum. There are 103 state-funded elementary schools in the Municipality of Zagreb, making up 12.6 percent of the total number of schools in Croatia. Schools were divided into two stratums: centrally-located schools (within the area usually referred to as Central Zagreb) and schools in the wider municipal area (an area referred to as Wider Zagreb). This distinction has been made due to the assumption of possible differences between schools in different locations within the municipality. This sampling strategy was selected over random sampling because, in considering the structure of the municipality of Zagreb, it offered the possibility for equal representation of schools from different geographical locations.

After this initial stratification, fourteen schools were randomly chosen from the pool of 103 schools using the computer software 'Research Randomizer' in order to build a sample of schools whose ratio would be proportional to the size of each stratum. One of these schools was initially approached in order to conduct instrument piloting. The remaining 13 schools were later contacted and, of these 13 schools, 10 expressed a willingness to participate in the research. Of these 10 schools, six were located in Central and four in Wider Zagreb. It should be noted that the school in which the qualitative phase was conducted was also included in the quantitative portion of the study. The rationale for this decision was three-fold:

- to provide an opportunity to pupils not participating in the qualitative part of the research to become involved with the research process
- to determine whether the school was comparable to other Zagreb schools
- to compare data collected from both phases with the previously-described group of 30 pupils. To allow for such a comparison, all '*qualitative*' participants willingly signed their questionnaires and their questionnaires were omitted from further statistical analyses.

Sampling at the class level

In each Croatian elementary school, pupils are divided into classes. In Zagreb elementary schools, there are, on average, 3.4 classes per grade, with an average of 25 pupils per class (MZOS, 2006). At the class level, a random selection technique was applied to select classes for participation in the research. In each school, one 6th and one 8th grade class were randomly selected to participate in the research. In order to secure smoother access, it was emphasized to each school that questionnaire administration would take place during 'home' period, the weekly session during which there is no lecturing, but class issues are discussed. Furthermore, research visits were scheduled so that, as much as possible, both 6th and 8th grade classes completed the questionnaires on the same day. This schedule was largely followed, thus minimising the possibility of systematic influences in the selection of the classes that participated in the research.

Sampling at the pupil level

Within each class, all available respondents were approached for participation in the study regardless of their participation in RE lessons. However, only the responses of those attending RE were included in further analysis. The proportion of pupils attending Catholic RE in the quantitative sample was 96.7 percent in the case of the 8th grade and 98.4 percent for the 6th grade cohort, both higher than the 87.7 percent reported nationally for that same school year (Razum, 2008). Pupils not attending Catholic RE were either attending RE of a different confession, or simply chose not to take this subject.

A brief description of the distributions and characteristics of the sample on the variables of gender, educational achievement and scientific achievement, all important elements for subsequent statistical analysis, are presented below.

Gender

The distribution of gender in both samples is provided in Table 4.3.

Table 4.3: Gender distribution of 2003 and 2006 research samples

	2006 (8th grade)	**2006 (6th grade)**	**2003 (Croatia)**	**2003 (Zagreb Region)**
Female	117 (57.6%)	114 (52.8%)	1320 (49.5%)	236 (52.3%)
Male	86 (42.4 %)	102 (47.2%)	1346 (50.5%)	215 (47.7%)
Total	**203**	**216**	**2666**	**451**

The frequencies in the table suggest a substantial bias towards female participants in the 8th grade sample, particularly when compared with that of 2003. However, when the present sample is compared to a sub-sample of the participants from the 2003 study consisting of pupils from the Zagreb region only, this difference was not significant. One factor possibly influencing the gender distribution amongst participants was that, in two schools, groups of five boys from the 8th grade were absent due to participation in a sporting event.

Level of achievement

In the present research, pupil achievement level has been conceptualised as the overall GPA achieved in the previous grade of elementary education.[37] Pupils in Croatia are assessed in each subject on a 5-point scale (1=insufficient, 2=sufficient, 3=good, 4=very good, and 5=excellent). All subjects are weighted

[37] As such, for the 8th grade pupils in the sample, the GPA from the 7th grade was used, while the GPA from the 5th grade was used for pupils in the 6th grade.

equally and an overall GPA is calculated as the average of the individual grades from each subject. Pupil GPA represents an overarching picture of a pupils' educational effort and, as such, is used as a measurement of overall educational achievement and for selection purposes in the enrolment into secondary education. In order to classify pupils officially, the achieved GPA of pupils is divided into four levels of achievement. This division is summarized in Table 4.4, where the percentage of pupils in the present sample falling within each achievement level is also presented.

Table 4.4: Grade distribution in the 2006 sample – quantitative phase

GPA	Overall grade	Percentage in the 8th grade sample	Percentage in the 6th grade sample
Less than 2.5	Sufficient	1.0	0.0
2.5 – 3.5	Good	16.6	11.2
3.5 – 4.5	Very good	34.6	38.3
4.5 – 5.0	Excellent	47.8	50.5

As evident from the table, the GPA distribution in Croatian elementary schools is significantly skewed towards higher levels of achievement.[38] Clearly, there seems to be far more 'successful' than 'unsuccessful' pupils, with nearly half of pupils in the present sample achieving an overall GPA equivalent to an 'excellent' grade. In order to establish a more reasonably distributed categorisation of achievement levels that would enable more diverse and meaningful statistical analyses, the achievement levels, as expressed through overall GPA from the previous grade, have been statistically divided into three categories. As shown in Table 4.5, these categories allowed for the creation of three nearly equal groups of pupils according to level of achievement.

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[38] For the 8th grade sample, the level of Skewness=-0.627: Standard error=0.170: Kurtosis=-0.653: Standard error=0.338; the results for the 6th grade sample stray from normality even more severely.

Table 4.5: Sample categorization according to achieved GPA – quantitative phase

Category	GPA 7th grade	Percentage in the 8th grade sample	GPA 5th grade	Percentage in the 6th grade sample
Low	Up to 3.8	32.2	Up to 4.2	32.7
Medium	3.81 – 4.6	31.7	4.21 – 4.7	36.4
High	4.61 – 5.0	36.1	4.71 – 5.0	30.9

Achievement in science

The science grades of older pupils served as a basis for a categorisation of their attainment in science. Here, pupils' grades from biology, physics and chemistry achieved in the 7th grade were summed and then averaged. Pupils were then categorised into three attainment levels. The percentages of pupils in each level are presented in Table 4.6.

Table 4.6: Sample categorization according to science achievement (8th grade) – quantitative phase

Category	Average grade in science subjects	Percentage in the 8th grade sample
Low	Up to 3.33	37.6
Medium	3.34 – 4.33	29.7
High	4.34 – 5.0	32.7

Participants in the quantitative research were also further categorised according to variables of self-reported religiosity, satisfaction elicited by Church attendance and parental Church attendance with respect to their responses to questionnaire items designed to measure these variables. The rationale for inclusion of these items and categorisation of pupils according to their responses is presented as a part of the discussion in Chapter Six.

4.3.2.3. Developing the questionnaire

The development of the questionnaire is one of the more complex topics of the present design. While it consisted of approximately 90 items, only those related to themes covered in the upcoming analysis will be considered here. Wherever appropriate, items were replicated directly from the 2003 questionnaire in order to make valid comparisons with the 2003 results. In other cases, due to the lack of appropriate instruments in Croatian, items from existing questionnaires, such as those on the relevance of science and attitudes towards Christianity, published in English were translated into Croatian. Furthermore, some of the concepts housed within the present research have only been researched previously with older pupils, and so some scales had to be modified for application with younger pupils. Finally, while the time needed to construct and pilot the questionnaire was limited by the research design, which was linked directly to specific points in the school calendar, a pilot study of the Croatian version of the scales was conducted and will be described below. Some restrictions on the choice of statistical tests and the subsequent generalisations of the results also exist, and will be addressed in the following paragraphs. Yet despite these limitations, the results present a clear picture of pupils' attitudes and provide a good basis for the construction of further questionnaires in the Croatian language and setting. Table 4.7 presents a summary of the probed concepts and forms of measurement employed in the questionnaire.

Table 4.7: Outline of questionnaire themes and forms of measurement

Concept	Measure
Subject related measures	• Semantic differential scales probing five dimensions of pupils' attitudes towards school subjects (replication from 2003) • General assessment of the content of specific subjects– grading on a scale from one to five • General assessment of subject teachers – grading on a scale from one to five • Assessment of the appropriateness of the number of teaching hours for each subject – four point categorical scale
Attitudes towards science	• Assessment of attitudes towards relevance of science – four point Likert-type scale (strongly disagree – strongly agree); adaptation from Menis (1989) and Francis &Greer (1999b) • Assessment of attitudes towards scientific career - four point Likert-type scale (strongly disagree – strongly agree); *not presented in the book* • Assessment of attitudes towards global warming – three items; categorical scale; *not presented in the book* • Scale of scientism - four point Likert-type scale (strongly disagree – strongly agree); adapted from Fulljames et al. (1991) and Francis & Greer (2001)
Attitudes towards religion	• Assessment of attitudes towards Christianity - four point Likert-type scale (strongly disagree – strongly agree); adapted short form of the Francis scale (Francis, Gibson & Greer, 1991) • Additional seven items from regular form of the Francis scale of Attitudes towards Christianity - four point Likert-type scale (strongly disagree – strongly agree); *not presented in book* • Assessment of biblical literalism - four point Likert-type scale (I do not believe at all – I completely believe); adapted from Fulljames et al. (1991) and Francis & Greer (1999)
Other items	• Gender, academic achievement, achievement in science and RE, participation in church/science activities • Church attendance, church satisfaction, parental church attendance, self reported level of religiosity – categorical scales • Understanding of the Bible, conceptualisations of Supreme being – categorical scales • Items probing concurrent teaching of origin – two items using categorical scales

Subject related measures

Through its findings on pupils' attitudes towards subject curricula, the 2003 study served as a starting point for the development of subject related measures in the present instrument. The pupils were asked to rate each school subject against five key dimensions on a 7-point bi-polar semantic differential scale identical to that used in 2003. The five dimensions were level of interest (not interesting – interesting), comprehensibility (not comprehensible – comprehensible), difficulty (difficult – easy), usefulness for present life (not useful for present life – useful for present life) and importance to future life (not important to future life – important to future life). The polarity of the scales was randomised. The sequential design, in which the qualitative phase preceded the quantitative, enabled the generation of further items designed to measure pupils' holistic estimations of subjects, their respective teachers and the time devoted to the teaching of science and RE.

It was important for comparative purposes to re-apply some of the 2003 items in identical format in this study, but this raised a number of obstacles to the application of parametric statistical procedures and limitations to the potential generalisiblity of the findings. The main reasons for this are the nature of the scale and the normality of the distribution of pupils' responses. In the first instance, semantic differential is a frequently used rating scale whose level of measurement, as in the case of Likert-type scales, has often been disputed. Although not possessing the characteristics of an interval scale, pupils' responses here reveal more than just an order or rank characteristic of ordinal measures. For these reasons, many psychologists and educational researchers treat these as interval scales, and subsequently analyse the data using parametric statistical procedures. Minium, King & Bear (1993) argue that this is understandable when the space between ordinal and interval is occupied by some of the more interesting psychological measurements. As a general rule, when a semantic differential or Likert item is considered individually, it should be treated like an ordinal measurement and analysed with nonparametric statistical procedures (Howitt & Cramer, 2005). However, when summated and/or scaled, such items can be treated as an interval measurement and subsequently analysed by parametric statistical procedures (ibid).

The second issue with regards to the use of a semantic differential is the non-normality of the response distributions on some of the dimensions for some of the subjects of interest.[39] This was to be expected due to the fact that the attitudinal objects are school subjects. Furthermore, the age of the participants may have also contributed to the non-normality of the responses, typified by a shift towards the extreme ends of the scale. As one of the main assumptions of parametric data, the normality of distribution is at times overlooked and not reported in psychological and educational research (Field, 2005). Nanna and Sawilowsky (1998) reported that, in applied research using Likert-type or other rating scales, normality is an exception rather than a norm. Miceri (1989) suggested that deviations from a normal distribution are frequent even for continuous data. These two arguments are further fortified with the notion, suggested by some statistics authors (e.g. Howitt & Cramer, 2005) that, in the case of a sufficiently large sample, the issue of data symmetry becomes less important and the advantages of nonparametric tests are severely reduced. Furthermore, some frequently used statistical procedures, such as t-tests and most particularly ANOVA, have been proven to be robust to non-normality (Lunney, 1970). Although together these arguments could serve as a justification for the use of parametric statistical procedures regardless of the violation of assumptions, the decision was made here to respect statistic rigour.

Thus, when considered separately at the level of dimensions, pupils' estimations will be analysed with non-parametric statistical procedures due to the disputed intervality and, in some cases, absence of normality of response distribution. However, there are two exceptions to this general rule.

First, when comparing the results to those of 2003, parametric testing will be applied as there is no valid 2003 database that would allow insight into raw responses thus enabling non parametric procedures in both data bases. As such, the generalisibility of the results of these comparisons will be taken cautiously.

39 This is especially the case with respect to pupils' estimations of the level of comprehensibility and difficulty of RE.

The second exception deserves more attention and care. One of the aims of the present research is to explore the influence of gender and achievement level on pupils' attitudes towards school subjects. Arguably, in order to assess the influence of these variables, the most appropriate parametrical procedure would be multivariate analysis of variance (MANOVA), in which gender and achievement level serve as independent variables while the measured dimensions for each subject serve as simultaneous dependent variables. In the case of the present measures, there are sound theoretical and statistical bases for selecting this statistical procedure. Theoretically, it could be assumed that when providing attitudinal estimations of a school subject, pupils view it as a holistic concept and thus provide their estimations according to a certain internal pattern. In other words, it could be assumed that they construct their attitudes towards a subject as a complete entity, which they then bracket into specific dimensions. Statistically, pupil estimations on the measured dimensions for each specific subject are inter-connected: for example, pupils' expression of difficulty is significantly related to their estimation of interest. Tabachnick and Fidell (2001) recommend MANOVA in cases where the dependent variables are moderately correlated, which is the case in the present research. It is important to distinguish this difference in light of the fact that MANOVA looks at the existence of effects on the combination of dimensions for each specific subject, and not on each particular dimension. While subsequent univariate ANOVAs would provide information about pupils' estimations for each specific dimension, an analysis of the contrasts and post hoc measures will enable us to distinguish between various groups of participants. Therefore, rather than analyzing the influence of each individual dimension separately using ANOVAs, thus failing to take the relationships amongst the dimensions into account and subsequently increasing the chance of Type I errors, a MANOVA can be used in order to allow for a consideration of all attitudinal dimensions towards a single subject.

In the previous discussion, it was argued that non-parametric statistical procedures are more appropriate. However, there is no non-parametric statistical procedure equivalent to MANOVA. Instead, a series of Friedman's ANOVAs for each independent variable on each dimension could have been conducted. This would have been statistically unsound as the possibility of Type I errors would be seriously inflated and the interconnectedness between attitudinal dimensions would not be taken into account. For these reasons, it was decided that, in the analysis of pupils' attitudes at the subject level, MANOVA would be used despite the aforementioned violations of some of its assumptions.

For all subjects, preliminary assumption testing was conducted to verify for the normality of distributions, indicating some of the dimensions did not have a normal distribution. However, as suggested by Field (2006), if the number of cases is sufficient, MANOVA is usually robust enough to neutralise such deviations from normality. In order to further ensure the appropriateness of the data for this statistical procedure, tests on univariate and multivariate outliers were conducted using Mahalanobis distance, which for each subject resulted in the deletion of respondents from further statistical analysis due to the extremity of their answers. Finally, homogeneity of variance and covariance matrices tests were conducted, both of which showed no serious violations. With all previous discussion considered, it should be noted that, due to the more pragmatic use of MANOVA in light of the violations of assumptions, the relevant results will be considered cautiously.

Relevance of science

The starting point for the measure of attitudes towards science used in the present research was a 10-item sub-scale of pupils' attitudes towards the importance of science developed by Menis (1989), which was adopted by Francis and Greer (1999a) and subsequently incorporated into their 20-item instrument measuring attitudes towards science that was primarily concerned with the affective responses towards science in school and in society (Francis & Greer, 1999b). Both the Menis sub-scale and the Francis & Greer instrument claim mono-dimensionality and include items measured on a three-point Likert type scale: *agree*, *not certain* and *disagree*. In the present research, only the items from the Menis subscale of the importance of science were included. However, since both scales were used with secondary education pupils, four items were omitted after probing their face validity with both cohorts in the qualitative phase of the research. These items were: *'Much of the anxiety in modern society is due to science'* (for both cohorts, the concepts of anxiety and modern society were not completely comprehensible), *'Scientific inventions have increased tensions between people'* (the majority of younger participants did not have a clear understanding of the relationship implied in the item), *'Science will help to make the world a better place in the future'* (the content of this item was not completely comprehensible for participants in both cohorts as they could not envisage the implied process), *'Money spent on science is well worth spending'* (this item functioned well with the older participants but was proclaimed incomprehensible by younger pupils who were often unaware of the financing of the scientific enterprise). It was also decided to adapt the items from a three-point to a four-point scale by omitting the middle point and spreading the range to accommodate the 'assumed' interval nature of the Likert-type scales.

The questionnaire included six items probing pupils' attitudes towards the relevance of science on a four-point Likert-type scale, ranging from *'disagree completely'* to *'agree completely'*. The six items were factor analysed for each cohort using principal component analysis with Oblimin (oblique) rotation. In the case of both cohorts, factor analysis resulted in a two factor solution with three items each, explaining a total of 55.76 percent of the variance for the entire set of variables in the older cohort and 50.26 percent in the younger cohort. These factors were named *'Utility of Science'* and *'Negative Aspects of Science'*. The commonalities in the younger cohort ranged from 0.39 to 0.64 and in the older cohort from a modest 0.43 to 0.65. In the case of both cohorts, the KMO and Bartlett's Test of Sphericity indicated that these sets of variables were adequately related for factor analysis. The results of the factor analysis are presented in Table 4.8.

The reliabilities of the factor scales were analysed separately for each factor and resulted in a relatively modest Cronbach α coefficients ranging from 0.49 to 0.60. Furthermore, in the younger cohort, item total correlations ranged from 0.29 to 0.37 for the 'Utility of Science' factor and from 0.29 to 0.35 for the 'Negative aspects of science' factor. In the case of older cohort, item total correlations for the first factor ranged from 0.33 to 0.42 and from 0.35 to

0.44 for the second factor. The identical loading of items on these two factors in both cohorts allowed for a meaningful comparison of solutions between cohorts. It is important to note that the factors were split according to the polarity of the statement, which may have been caused by the age of participants. Pupils' answers on items in each of the scales were summated, forming a scale ranging from three to twelve. Due to the nature of this instrument, its metric characteristics and the two-factor solution, the results should be taken more informatively and illustratively rather than inferentially.

Table 4.8: Factor analysis of items probing relevance of science

	6th grade			8th grade		
	US*	**NA****	**C*****	**US***	**NA****	**C*****
Science is important for the development of the state.	0.80		0.64	**0.82**		0.65
Scientific discoveries improve the standard of living.	0.63		0.50	**0.72**		0.56
Science is useful for solving problems in everyday life.	0.63		0.39	0.65		0.43
Science and technology are the cause of many problems in the world.		0.62	0.39		**0.74**	0.57
Scientific discoveries cause more harm than good.		0.76	0.58		**0.72**	0.59
Science has contributed, and still does, to the destruction of the environment.		0.71	0.51		**0.76**	0.55
Eigenvalues	**1.21**	**1.80**		**2.06**	**1.29**	
Explained Variance	**20.24**	**30.02**		**34.29**	**21.48**	
TotalVariance Explained			**50.26**			**55.77**
Reliability (Cronbach α)	**0.49**	**0.50**		**0.58**	**0.60**	

* Utility of Science factor
** Negative Aspects of Science factor
*** Communality

Attitudes towards Christianity

The questionnaire also included a translated attitudinal scale for measuring pupil attitudes towards Christianity, originally developed by Leslie Francis. The original 24-item scale (Francis, 1978; 1989) was designed for use with 8 to 16 year olds and probed pupils' affective responses to God, the Bible, Jesus, prayer and the Church. Scoring is on a five-point Likert type scale, ranging from 'agree strongly' through 'uncertain' to 'disagree strongly'. A short form of the scale, consisting of seven items selected using the highest item total correlation value, was subsequently developed (Francis, Greer & Gibson, 1991). This scale, intended to be mono-dimensional, has been widely used internationally for research purposes and is recommended for use on occasions where time or space place constraints on administration (Francis et al., 1991). Both the original and the short version of the scale have proved to have very good metric characteristics and ecological validity and more than one hundred studies have been published using one form of the instrument (Lewis, Shevlin & Adamson, 1998).[40]

The application of the scale in the Croatian context of Catholic RE was challenging. During both the initial qualitative phase and a pilot study, the five-point scale proved to be problematic for pupils as they could not comprehend and accept the meaning of the category *'not certain'*. For them, this category seemed to collide not so much with the pattern of their attitudes, but more so in the way that one could not be uncertain regarding the content of the items covered. This was especially troublesome for the younger cohort. Lewis and Francis (2004), in a validation of the French translation of the short adult scale, also report problems with this middle point. The fact that the participants found this category confusing should not be surprising in the context of the formational nature of Catholic RE which not only puts an emphasis on a positive attitude towards Christianity, but also on the belief that one should not be indifferent regarding concepts such as the Bible, God, Jesus and others covered in the scale. Due to these reasons, the scale was reduced from five to four points and the category *'not certain'* was omitted in the final form of the instrument used in the main part of the research.

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40 Use of the Francis scale has been reported amongst pupils in international settings as varied as England (Francis, 1987, 1989), Republic of Ireland (Francis & Greer, 1990; Greer & Francis, 1991), Kenya (Fulljames & Francis, 1989) and Norway (Francis & Enger, 2002).

The seven items from the Francis Scale of Attitudes towards Christianity were factor analysed for each cohort using principal component analysis with Oblimin rotation. The analysis in the 6th grade cohort yielded a one-factor solution explaining a total of 56.37 percent of the variance for the entire set of variables. The same procedure in the 8th grade cohort produced a one factor solution explaining a total of 60.34 percent of variance for the entire set of variables. The commonalities in this cohort ranged from 0.23 to 0.76. The commonalities of the items in the younger cohort ranged from a modest 0.39 to as high as 0.75. There was, however, one exception, arising for the item '*I think the Bible is out of date*', which had a commonality of only 0.05. The KMO and Bartlett's Test of Sphericity both indicated that this set of variables were adequately related for factor analysis. The results of the factor analysis are presented in Table 4.9.

Table 4.9: Factor analysis of items probing attitudes towards Christianity

	6th grade		**8th grade**	
	C**	**I - T r*****	**C****	**I – T r*****
I know that Jesus helps me.	0.75	0.77	0.72	0.75
*I think that going to church is a waste of time**	0.39	0.51	0.49	0.63
God helps me to lead a better life.	0.65	0.68	0.76	0.79
God means a lot to me	0.75	0.77	0.66	0.71
Prayer helps me a lot	0.64	0.67	0.69	0.74
I know that Jesus is very close to me.	0.70	0.73	0.67	0.72
*I think the Bible is out of date.**	0.05	0.18	0.23	0.39
Eigenvalue	**3.95**		**4.22**	
Total Variance Explained	**56.37**		**60.34**	
Reliability (Cronbach α)		**0.84**		**0.88**

** In order to compute item-total correlations the negative items were reverse scored*
*** Communality*
**** Item – total correlation*

The results of the factor analysis suggest that the seventh item holds the lowest levels of commonality and item-total correlation for this set of items.

As such, the inclusion of this item was deemed questionable. Furthermore, the factorial solution without it resulted in higher eigenvalues and higher percentages of explained variance as well as higher reliability levels. Maltby and Lewis (1997), in a psychometric examination of this scale, also reported that the second and seventh items had the lowest item-total correlations. Furthermore, Francis (1989) reports that negative items may be problematic for younger pupils. In their comparison of the confirmatory and exploratory factor analysis of the Francis short scale, Lewis et al. (1998) were faced with a similar set of problems with the seventh item. In order to solve this problem, these researchers used a matrix of polychoric correlations which were analysed with weighted least squares with an appropriate weight matrix in which they compared a single factor model and the two factor model. Their results suggested that the scale could be considered as a single factor model. Thus, in the present analysis, it will also be treated this way. As such, pupils' answers on the seven items were summated and treated like an interval measurement. Pupils' ratings on each individual item were summated and formed a scale that ranged from 7 to 28.

Biblical literalism

Levels of biblical literalism amongst pupils were probed using an adaptation of a scale of creationist belief initiated by Fulljames and Francis (1987) and further developed by Francis and Greer (1999). For several reasons, this scale needed serious adaptation for its use in the present research. First, the original scale was concerned with creationism defined as a stance that incorporates the belief that the account of the origins of creation is literally true and that evolutionary theories are false (Fulljames, Gibson and Francis, 1991). As such, the Francis and Greer (1999) scale combined items indicating both the acceptance of biblical literalism and the rejection of evolutionary theory. The present study was concerned only with the former, or the belief that the statements exposed in the Bible actually occurred. The decision to focus on this line of investigation was in light of the lesson content of both science and RE in Croatia, the age of participants and, most especially, the coexistence of two explanations for the origin of life in the subject curricula of biology and

RE. Secondly, the scale was again adapted from a five- to a four-point rating by omitting the middle *'not certain'* option. The rationale for this change was twofold: while some pupils, in light of their strong belief, reacted negatively to this point in the scale during piloting, others demonstrated a tendency to overuse the *'not certain'* option, claiming that they had an opinion but that this category allowed them not to expose it. For these reasons, a back translation of the six items from the original scale dealing only with the biblical account of creation was carried out. Due to the age of respondents, special attention was given to the instructions for these items. The wording was as follows:

'What follows are a series of statements that come from the Bible. Your task is not to answer if these statements actually exist in the Bible or not, but you are kindly asked to provide an answer whether you believe the content of the statements actually happened.'

The corresponding scale was worded as: *I do not believe at all, Mostly I do not believe, Mostly I believe, I completely believe*. Six items measuring pupils' belief in the literal description of the biblical account of creation were factor analysed using principal component analysis with Oblimin rotation for each cohort, yielding a mono-factorial structure in both cases, explaining a total of 53.33 percent (for the 6^{th} grade cohort) and 59.41 percent (for the 8^{th} grade cohort) of the variance for the entire set of variables. Cronbach alphas were 0.82 and 0.86, respectively. The commonalities of the variables included were moderate, between 0.37 and 0.68, suggesting that the variables chosen for this analysis were sufficiently related with each other. The KMO and Bartlett's Test of Sphericity both indicate that the set of variables were at least adequately related for factor analysis. The results of the factor analysis are presented in Table 4.10.

Pupils' responses on these six items were summated, forming a scale of biblical literalism ranging from 4 to 24, and were analysed using parametric statistical procedures.

Table 4.10: Factor analysis of items probing biblical literalism

	6th grade		8th grade	
	C*	I - T r**	C*	I – T r**
God created the world as described in the Bible	0.50	0.56	0.68	0.72
God created the world in six days	0.65	0.67	0.56	0.62
God created the universe, including humans and other forms of life, out of nothing	0.49	0.56	0.51	0.59
God formed man out of the dust of the Earth	0.37	0.48	0.60	0.67
God made woman out of Adam's rib	0.56	0.62	0.60	0.66
God rested on the seventh day after he had finished his work of creation	0.63	0.66	0.63	0.68
Eigenvalue	**3.20**		**3.57**	
Total Variance Explained	**53.33**		**59.41**	
Reliability (Cronbach α)		**0.822**		**0.861**

** Communality*
*** Item – total correlation*

Scientism

The concept of scientism, adapted from the previously-mentioned research from Fulljames et al. (1991) and Francis and Greer (2001), was probed only with the 8th grade pupils. Scientism is defined as the view that science, through its theories and methods, can attain an absolute truth. The original scale contained five items with a considerably low reliability coefficient and item-total correlations. Furthermore, because both research efforts were conducted with upper secondary pupils, some of the items proved to be too complex for the participants in the present research. As such, the item *'Theories in science are never proved with absolute certainty'* was proclaimed as incomprehensible by participants in the piloting of the questionnaire in the qualitative part of the research. In addition, the item *'Science will eventually give us complete control over the world'* seemed ambiguous to pupils in both the qualitative phase and the quantitative pilot of the questionnaire. In the end, only three items on a four-point Likert type scale, ranging from *'agree strongly'* to *'disagree strongly',* were included in the factor analysis using principal component analysis with Oblimin rotation. The analysis, conducted for the 8th grade cohort only, yielded one factor, explaining a total of 48.57 percent of the variance for the entire set of variables. The commonalities of the variables included were moderate, between 0.38 and 0.56, which suggests that the variables chosen for this analysis were sufficiently related to each other. The KMO and Bartlett's Test of Sphericity both indicate that the set of variables are at least adequately related for factor analysis. The results of the factor analysis are presented in Table 4.11.

Table 4.11: Factor analysis of items probing scientism – 8th grade participants

	C*	I - T r**
The laws of science will never be changed	**0.56**	**0.32**
Nothing should be believed unless it can be scientifically proven.	**0.52**	**0.30**
Scientific theories are always completely true.	**0.38**	**0.29**
Eigenvalue	**1.46**	
Total Variance Explained	**48.57**	
Reliability (Cronbach α)		**0.45**

** Communality*
*** Item – total correlation*

The reliability coefficient and item-total correlation values are in the range reported for the original scale (Francis & Greer, 2001; Fulljames et al., 1991). However, these indicators are quite low, thus limiting generalisibilty based on this measure. Pupils' scores on each item were summated and formed a scale ranging from 3 to 12.

Other items

Another set of categorical items probed pupils' views on the object of their belief, the Bible and the processes of creation and evolution. The questionnaire also included items examining pupils' self-reported religiosity (on a four-point scale from *'not religious at all'* to *'very religious')* and pupils Church attendance (on a scale of *'never'*, *'a few times a year'*, *'at least once a month'*, *'at least once a week'* and *'more than once a week')*. This same scale was used to probe pupils' assessment of their parents' Church attendance. Additionally, pupils were asked to rate their own satisfaction elicited by Church attendance on a five-point scale from *'none at all'* to *'large'*. Further consideration of these sets of items is presented in the forthcoming chapters. Finally, a set of items served to gather information related to pupils' gender, achievement and their participation in extra-curricular activities related to the subjects of interest.

4.3.2.4. Piloting the questionnaire

Due to the manner in which the instrument was developed, it was necessary to include two pilot phases for this quantitative phase of the research. First, in the qualitative phase, piloting was used to ensure that items were expressed with adequate levels of clarity and that they were sufficiently understandable to pupils of both cohorts. Based on this, several items were removed and a preliminary form of the questionnaire was constructed. Secondly, questionnaire piloting was carried out with one 6th grade and one 8th grade class in a single school in October, 2006. This further enabled the researcher to determine how pupils' responses were distributed, thus indicating whether the items were adequately discriminative for illustrating the expected variance of attitudes amongst pupils. It also enabled coarse testing of the scale measurement used in the present research. Finally, this procedure was necessary to examine the accuracy of the Croatian translation of the English-language scales referred to in previous sections. Based on these two piloting procedures, two important decisions were made. First, some items were omitted from the final questionnaire because they appeared inappropriate for the younger cohort. Secondly, as mentioned previously, the format of some of the scales was changed as a result of feedback from the participants.

4.3.2.5. Administration of the questionnaire

Participating schools were contacted in advance in order to schedule questionnaire administration. Administration of the questionnaire was conducted personally by the researcher in all 11 schools. Upon arrival, the head teacher or classroom teacher brought the researcher to the class and introduced him to the pupils. Teaching staff were asked not to be present during the process of questionnaire administration in order to guarantee anonymity and confidentiality of pupils' answers. Participants were not asked to offer any personal details and their anonymity was guaranteed. Prior to administering the questionnaire, the goals of the study and the manner in which the questionnaire should be completed were thoroughly reviewed with the participants. In addition, pupils were told that their participation in the research was voluntary and that they did not have to participate if they did not wish to do so. They were also reminded that they were free to stop at any point during the questionnaire application if they felt that they did not wish to participate in the research anymore. The questionnaire was administered collectively for each cohort during one regular (45 minute) school period. The administration usually lasted around 35 minutes. After completion, pupils were given the opportunity to ask questions about the research itself and the research enterprise in general. Following data analysis, each participating school was provided with a summary of the results from the sample as a whole and from their school in particular. In general, no problems were encountered during the questionnaire application, except in a few cases in which a small number of pupils were unfocused or acted out. In these cases, the researcher encouraged these pupils not to complete the questionnaire in order to avoid the risk of skewing the research results.

4.3.3. Analytical framework

The previous two sections have outlined how two separate, yet interacting, phases of the research were carried out. The following section will briefly introduce how both qualitative and quantitative data were analysed, as well as how both parts of the present research were integrated, in order to develop answers to the posed research questions.

4.3.3.1. Qualitative analysis

For the purpose of generating ideas for the quantitative phase of the research, the data gathered in the first part of the qualitative phase of the research was preliminarily analysed in the summer of 2006. This analysis was used for the development of items for the revised questionnaire. Secondly, both qualitative phases were analysed after the completion of the second phase in efforts to address the research questions. All interviews with pupils and teachers were fully transcribed and then coded with support from the NVivo software. Ascription of the codes was conducted in a dual temporal fashion, where some of the codes were decided upon in advance to enable adequate triangulation with the quantitative data while others emerged in response to the collected data.

The general framework for the qualitative analysis was based on twelve tactics for generating meaning from interview data suggested by Miles and Huberman (1994). Although, at first glance, this method resembles a reductionist and positivist one, their suggestion of a progression from specific notions from rough data to general ideas seems especially important in the present study, which is characterised by an abundance of qualitative data that risked leading to data overload. In line with the mixed methods approach, efforts at answering the research questions employed varied analytical approaches for examining the qualitative data.

First, findings regarding pupils' attitudes towards school subjects arose from an analysis of both pupil and teacher interviews and data from research diaries. Here, a constant comparative approach was used, which combined elements of inductive category coding with a simultaneous comparison of data with that collected from other sources (Strauss & Corbin, 1998). This allowed for a comparison of pupils' attitudes between groups of pupils in each cohort, but also between cohorts. This constant comparison across interview sessions, two qualitative phases, pupil groups, two cohorts and a range of methods is reminiscent of and corresponds to the process of triangulation itself (Cohen et al., 2000). In order to triangulate these findings with the quantitative data, coding of pupils' views on attitudinal dimensions served as a lead to deciphering the formational elements behind their attitudes that arose from the qualitative data.

Similarly, the analysis of pupils' views on religion and science employed the constant comparative approach, but also used Miles and Huberman's (1994) approach and resulted in the formation of response matrices. This was complemented by the use of three vignette mini cases, where three pupils were examined in finer detail and will be described in Chapter Six in order to illustrate the complexity of pupils' responses to the researched themes.

Finally, the coexistence of evolutionary and creationistic explanations of the origin of life in elementary education, and pupils' perspectives on them, were investigated using documentary analysis of the subject plans and programmes as well as the constant comparative approach and method advocated by Miles and Huberman (1994) for analysing interviews.

From these three lines of analysis, a framework of thematic codes was developed that was used to organize and classify findings and further develop a thematic structure to the results.

Verification procedures used in the qualitative phase of the research

As the aim of this part of the research was to gain insight into elements forming pupils' attitudes and understandings, the verifiability of the research findings were considered by ensuring and examining trustworthiness, confirmability, transferability, credibility and dependability as equivalents for psychometric indicators in quantitative data (Lincoln & Guba 1985). First, the strength of the argument enclosed in the results should demonstrate both transferability and credibility (Strauss & Corbin, 1990). Here, transferability of data occurs at two levels: the level to which the findings are transferable within the populations studied in Croatian elementary education, and the degree to which the results are transferable to other populations. Thick, rich description of cases in the second analytical chapter as well as extensive interview excerpts should further contribute to data verification as it permits the reader to make decisions regarding transferability to other settings due to the degree of provided detail (Lincoln & Guba, 1985). The dependability of results relates to the issue of ensuring data collected is stable and consistent over time, a condition that is met in the present research by the prolonged data collection period and the use of extensive interviewing in a single setting over a whole year. The dependability and confirmability of the research have also been enhanced by the use of audio-taping and verbatim transcriptions (Maxwell, 1996). Arguably, confirmability is also evident in the manner in which sufficient details of the research are presented to allow for external assessment and reproduction of the data. The trustworthiness of the data is strengthened by the use of multiple methods (Patton, 1990) and by a relatively large number of interview participants, both serving to provide supporting evidence (Miles & Huberman, 1984). Finally, the credibility of the results is strengthened by the researcher's continuous activity in the school (Yin, 1994) and by the consideration, analysis and exposure of cases opposite to the general patterns emerging from the findings (Miles & Huberman, 1984).

4.3.3.2. Quantitative analysis

Quantitative data was analysed using the SPSS statistical package. Challenges presented by the analysis have already been discussed in Section 4.3.2. For summated scales, parametric statistical procedures were used to examine within-group and between-group statistical differences. For items not using an interval scale, the appropriate non-parametric procedures were applied. For almost all of the reported statistical analyses, effect sizes were calculated and expressed in terms of r – Pearson product moment correlation. Where appropriate, other measures of effect size were calculated. In brief, the following procedures were implemented: t-test for independent samples, ANOVA, MANOVA, Mann-Whitney test, Wilcoxon signed-rank test, Kruskal-Wallis test, Friedman's ANOVA, Pearson's coefficient of correlation and Chi-square testing. These techniques will be identified as they were used in the chapters discussing the findings.

4.3.3.3. Analytical integration

The qualitative and quantitative data were initially analysed separately through the frameworks described above. However, the research questions required an integration of this complementary data. This intrinsic and fundamental connection between the qualitative and quantitative parts of the study has been repeatedly emphasised in the text and, as such, findings from both phases will be presented and discussed concurrently in the analytical chapters. However, it is not the intention of this mixed method design, which integrates both qualitative methods and a quantitative questionnaire, to depict any causality within the phenomena of interest. Indeed, it does not have the methodological strength to do so. Instead, the present design aimed to develop a clearer and more highly developed understanding of the nature of pupils' attitudes and experiences. By concurrently examining individual perspectives over time and statistical indicators from a large sample, the present research effort intended to develop this understanding further and, in so doing, serves to further the development of educational policy in Croatia.

4.4. A QUESTION OF ACCESS AND ETHICAL CONSIDERATIONS

The issues of access and ethics needed careful consideration in the design of this study and are in line with the educational research guidelines laid out by the British Educational Research Association (BERA, 2004). The question of access presented a complex practical problem as it involved negotiations at the level of the Ministry and participating schools. The ethical considerations proved to be an even more complex concern. Alongside all of the usual ethical cannons of research, such as informed consent, privacy, and reciprocity, there were also considerations stemming from the research topic itself, the age of the participants and the prolonged involvement of the researcher in the school where the qualitative data were collected.

Access at the Ministerial level

Every research endeavour carried out in the Croatian educational system needs formal approval from the Ministry. An application describing the research problem, aims, methods, and analytical framework and, most importantly, the ethical considerations emerging from the research, was sent to the Ministry in February of 2006. The Ministry issued permission for carrying out the proposed research and promptly stated their recommendation for approached schools to participate in the research.

Access in the quantitative part of the study

With the Ministry's approval and recommendation, schools were approached and invited to participate in the quantitative phase of the research. A letter to the schools included a brief description of the researcher and his previous work and a detailed explanation of the purpose of the research, the procedures that would be carried out, potential benefits of participation for the school and its pupils and the researcher's contact details. As an indicator of reciprocity for participating in the research, schools were offered individualised school results in relation to the overall sample, as information beneficial to school staff in furthering their understanding of pupils' perceptions of science education and RE in their particular school. These reports were composed and mailed back to schools. Upon receiving the letter, principals were contacted by phone and a date for questionnaire administration was negotiated.

Access in the qualitative part of the study

Special care in negotiating access was given to the school that participated in the qualitative part of research. The researcher visited the school and, upon introducing himself to the principal, thoroughly explained the aims, rationale and design of the study. On that occasion, the researcher explained the sampling procedure that would require the cooperation of subject teachers and left all necessary documentation and research materials for the principal to consider further and disseminate to the respective subject teachers. One week later, the researcher was contacted by the principal, who expressed an interest and willingness to participate in the study. A meeting was set up with subject teachers, where the researcher explained numerous facets of the research and teachers confirmed their willingness to participate in the research.

Addressing ethical considerations in the quantitative part of the study

As previously explained, principals were thoroughly informed about the nature, design and procedures of the research. In addition, they were given the questionnaire in order to consider its appropriateness for administration with pupils. In some cases, principals additionally invited science and RE teachers to confirm approval for participation. There were no objections to the contents of the questionnaire or the proposed method of data collection in any of the schools. Schools were assured that the data regarding their institution would be treated with the utmost confidentiality and that the names and characteristics of participating schools would not be mentioned in the final report. Furthermore, assurances were made that no other institution or person other than the researcher would have access to the data.

On the day of questionnaire administration, the researcher was accompanied to the classroom and introduced to pupils by a teacher or the principal. It was arranged and mutually agreed that, during questionnaire administration, school staff would not be present so as not to inhibit pupils' responses. The researcher thoroughly explained the purpose of the research and questionnaire duration to pupils. He emphasised his wish to explore pupils' voices and perspectives as a vital part to understanding the educational process. Special attention was devoted to an explanation of the voluntary nature of pupils' participation and their full right to withdraw before or at any time during questionnaire administration. In addition, it was stressed that pupils did not have to provide rationale for doing so. At this point, pupils were asked for their informed consent to participate in the research. Of more than five hundred pupils, there were two occasions when two pupils decided not to participate before questionnaire administration began and one occasion where a single pupil decided to stop during administration. In all cases, the researcher thanked them for their participation.

Two further ethical issues arose from questionnaire administration. First, the sample included seven pupils who attended RE of a different confession. On these occasions, pupils were encouraged to complete the questionnaire. Although the researcher believed that an ethical issue existed in the fact that these pupils themselves stated their distinction from the others, pupils were open about this distinction and there was no sense of ostracism from any pupils. Secondly, some pupils did not attend Catholic or any other form or RE. On these occasions, the researcher provided the option to pupils to answer only the items on science education and the relevance of science or not to participate in the research. Questionnaires of these pupils were not used in final analysis.

Special attention was given to the issue of privacy through anonymity and confidentiality, as can be evidenced in the opening page of the questionnaire. These issues were further addressed to pupils at the outset of questionnaire administration, when the researcher orally stated that the questionnaire would remain completely anonymous. Despite these measures, some pupils consciously signed the questionnaire, stating that they wished their responses to bear their name. The promise of confidentiality was further given in the promise that no person other than the researcher would have insight into pupils' individual answers. Upon completion of questionnaire administration, the researcher debriefed participants by offering further insight into the other parts of the research design and how pupils' responses would be used. Special attention was devoted to giving pupils an opportunity to voice feelings, thoughts, motivation and level of elicited interest during the administration process. In general, participants were open about their experiences, stating that the questionnaire was interesting and that they would like to do more of these activities in school. There were no occasions where pupils expressed major dissatisfaction with the process. Before departing, the researcher thanked pupils for their participation in the research.

Addressing ethical considerations in the qualitative part of the study

The qualitative part of the study required careful ethical consideration at the level of teacher, pupil, and also researcher. These will be considered in turn in the following paragraphs.

Ethical consideration at the level of teacher

The dual role of teachers in the selection of the pupil sample and as research participants themselves raised several ethical issues. As stated, teachers voluntarily accepted to participate in the research. Amongst the school staff, they were most informed about the procedures and themes covered in the research. For these reasons, it was very important to establish rapport with these teachers, which was excellent from the outset. Teachers were very interested in the research, fully supporting it and often mediating practical issues that arose during the two qualitative research phases. In turn, the researcher treated teachers, their experience and their disciplines with the utmost respect and admiration.

The first ethical issue that deserves special mention is the teachers' role in the selection of participants, a role they did not have any problems carrying out. However, one teacher reported that, in one of the older cohort classes, some girls were upset with her for not selecting them for research participation. This was a sensitive issue and, in an attempt to prevent any negative feelings amongst pupils, the researcher asked this teacher to explain more fully the research design to these pupils. The second issue to arise was in the more personal role of teachers as research participants. As was the case for pupils, teachers were assured of the utmost confidentiality and anonymity in the present research and subsequent reporting. Teachers were very open in their responses from the outset. Some of the themes probed in the interviews were personal and teachers were assured that they did not have to provide an answer if they did not wish to do so. At the end of each phase, teachers were asked to share their feelings, attitudes, motivation and operational difficulties regarding the research process.

Ethical considerations at the level of pupils

Once an initial selection of the participants was made, pupils were assembled together for a meeting with the researcher. Here, the purpose, aim, and procedures of the research were thoroughly discussed. Furthermore, their right to decline and withdraw from participation at any time and for any reason was strongly emphasised. Participants' tasks were explained and pupils were assured that all research activities would be conducted in a manner in which they did not lose anything from regular school activities. The importance of pupils' voices and experiences was set as a main element guiding the present research. As benefits to participating, the experience itself and insight into the world of scientific research were emphasized. All selected pupils were given a letter for parents that introduced the researcher, explained all characteristics of the research design and, most especially, stressed the cooperation of the school, the beneficence of pupils' participation and the assurance that pupils would not miss out on regular school activities. Furthermore, special attention was given to the fact that the research covers the sensitive topics of religion and science. Here, the researchers reverence for both intellectual domains was made explicit, as was the fact that pupils' attitudes and voices would be treated with the utmost respect. At the end of this letter, there was an informed consent box containing a statement of parental and pupil agreement for participation in the project and asked for both pupil and parent signatures. Only those pupils who expressed a willingness to participate and for whom parental consent had been given were included in the sample.

In the initial interview, all aspects of the research design and process were once again explained to pupils. They were assured of the privacy and confidentiality of their responses, a promise that included parents and teachers. Again, it was important to establish rapport and a sense of trust with pupils in the assumption that they would be more willing and open in sharing their attitudes and experiences with a researcher who showed a particular interest in their views. Here, three key elements were stressed: a relationship of respect, mutuality and promise keeping. All three were necessary in order to minimise the power gradient that often appears when an adult enters the world of pupils, and additionally served to distinguish the researcher from the school setting and the discourse characteristic of it. In interviews, pupils were encouraged to be open, unrestrained, and critically reflective and to express themselves in the manner they thought most appropriate.

Two issues arise in the present design that had the potential to expose pupils to risk. The first issue stems from the selection procedure, where pupils were selected by their teachers. To ensure honest dialogue free of any fear of consequences, there was a need to assure pupils that they could speak openly about school practices and that their responses and views would be entirely confidential. Secondly, several ethical issues arise in light of the research focus on religion and science. In the first instance, the structure of interviews allowed time for rapport between researcher and participants to be established before introducing these topics in the third interview. Further, because the overarching goal behind the investigation of these topics was to examine and understand pupils' attitudes and experiences, and not to change them, the interview approach used was sensitive and balanced, using pupils' understandings and attitudes, rather than any prescribed scheme, as a starting point. Overall, probing of these concepts proved to be without serious obstacles. Finally, on various occasions, pupils were asked about their satisfaction with the interview process and were further debriefed at the end of both phases of the research. At the termination of all interviews, all pupils expressed satisfaction with their involvement in the research.

CHAPTER FIVE: ATTITUDES TOWARDS SCHOOL SUBJECTS

This chapter starts with a brief comparison of the 2003 and 2006 data sets and further exploration of the 2006 results at the level of each individual dimension. This will be followed by a more finely detailed deliberation of the attitudes of different groups of pupils for each subject. First, the attitudes and experiences of the 8th grade cohort towards biology, physics, chemistry and RE will be presented and discussed. This will be followed by a consideration of the attitudes of 6th grade pupils towards nature and RE, as well as their preconceptions regarding physics and chemistry in comparison to the attitudes and experiences of their 8th grade colleagues.

5.1. ATTITUDINAL DIMENSION ANALYSES: 2003 COMPARISON AND 2006 RESULTS

The first goal of the present research was to determine if pupils' attitudes regarding science subjects and RE have changed since the 2003 study. Replication of items which measured pupils' attitudes towards subjects using semantic differential scales on dimensions of perceived level of interest, comprehensibility, difficulty, usefulness for present life and importance to future life allowed for a statistical comparison of the two data sets.

Apart from the passage of time, several systematic factors had the potential to contribute to an attitudinal change. Perhaps the most significant was the aforementioned introduction, in 2006, of the new Teaching Plans and Programmes for Elementary Education, which focused on the reduction of curricular content and an in-practice change of teaching methods and class work and were intended principally to make pupils' experience with school and subjects more understandable, more meaningful and easier (MZOS, 2006). This change was intended to be thorough and of high intensity with the goal of setting a new standard in elementary education. Secondly, it might be argued that four years represents a substantial period in both social and educational terms, during which time various social changes might have contributed to a change in pupils' perceptions of subjects. In addition, the two research studies have been conducted on samples from two different generations of pupils, which could themselves differ. Finally, methodological differences between the two research efforts also could have contributed to results suggesting an attitudinal shift.[41] Together, these factors might lead to an expectation of a significant change in pupil attitudes. However, as we will see, the results actually depict limited, if any, change.

5.1.1. Level of interest

Figure 5.1 compares the 2006 and 2003 data on 8th grade pupil attitudes towards each subject on the 'interest' dimension. It is of vital importance to mention that Figures presented in this chapter are only of illustrative value as they are expressed in terms of arithmetic mean, which demands a different illustration. The inclusion of the figures was deemed necessary due to the large body of data and serves solely as a conceptual organising device for the reader.[42]

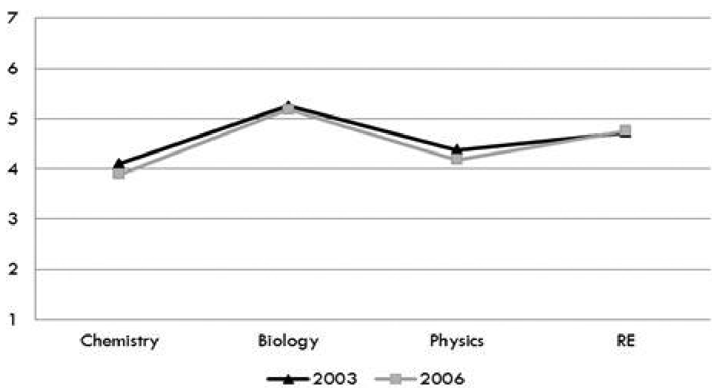

Figure 5.1: Level of interest estimates by 8th grade pupils

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[41] Specifically, while the 2003 effort was a large scale project conducted in 20 percent of all Croatian elementary schools and in which more than 2500 8th grade pupils participated, the present study was a personal effort on a much smaller scale and cannot claim such robust sample numbers.

[42] The x-axis is categorical and does not imply any progression. Furthermore, due to all of the mentioned limitations, lines were purposely smoothed in order to emphasise the illustrative nature of the figures.

Independent t-tests revealed no statistically significant differences in perceived level of interest between the 2003 and 2006 data[43], suggesting that pupils' level of interest for all subjects have remained stable over the course of four years.

In order to assess any statistical differences between subjects for this dimension in the 2006 data, a non-parametric procedure of Friedman's ANOVA was applied.[44] Here, it was assumed that pupil estimations of different subjects on the same dimension are logically related, and, as such, can be treated as a repeated measure of the same characteristic applied to four different subjects. As in 2003, the 2006 results demonstrated statistically significant differences amongst subjects on the 'level of interest' dimension ($\chi^2(3)=42.81$, $p<0.001$). For all dimensions, Wilcoxon signed rank tests were used to follow up this finding. A Bonferroni correction was applied and, as such, all effects are reported at a 0.0125 level of significance. The results confirm the problematic situation, demonstrated in 2003, that physics, and most especially chemistry, are not perceived as dominantly interesting subjects. Pairwise comparisons between subjects, presented in Table 5.1, revealed that both chemistry and physics were perceived to be significantly less interesting than both biology and RE. Biology has remained the most interesting subject not only amongst science but also amongst all four of the researched subjects, while RE has retained moderate levels of pupil interest.

Table 5.1: Pairwise subject comparisons (Interest dimension) – 8th grade

Level of interest			
Pairwise comparisons	z	p	r
biology – physics	4.68	0.000	0.24
biology – chemistry	6.93	0.000	0.38
biology – RE	2.23	0.026	0.11

43 Conducted independent t – test: chemistry interest (t=1.62; df=2891; p>0.05; r=0.03); biology interest (t=0.54; df=295; p>0.05; r=0.00); physics interest (t=0.60; df=2892; p>0.05; r=0.01); RE interest (t=1.23; df=288, 54; p>0.05; r=0.07)

44 The same statistical procedures were applied in the case of all other dimensions.

Level of interest			
Pairwise comparisons	z	p	r
physics – chemistry	1.46	0.143	0.08
physics – **RE**	2.73	0.006	0.14
chemistry – **RE**	4.19	0.000	0.21

* z=z value; p=exact significance level; r=Pearson's correlation effect size
** Subjects with higher estimations are presented in bold.

5.1.2. Level of comprehensibility

Figure 5.2 presents the results of pupils' perceived comprehensibility for each subject.

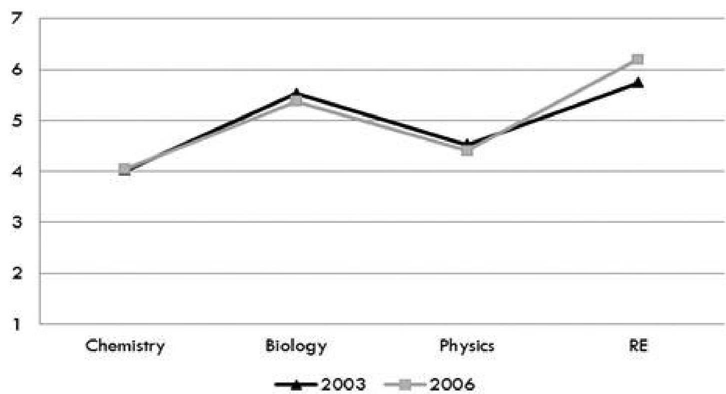

Figure 5.2: Level of comprehensibility estimates by 8th grade pupils

Again, as in 2003, the 2006 results demonstrated statistically significant differences amongst subjects on this dimension ($\chi^2(3)=139.26$, $p<0.001$). Pairwise comparisons, presented in Table 5.2, revealed that RE is perceived to be significantly more comprehensible than all other subjects. Amongst the science subjects, biology was reported to be significantly more comprehensible than both chemistry and physics. In general, pupil attitudes suggest low levels of understanding for chemistry and physics. This pattern seems especially critical in the case of chemistry, where more than half of respondents provided estimations for this dimension on the lower half of the response scale and a full 34.1 percent claimed the subject to be almost completely incomprehensible.[45] Again, as in the 2003 study, chemistry seems to be perceived to be the least comprehensible science subject by pupils.

Table 5.2: Pairwise subject comparisons (Comprehensibility dimension) – 8th grade

Level of comprehensibility			
Pairwise comparisons	z	p	r
biology – physics	4.89	0.000	0.25
biology – chemistry	6.71	0.000	0.34
biology – **RE**	6.21	0.000	0.31
physics – chemistry	1.97	0.049	0.10
physics – **RE**	7.97	0.000	0.40
chemistry – **RE**	9.09	0.000	0.46

As for the 'interest' dimension, the attitudinal patterns revealed in the 2003 study were, for the most part, confirmed by the present data. Specifically, there were no statistically significant differences for the three science subjects.[46] However, there does exist a statistically significant difference in evaluations of comprehensibility of RE ($t=5.10$, $df=2880$ $p<0.001$; $r=0.11$), where pupils in the 2006 sample reported RE to be more comprehensible than those in 2003. Two factors might have had an influence on this apparent increase. First, the subject itself might have become more comprehensible for pupils, a suggestion discussed later through the qualitative analyses. Secondly, a methodological difference in the relative nature of the judgements made might explain this change. In 2003, pupils were asked to make estimations

45 This can be compared to the responses for other subjects, where 26.4 percent of pupils claimed physics to be almost or completely incomprehensible while 14.1 percent of pupils reported the same for biology.

46 Conducted independent t – test: chemistry understanding ($t=0.36$; $df=2885$; $p>0.05$; $r=0.01$); biology understanding ($t=1.53$; $df=2882$; $p>0.05$; $r=0.03$); physics understanding ($t=0.22$; $df=2888$; $p>0.05$; $r=0.00$)

for all subjects taught in elementary education, while in 2006, pupils rated RE alongside science subjects only. Thus, participants in the 2006 study were providing ratings for a subject generally perceived to be both easy and comprehensible while providing similar ratings for subjects generally perceived to be both difficult and not comprehensible, a condition that might have falsely boosted ratings on this and other dimensions for RE. However, despite the potential influence of this contrast on pupil responses, the fact remains that, in 2006, 82.4 percent of participants evaluated the subject as completely comprehensible, illustrating the extremity of attitudes towards RE on this dimension.

5.1.3. Level of difficulty[47]

A comparison of pupils' estimations, from both samples, on the *'difficulty'* dimension is presented in Figure 5.3.

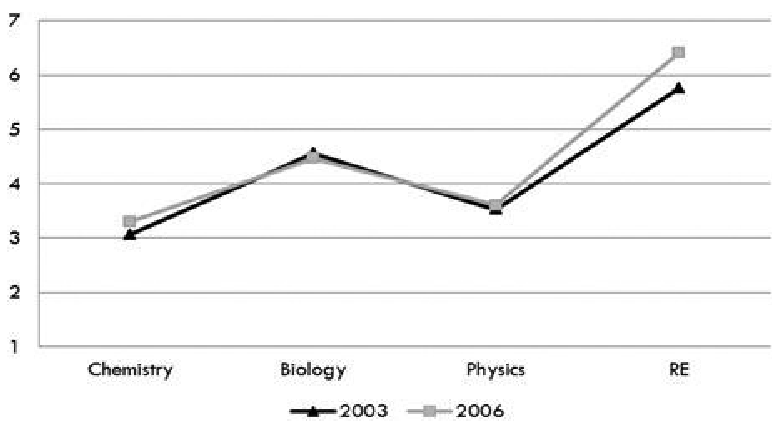

Figure 5.3: Level of difficulty estimates by 8th grade pupils

Once again, the only statistically significant difference between the 2003 and 2006 data sets occurs in the perceived level of difficulty of RE (t=8.86;

[47] Here, higher estimations indicate lower levels of difficulty.

df=2880; p<0.001; r=0.16).[48] As with the comprehensibility dimension, RE was estimated to be even less difficult then in 2003, and similar explanations for this perceived drop in difficulty level must be considered. As illustrated in Table 5.3, cross–subject comparisons show that RE was rated as significantly less difficult than all three science subjects ($\chi^2(3)=253.37$, $p<0.001$).

Table 5.3: Pairwise subject comparisons (Difficulty dimension) – 8th grade

Level of difficulty			
Pairwise comparisons	z	p	r
biology – physics	4.78	0.000	0.24
biology – chemistry	6.73	0.000	0.34
biology – **RE**	9.99	0.000	0.50
physics – chemistry	1.80	0.072	0.09
physics – **RE**	10.64	0.000	0.54
chemistry - **RE**	11.11	0.000	0.56

Here, biology was perceived as the least difficult of the science subjects, with no statistically significant difference between physics and chemistry. In fact, both subjects, and particularly chemistry, were generally considered to be very difficult, a finding in line with those from 2003, which found chemistry and physics to be amongst the subjects rated as the most difficult in elementary education. Pupils' ratings also suggest that, while biology was perceived to be the least difficult of the three science subjects, it was not judged to be overly easy. Possible explanations for this pattern of pupil attitudes towards the difficulty of science subjects will be discussed later.

5.1.4. Level of usefulness for present life

Figure 5.4 presents the results from both studies of pupil ratings on the 'usefulness for present life' dimension.

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48 Conducted independent t – test: chemistry difficulty (t=1.10; df=2887; p>0.05; r=0.02); biology difficulty (t=0,23; df=2881; p>0.05; r=0.00); physics difficulty (t=0.47; df=2884; p>0.05; r=0.01)

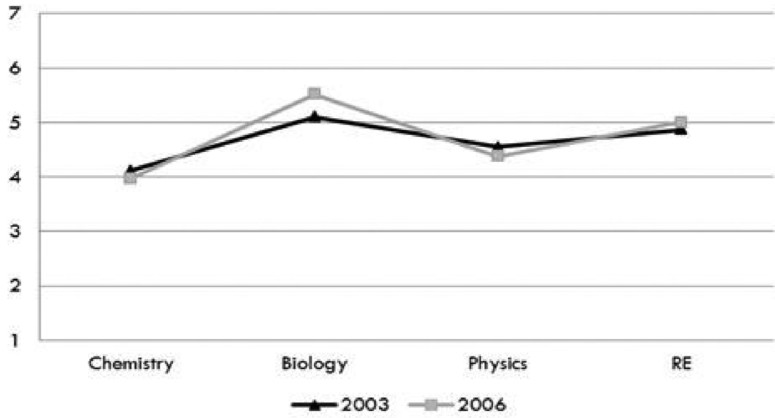

Figure 5.4: Level of usefulness estimates by 8th grade pupils

On this dimension, the 2006 findings revealed statistically significant differences in pupil ratings across subjects similar to those from 2003 ($\chi^2(3)=76.178$, $p<0.001$). Pairwise comparisons, presented in Table 5.4, revealed that biology is perceived to be significantly more useful for pupils' present life than any of the remaining three subjects. RE also achieved moderate levels of perceived usefulness and was rated significantly higher on this dimension than both chemistry and physics, whose relatively low ratings suggest pupils do not perceive these to be predominantly useful. Again, the negative estimations of pupils on this dimension seem to be especially salient for chemistry, which was perceived to be significantly less useful than physics.

Table 5.4: Pairwise subject comparisons (Usefulness dimension) – 8th grade

Level of usefulness for the present life			
Pairwise comparisons	z	p	r
biology – physics	5.72	0.000	0.29
biology – chemistry	8.15	0.000	0.41
biology – RE	2.82	0.005	0.14
physics – chemistry	2.55	0.011	0.13
physics – **RE**	2.99	0.003	0.15
chemistry - **RE**	4.96	0.000	0.25

Finally, pupil ratings for biology on this dimension also differed significantly between the two study cohorts (t=3.22; df=2883; p<0.001; r=0.06)[49], where biology was evaluated as more useful in 2006 than in the 2003 study. This is especially significant if one considers that pupil ratings from 2003 were made amongst ratings of all taught subjects, where biology was already positioned on this dimension in the upper half of all subjects. There are multiple factors which might have contributed to this difference: most notably, the introduction of HNOS, or the restricted selection of subjects in the 2006 study, as discussed above. Thus, biology's perceived usefulness might have been inflated when considered solely in comparison to chemistry and physics, which are perceived as significantly less useful. This and other possible reasons for this difference will be considered later in a discussion of both qualitative and quantitative results concerning each specific subject.

5.1.5. Level of importance to future life

In Figure 5.5, pupils' estimations on the 'importance to future life' dimension from 2003 and 2006 are presented.

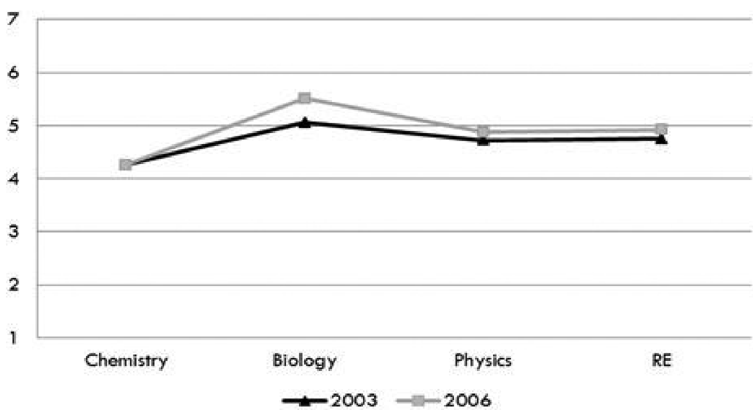

Figure 5.5: Level of importance estimates by 8th grade pupils

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49 Conducted independent t – test: chemistry usefulness (t=1.15; df=2891; p>0.05; r=0.02); RE usefulness (t=1,19; df=2693; p>0.05; r=0.02); physics usefulness (t=0.88; df=2878; p>0.05; r=0.02)

Again, the only statistically significant difference between the data sets of 2003 and 2006 is found between pupils' estimations of the importance of biology to their future life ($t=3.43$; $df=2874$; $p<0.01$; $r=0.07$)[50], a result possibly explained by the same factors discussed in the previous section. Consistent with the 2003 data, the 2006 results demonstrated statistically significant differences across subjects on this dimension ($\chi^2(3)=59.13$, $p<0.001$). Pairwise comparisons of this data, presented in Table 5.5, suggest that biology was perceived to be significantly more important to pupils' future life than any of the other three subjects.

Table 5.5 Pairwise subject comparisons (Importance dimension) – 8th grade

Level of importance for the future life			
Pairwise comparisons	z	p	r
biology – physics	3.78	0.000	0.19
biology – chemistry	7.30	0.000	0.37
biology – RE	2.96	0.003	0.15
physics – chemistry	3.61	0.000	0.18
physics – RE	0.33	0.742	0.02
chemistry - **RE**	3.72	0.000	0.19

Once more, chemistry is perceived to be significantly less important than the other subjects. It is also interesting to note a lack of statistical difference between pupil evaluations for physics and RE, a finding that will become more significant in forthcoming results and discussion.

5.1.6. Integrating the results

These results offer several interesting points for discussion. First, they suggest limited change in pupil attitudes over the span of four years despite considerable potential for change, including the passage of time, a cohort effect,

50 Conducted independent t – test: chemistry importance ($t=0.14$; $df=2888$; $p>0.05$; $r=0.00$); RE importance ($t=1.88$; $df=2692$; $p>0.05$; $r=0.03$); physics importance ($t=1.42$; $df=2874$; $p>0.05$; $r=0.04$)

methodological differences and, most interestingly, the systematic changes introduced in Croatian subject curricula during the elapsed time period. A comparison of the two data sets indicates that, six months into the implementation of the new Teaching Plans and Programmes, no change in pupil perceptions on these four subjects has been achieved. Although the initial six months may not represent a reliable timeframe for estimating the impact of reforms on pupils' attitudes, the present findings indirectly suggest limited change since 2003: the low estimation of chemistry and physics remains.

In general, pupils' perceptions of subjects on each dimension appear to be stable. Of the four, biology is consistently perceived most favourably amongst pupils, awarded the highest ratings on the dimensions of interest, usefulness for present life and importance to future life. This intersection between high intrinsic value, interest, instrumentality and utility clearly differentiates it from the other two science subjects. Further, it seems warranted to label the position of chemistry in the attitudinal schema of Croatian pupils as disastrous, in that it is the lowest rated subject on all five dimensions, while the position of physics appears to be somewhere between biology and chemistry. Pupils' evaluations of RE elude a single characterisation in that it is perceived as an easy and very comprehensible subject yet is awarded average levels of interest and utility for pupils.

In addition to the questionnaire survey of pupil attitudes, the present research encompassed qualitative data that investigated the content and formation of pupil attitudes more specifically. To pursue these themes, the following sections will draw on both quantitative and qualitative data derived from pupils and their teachers.

5.2. PUPIL ATTITUDES AT THE SUBJECT LEVEL

In addition to the responses of pupils on the attitudinal dimensions, data from general pupil estimations of each subject, their teachers and the number of teaching hours dedicated to each subject will be presented. These will be mutually complemented and triangulated by a presentation of the subject-by-subject analysis carried out with the qualitative data, which aimed to explore more thoroughly what lies behind the attitudinal patterns exposed through the quantitative analysis. While the expressed reflections of participants, through interviews and their research diaries, will be primarily analysed and presented at the most general cohort level, there will also be occasions where differences in attitudinal patterns will be sought between three predetermined pupil interest profiles, as well as between genders. Finally, an examination of the interviews carried out with subject teachers will serve as both an additional source of information and a tool for data triangulation.

5.2.1. Biology

'Biology is medium difficult. It really depends on the content. For now it doesn't seem problematic to me. I don't find it very interesting (in a way that I would be crazy about it) although I like being in Bio lessons because I can learn a lot and, after all, we are learning about our environment. It's not difficult to understand because everything seems well connected in this subject. I think that this is because it's coming from real life and you can see what you can use and what you can't. I think it is an important subject. Right now it is not super-important, but I think soon I will be able to use this knowledge I am getting.'

This research diary extract accurately portrays the general attitude of pupils towards this predominantly liked subject. The favourable stance of biology uncovered in the quantitative data was mirrored in pupils' responses in the qualitative phase of the research. Almost all participating pupils perceived it positively, an attitude only augmented by consistently positive perceptions of their biology teacher. This combination of a subject exploring relevant content with highly valued teaching has made biology one of the most beloved subjects in the participating school. In addition to favourable teaching, qualitative analyses of pupils' interview responses indicated other factors potentially contributing to this positive attitude.

First, pupil responses suggest that the specific content covered in biology corresponds intrinsically with their general and out of school interests. Namely, pupils perceive the subject to be intrinsically related to themselves and their own lives, as illustrated in the following excerpt:

'I love it because we learn about us, our lives, our body and that is not the case in physics, and especially not in chemistry.'

This intrinsic relevance, so often invisible in other subjects, served as a direct influence on pupils' favourable position towards the subject. This notion is confirmed in the words of the biology/nature teacher, a highly experienced educationalist and devoted biologist:

'It is an easy subject that is luckily quite well adjusted to pupils' abilities. I perceive them as little sponges able to absorb the many things you present them. In many ways and through a lot of its content, though not all, it is connected with and corresponds well with their experiences of life.'

In general, pupils repeatedly referred to a preference for the exploration of *'a subject about me'*, *'life, world, and the environment around us',* as well for learning *'useful things about the world around us'*. Arguably, this is what makes biology more salient for pupils.

When asked why the subject is included in the national curriculum, pupils once again offered general, but personal and positive, answers. They state:

'We are learning it (biology) in order to start understanding the world soon enough.'

And further:

'We learn it in order to get to know ourselves better. To know what is going on with and around us.'

Further insight into the elements of positive attitudes might be found in the higher correspondence of subject materials with the out-of-school interests of pupils. Specifically, as one pupil stated, an interest in animals seemed to serve as an important agent for the development of a positive attitude towards the subject:

'I like biology the most because I love animals. I have three dogs so some things we learn I can use at home.'

Pupils' statements clearly suggest that their preferred curricular content in biology is that which covers the biology of humans and animals, with content covering topics in botany being of less interest for them. This is illustrated from the following excerpt from the interview with the teacher:

'In the 7th grade, most of them have already entered puberty, so they seem to be more interested to learn about the body and behaviour and less about other forms of life, especially plants.'

The favoured content clearly suggests the direct relationship between curricular content and pupils' personal experience of their surroundings and their life. This positive regard for biology as a relevant subject to pupils personally is suggestive of its higher instrumental and practical value, and is clearly suggested by the above quotes depicting the subject as relevant and true to everyday life experience.

All of the aforementioned factors also appear to have clear implications for the ways in which pupils approach the study of this subject. Here, pupils' responses indicate the unique attitudinal position biology holds in relation to the other science subjects, as illustrated by the following statement:

'I: Do you prepare differently for physics, chemistry and biology?
P: Hmmm...yes. For me biology is the most logical and coherent out of the three so I learn, you know, with understanding. In physics some things I get and some I don't and chemistry....chemistry I just memorise as I do not understand much.'

Other pupils also stated that their approach to learning content in biology is characterized by the use of deeper learning strategies, a situation substantially different than in most other subjects (Jokić, 2007).

Participants were also asked to describe and explain, in their research diaries, the difference between a typical and ideal lesson in each respective subject. Here, the aim was to encourage students to discuss frankly the current practices of subject lessons, their own particular subject needs and wishes, and how they would like to see lessons changed. This comparison would further serve as an indication of pupils' opinions concerning the manner in which a subject is conceptualised and delivered. In the case of biology, most pupils once again affirmed a positive attitude towards both subject and teacher:

'Usually we discuss the contents we are covering and the teacher makes it fun, often joking with us. She is really a lot of fun and I would like that her classes are always so energetic and interesting. Needless to say, I would not change anything as I see this as ideal.'

Or in the words of another pupil:

'The ideal class of biology already exists; because the way the teacher delivers the content is exactly like it should be.'

These positive notions of both subject content and delivery were predominant among almost all participants, and clearly indicate the large amount of energy and enthusiasm invested by the teacher. This was reflected in the teacher's thoughts on the importance of the role of the teacher in shaping pupils' attitudes towards the subject:

'Pupils find something interesting if a teacher can transfer and present material in such a manner. I think that the teacher is the key to everything. You know, making things interesting is not an easy task and many teachers cannot do it. Every time I need to plan a little show for them and it takes a lot of planning and preparation.'

Despite generally positive perceptions and favourable attitudes, both pupils and the teacher were additionally asked to discuss any problematic points concerning the subject. When identifying areas for improvement, pupils articulated a wish for a higher prevalence of practical work and field classes:

'I would like it if we would go more to the nature, to a mountain for example. oooh, man, that would be cool, or to visit animal shelters and reserves, and to be given tasks like: plant a flower…I mean it would be better if it was more practical.'

Or in the words of one participant during interview:

'Biology is cool, but it would be even better if the teacher would show us practical examples because our classroom is, thank God, well equipped. For example, it would be super cool if we would dissect frogs.'

Some of these elements were also evident in the teachers' responses regarding problematic content, where she expressed reservations about the inclusion of certain topics while arguing that other topics should be added to or more greatly emphasized in the curriculum:

'I just have a feeling that sometimes there's too much of it for pupils and it is not equal in each grade. For example, the first semester of the 5th grade is so easy that pupils get bored, and then you have the second semester of the 7th grade where there is just too much…I would exclude some things from the curriculum like the intestinal systems of animals, or detailed teaching of the nervous system and would place much bigger emphasis on ecological themes and introduce genetics. And of course I would take pupils out as much as possible, but that is practically impossible because of the way the school is organised.'

While discussing course content that seemed particularly difficult for pupils, the teacher also raised an issue central to the present work:

'Pupils have a problem with everything abstract to them, concepts they cannot physically see. Fortunately, in biology, a lot of things are observable except maybe some things like mitosis, meiosis or photosynthesis.'

This statement indicates the teacher's awareness of biology's favourable position in relation to other science subjects, a situation she attributes to the abstractness of the material and to the unequal cognitive demands of the three subjects:

'*Kids like physics, and especially chemistry, less because their content is much more abstract. Especially in chemistry, where it is very hard, with our current infrastructure, to do much experimentation. The other thing, and I know this well from my student days, is that chemistry and physics are much more complicated subjects. Biology is mostly descriptive in elementary and secondary education, even at university, but for physics and chemistry, you have to have a bit more brains. And when pupils are challenged, they like the subject less.*'

The qualitative data has, among other things, crystallised several central characteristics behind pupils' positive attitudes towards biology. Arguably, two major contributing factors to this position are the relevance and utility of the subject and its contents to their everyday lives and its relatively low levels of abstractness which corresponds to their own life experience.

5.2.1.1. Group differences

In order to probe whether different groups of pupils have different attitudinal patterns towards biology, MANOVAs were performed with the aim of investigating the influence of gender and academic achievement on pupil attitudes. The MANOVAs revealed a statistically significant difference between boys and girls on the combined dependent variable of biology ($F(5, 189)=2.56$, $p<0.05$, Wilks Lambda=0.94), where girls responded more affirmatively. There also existed a statistically significant difference between the three academic achievement groups ($F(10, 370)=2.76$, $p<0.01$, Wilks' Lambda=0.87). In order to investigate the nature of these differences more specifically, results for the dependent variables (i.e. attitudinal dimensions) were considered separately for each independent variable using univariate ANOVAs.

When the individual dependent variables were considered separately against the independent variable of gender, the dimensions of usefulness for present life ($F(1, 193)=7.92$; $p<0.01$, $r=0.19$) and importance to future life (F

(1,193)=10.35; p<0.01, r=0.23) indicated statistically significant differences between boys and girls, thus primarily contributing to the main effect of gender. An inspection of estimated mean scores indicated that girls tended to give higher estimates on both dimensions. On all other dimensions, although there were no significant differences, girls also achieved higher estimated means, as illustrated in Figure 5.6.

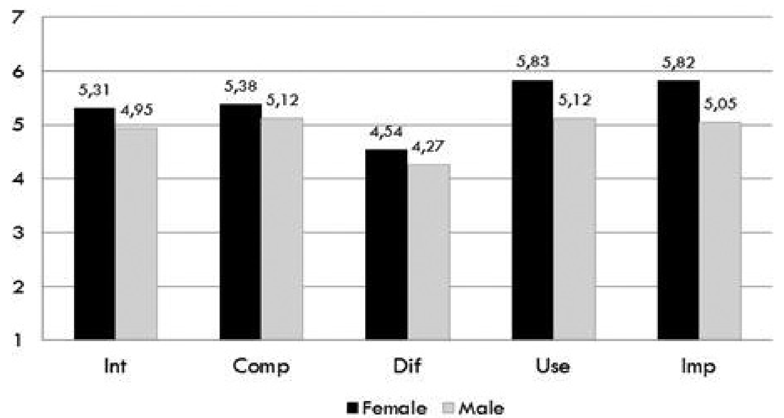

Figure 5.6: Estimated dimensional means for biology (Gender comparison)

The presence of statistically significant differences on these two dimensions suggests that girls evaluate biology with greater utility and instrumentality. However analyses of pupil interviews generally indicated limited gender differences in pupils' perceptions. The only substantial difference was the greater occurrence, amongst girls, of an affinity towards curricular content covering topics on the human body and its physiological and psychological processes, suggesting that themes dealing with personal development seem more applicable and important for female pupils at this stage of their development. This is illustrated in the following interview excerpt with one female participant:

'P: The good thing is that in biology we sometimes learn about the things that are important to us and that we speak about between us, like sexuality or what is going on with our body, you know. These are, like, very important things.

I: Would you say that there is a difference between boys and girls when you learn about these topics?
P: Almost all girls are interested in these things and boys are funny.
I: What do you mean by funny?
P: They either make fun of it, or are really shy, but they are stupid anyway.'

MANOVA testing also revealed statistically significant differences in attitudes towards biology between academic achievement groups. Univariate ANOVA testing indicates differences between these groups on the dimensions of interest (F (2,189)=5.19; p<0.01, r=0.24), comprehensibility (F (2,189)=8.34; p<0.01, r=0.28) and difficulty (F (2,189)=5.04, p<0.01, r=0.23), but not on the remaining two dimensions, as illustrated in Figure 5.7.

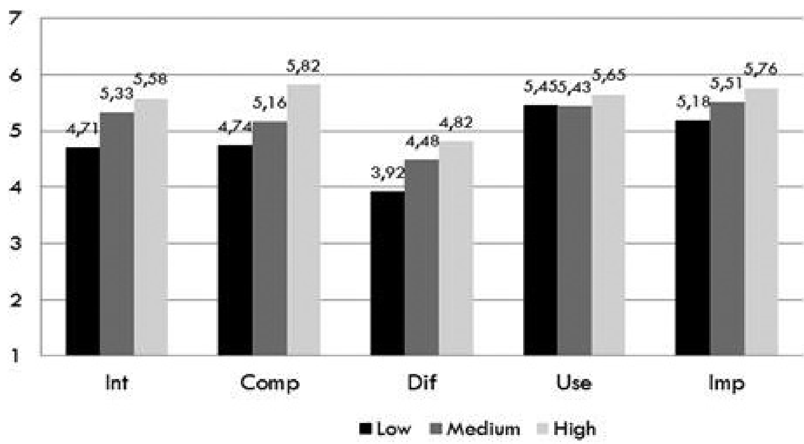

Figure 5.7: Estimated dimensional means for biology (Achievement comparison)

The above figure discloses several interesting patterns. First, the lines for both perceived usefulness and importance approach horizontality, suggesting that, regardless of achievement level, pupils perceive this subject as equally useful and important. Thus, it seems that pupils perceive it as personally relevant regardless of achievement level, a potentially crucial indicator of their affirmative stance towards this subject and the instrumentality and salience of its content. Duncan post hoc tests indicate that the differences found on the interest dimension are mainly due to lesser estimations by the low achieving group as compared to those of the other two groups. The situation is different on the comprehensibility dimension, where the ratings from pupils in the high achieving group are significantly higher than those of the lower and medium achieving groups. Finally, and perhaps not surprisingly, on the difficulty dimension, the significant difference amongst groups is due to a difference in estimations between low and high achieving groups. These results are in some ways expected: higher achieving pupils tend to have more positive estimations of interest in subjects at which they excel, and would be expected to rate such subjects as more understandable and less difficult.

The qualitative analyses considered group differences in the experiences and attitudes of pupils with differing patterns of interest towards science and religion, which did not indicate major differences in pupils' position towards biology. This finding might be attributed to several factors. First, pupils generally expressed very positive experiences with and attitudes towards this subject and its content, making it very difficult to differentiate more positive from less positive attitudes. Secondly, the pupils' highly positive attitudes towards the teacher dominated and perhaps overshadowed some potentially critical opinions towards the subject. As the analysis in Chapter Seven will show, the attitudes and conceptions of these three groups differed with regards to some of the topics covered in biology, such as evolution and sexuality, while the overall attitude towards the subject proved to be consistently positive.

5.2.1.2. General biology related estimates

In addition to estimations on the attitudinal dimensions, pupils were asked to assign a grade, from 1 (insufficient) to 5 (excellent), to both the subject and teacher in a fashion similar to the assessment of their own work. Both of these estimates served as a holistic view of the subject. In each respective questionnaire item, pupils were reminded that they should try to exclude the influence of one grade on the other, so that when they graded a particular subject, they should exclude their opinion of the subject teacher in assigning this grade. Finally, pupil attitudes towards biology were explored through an item probing their opinion on the number of teaching hours assigned to the subject. The results for all three measures, expressed as percentages of pupil' answers, are presented in Table 5.6.

Table 5.6: General pupil estimates – biology

Grade	Subject content	Teacher		Number of hours
1 (Insufficient)	1.5*	15.8	Lower	17.8
2 (Sufficient)	13.3	11.3	Keep the same	59.4
3 (Good)	17.7	9.9	Increase	16.8
4 (Very Good)	32.5	16.7	Eject	6.0
5 (Excellent)	35.0	46.3		

*Figures expressed in this and all other tables, unless otherwise noted, represent percentages of pupils awarding the specified grade
** For the analysis of the statistical difference in pupils' estimations of subject content and teachers, the Mann Whitney test was used for gender and the Kruskal-Wallis test for academic achievement. For the estimations of number of teaching hours, chi square tests were calculated.

While there were no statistically significant differences in these estimates regarding the variable of gender, the estimates differed significantly according to academic achievement, where more successful pupils gave higher grades of both content and teachers and opted more for retaining or increasing the number of teaching hours.[51] The results of these three assessments further confirm the consistently positive position of biology amongst participants.

5.2.1.3. Biology: A summary

The results from the quantitative part of the study suggest an overall positive attitudinal pattern towards biology, which has been estimated to be both interesting and comprehensible, while at the same time remaining relatively

[51] Gender: content (U=4565.5, z=1.18, p>0.05, r=0.12); teacher (U=4033, z=2.56, p<0.05, r=0.18); teaching hours (χ^2.=1.95, df=3, p>0.05, Cramer's V=0.10)
Academic achievement: content (H (2)=34.37, p<0.001); teacher (H (2)=17.49, p<0.001); teaching hours (χ^2=24.94, df=6, p<0.001, Cramer's V=0.25)

challenging. Furthermore, pupils perceive the subject to have both high levels of utility in their present life as well as salience for future life. Holistic estimates of both the subject and its teachers confirmed this positive stance. While analyses indicated some significant differences in attitudes towards biology according to achievement level, the lack of significant differences on the dimensions of utility for present life and salience to future life here suggests the consistently high relevance of the subject for pupils across achievement levels. The effect of gender was marginally significant, where girls' estimations of higher utility and salience levels mostly contributed to this difference, perhaps suggesting a higher relevance of biology and its content for girls.

These positive attitudinal patterns were clearly confirmed in qualitative analyses, which resonated with pupils' very positive perceptions of the teacher's delivery of course content. The qualitative analysis additionally allowed for the exploration of factors contributing to the positive attitudes towards this subject. First, the subject content was reported to be highly relevant and true to pupils' everyday life experience, and in many ways adequately corresponded with pupils' out of school affinities and activities. Through its practical and concrete orientation, biology seems to avoid the problems of abstractness characteristic of the other science subjects, thus raising its levels of utility and salience for pupils. Qualitative analyses also indicated that the gender difference suggested by the quantitative data might be attributable to higher interest levels and better reception of materials covering the human body amongst girls. Despite the generally positive reception, the analyses also suggested several problematic issues, primarily linked with the scarcity of practical lessons in the outdoors. Finally, the subject teacher identified several topics within the course with which pupils have difficulty, topics best characterised by elevated levels of abstractness.

5.2.2. Physics

'It's a very interesting subject. We learn definitions and solve problems, but in a really interesting manner. It offers many questions to which we try to give answers.'

'I don't understand the things we learn in physics, like, 90% of the time. Some things I get, like metric conversions, but things like more complex calculations, energy, force…I don't have a clue.'

Unlike the almost consensual views towards biology, these two contrasting excerpts from pupils' research diaries reveal the heterogeneous nature of attitudes towards physics. Both the qualitative and quantitative data suggest this subject holds a unique position in pupils' attitudinal framework. Furthermore, along the lines of gender and academic achievement, physics seems to be one of the most divisive subjects taught in elementary education.

The analysis of the qualitative data partially confirmed the coarse quantitative findings for pupil estimations on the various dimensions. First, the difficulty of the subject seemed to be one of the most prevalent and consistent positions amongst participants, as illustrated by the following excerpt:

'It is very demanding and difficult. One of the few subjects where you really need to work systematically'.

This was echoed in the words of the physics teacher, who stated:

'I would say it is not an easy subject and my impression is that, at the elementary education level, it is one of the most difficult ones. I have to admit that not all of my pupils can understand the content and there are rare cases when I can say: she or he understood what physics is.'

The perceived difficulty level seems to have contributed to one of two contrasting views on participants' interest in the subject. In the first case, some pupils expressed interest despite its challenging nature:

'I like it very much, but I have to say it's sometimes difficult for me. Regardless of that, it is very interesting.'

In contrast, some pupils expressed consistently negative attitudes on all dimensions, including interest:

'I hate it absolutely. I'm bad in it and there's just nothing interesting or useful for me.'

With the exception of two boys who expressed an intrinsic interest and perceived physics as not difficult, the majority of participants, regardless of their level of interest in the subject, professed it to be a highly demanding subject. Further qualitative analysis revealed some of the factors to which pupils attribute this difficulty. Namely, it seems that this sentiment is inherently connected with pupils' problems in mathematics:

'Physics is very difficult for me because we always need to solve some problems and in almost all cases these problems are numeric and I am so-so with numbers'

Or in the words of another pupil:

'I think I would like it more if there were less calculations. You know I'm not so good in maths and now I have a feeling that my physics also suffers.'

This was clearly triangulated with the teacher's responses:

'I know they dislike numerical problems but I need to teach that because that is what is expected of them in secondary education.'

She further elaborated:

'It (problems with physics a.n.) mostly comes from their problems with mathematics, but here the problem is even more complex, as the problems are not only set in numerical terms, but in most cases they are verbal, thus they need to make a transformation of words into numbers plus they need to set the problem correctly. All of this is cognitively demanding.'

Together, these quotes suggest a transfer of problems in mathematics to physics, a finding consistent with recent research suggesting that mathematics presents the single biggest challenge to Croatian pupils in light of the fact that 46 percent of all secondary education pupils undergo private tutoring for mathematics while physics is the second most common subject in which private lessons are used (Jokić & Ristić Dedić, 2007).

However, pupils' responses indicate that this cross-subject transfer is not the only factor contributing to the perceived higher levels of difficulty. The responses of a substantial number of pupils also suggest low levels of comprehensibility connected to feelings of an inability to adequately grasp and understand the content of the subject, as illustrated by the following comment:

'I have a problem with it, because to me it sounds so weird. It's like something completely different than other subjects like languages, history…I mean, I know it's connected with biology and chemistry, and all of the mathematic calculations, but many things I can't imagine and visualise.'

This excerpt further confirms the points raised by the biology teacher in the previous section concerning the varying levels of abstractness amongst science subjects and the problems pupils experience with abstract content. In elementary education, the physics curriculum contains concepts often perceived to be highly abstract in a manner not found in most other subjects. The teacher was fully aware of this and, by way of illustration, stated that pupils often have particular difficulties with content covering electricity, encountered in the 8th grade, whereas mechanics, a topic covered in the 7th grade, seemed to be more comprehensible for pupils. The teacher attributed this difference to the differing levels of abstractness of the two topics:

'What kids find interesting and easier in this subject are the things they can see and notice around themselves; in nature, technology. For mechanics, the level of abstractness is very low and most of the content can be shown in practical terms and through experiments. Here, we deal with concepts of mass, weight and inertia. Electricity and light is a different story, as they are much more abstract. I mean, also for me, electricity was the part of physics that was hardest to understand because you do not see the actual electricity.'

Arguably, this quote reveals some of the fundamental influences behind pupils' attitudes. First, the teacher confirms that pupils are more receptive to the concepts in physics that are more readily visible to them. Secondly, it seems clear that pupil attitudes vary in accordance with the relevance of the content to their everyday life experience. Finally, the teachers' words confirm the notion that level of abstractness is one of the main factors contributing to differing attitudes towards science subjects.

An analysis of pupil responses regarding their typical and ideal physics lesson revealed general feelings of satisfaction with their current lessons and the teacher's delivery. Criticism of the subject was most frequently associated with the assessment criteria used to evaluate pupils and the algebraic nature of the content:

'In physics we just do too many calculations. My ideal lesson would include coming to a solution through some other, more fun, way.'

Or in the words of another pupil:

'During physics, our teacher examines all of the time and always gives us some problems to solve for a grade. I would like that the teacher examines less and not doing calculations all of the time.'

Pupils further reported feeling that physics lessons might be better conducted in a more exploratory or 'hands on' fashion, incorporating more practical experiments and demonstrations:

'My ideal lesson is sometimes the one that we actually have. It's the lesson when we experiment, because then I have a feeling that we are playing. These lessons are very rare though and I wish that they were more often.'

Pupil estimations of their teacher were generally positive, in contrast to the more critical stance held towards the subject in general. Pupils described this teacher as strict but fair, despite an insistence on repeated examination, and reported enjoying her humorous nature and strong teaching and explanation skills. When asked to describe what pupils like about physics, the teacher included *'experimentation'*, *'theory'* and *'unusual things they encounter'* as the main attracting points of the subject. She expressed a belief that the theoretical content of the lessons was understandable for most pupils, unlike numerical problems, which she related to difficulties with mathematics. In general, the teacher believed the subject curriculum to be well constructed with few problematic points, out of which the most serious was the low compatibility of the mathematics and physics programmes. In addition, the teacher reported a lack of material resources for experimentation to be the second major obstacle to the effective teaching of physics.

5.2.2.1. Group differences

Another finding crystallized through both quantitative and the qualitative analysis was the polarization of pupils' interest for physics. For some pupils in the qualitative part of the study, this subject appeared to be a highly despised one, but for a slightly larger group of participants, it was reported to be one of the more interesting and beloved subjects in elementary education. Upon closer inspection of both data sets, it seems that this division of attitudes readily corresponded with groupings according to gender, general interest in science and academic achievement. To further illustrate this important finding, the quantitative data illustrating between group differences in pupils' attitudes will first be presented. This will be followed by further consideration of the qualitative data.

MANOVAs were performed to investigate the influence of gender and academic achievement on pupil attitudes towards physics. MANOVA testing suggested a statistically significant difference between boys and girls on the combined dimensions ($F=3.47$; $df=5, 191$; $p<0.01$, Wilks' Lambda=0.92), with boys evaluating the subject more positively. Additionally, a statistically significant difference was found between academic achievement groups ($F=2.04$; $df=10, 372$; $p<0.05$, Wilks' Lambda=0.90).

Looking separately at the effect of gender on each dimension, there is a statistically significant difference between males and females on all five dimensions. The estimated means for both genders on each of the dimensions are presented in Figure 5.8.

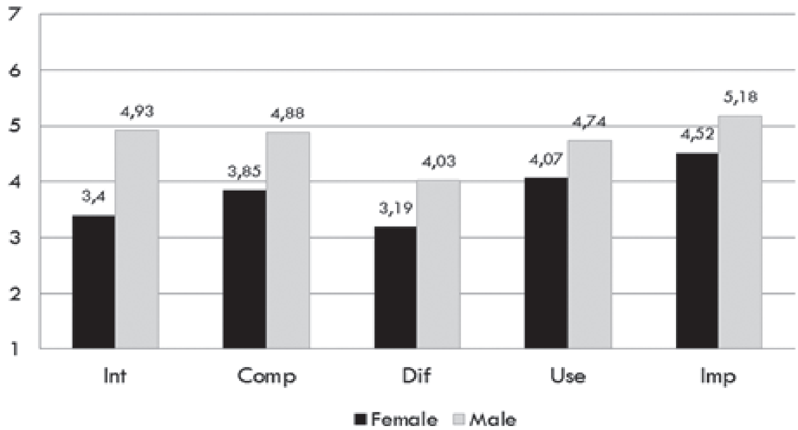

Figure 5.8: Estimated dimensional means for physics (Gender comparison)

These results offer a stimulating platform from which to further consider pupil attitudes. First, the presence of significant differences on all five dimensions signifies a fundamental and complex attitudinal difference between genders. Secondly the direction of the difference reveals that boys consistently give higher estimations. Specifically, boys tend to identify physics as more understandable ($F=7.61$, $df=1, 195$, $p<0.01$, $r=0.20$) than girls. They also deem it to be more important to their future life ($F=3.65$, $df=1, 195$, $p<0.05$, $r=0.14$), a marginal yet still statistically significant difference, and view it as more useful for their present life ($F=4.68$, $df=1,195$, $p<0.05$, $r=0.17$). Perhaps most significantly, boys perceive the subject to be more interesting ($F=17.05$, $df=1,195$, $p<0.01$, $r=0.31$), where the mean estimations for boys and girls differ by more than 1.5 scale value. Although the attitudinal trend for this subject seems to be unquestionable, closer inspection of the mean values of pupils' estimations for the final attitudinal dimension - level of difficulty - reveal that, although there exists a statistically significant difference in favour of boys ($F=6.45$, $df=1,195$, $p<0.05$, $r=0.18$), both genders identify physics as a difficult subject.[52]

52 So while the means of the boys' estimations are significantly higher than those of the girls' estimations, these latter ratings still barely reached the middle grade level of 4.

Further analysis of the qualitative data confirmed this gender difference in pupil attitudes. Here, boys expressed an almost unanimous affinity for the subject, emphasising especially their keen interest. Amongst them, only one pupil expressed a dislike for the subject, primarily attributing it to the previously mentioned relationship of physics to mathematics, a subject that he disliked and at which he does not excel. On the other hand, the responses of female participants towards physics were more polarised. A small number of girls expressed a fondness for the subject, as indicated by the following quote:

'I think it's quite difficult to understand for many pupils, sometimes me included, especially with those complicated problems but it's also very interesting because it explains things and phenomena that I did not even know exist.'

However, a larger proportion of girls appeared to dislike the subject, mainly because of the abstract nature of the course content and the lack of any connection to their everyday life and interests:

'I know it's important, but it's not interesting to me. I just don't have an interest in the things we learn, like energy and how things move.'

The gender difference is also apparent in the views expressed by the teacher, who observed a higher aptitude for physics amongst boys:

'They are more motivated and they just get it better. I cannot explain it, but in both schools I work in and throughout my teaching career, it was boys who were overall better. Also, those few who were exceptional were also boys. I do not know, because I am a woman too, but in this subject it is not just about learning, learning, learning; here you need to understand, make sound conclusions, sometimes almost on instinct. Boys just seem better at that.'

Despite this teacher's observations, it would be somewhat implausible to attribute the gender difference in attitudes to differing cognitive abilities. Indeed, a more accurate answer might be found in pupils' responses. Namely, they suggest two overarching factors contributing to this difference: a more apt fit of subject content to the interests and aptitudes of boys, both in general and out of school. Firstly, some of the course content seems to fit their interests, as one male pupil explains:

'Even when I was in the lower grades, I always wanted to know about many of these things like speed, force and all other things connected with cars.'

While it might be dangerous to attribute the gender difference along the stereotypical lines of gender roles and interests, pupils often named exactly these factors, as one girl explained:

'You know boys like physics because they are anyway interested in the things we learn there. All they talk is sports and cars anyway.'

In addition, the interviews indicated that boys seemed to find course content more relevant in their everyday life:

'It's useful for me, because, for example, when we learned about the conductors and I was doing something with my father in the house, I knew some things that he was surprised I know. It made me proud.'

While socialisation and gender roles in the family might have partially contributed to pupils' differing interest for the concepts covered in physics, data also indicated a second factor contributing to this difference:

'I like science fiction and physics is the subject that reminds me mostly of the things I read in comic books, see in the movies. It's weird at times and that is what makes it interesting.'

This is additionally confirmed in the words of another pupil:

'*It's cool, one of the rare subjects in which I discover things and things aren't set in a usual way. Read a lesson, memorise a lesson, get an A. There is more to it.'*

While it would surely be false to suggest that girls are less inclined towards the aspects of inquiry and discovery tied to physics, it is possible that the manner in which physics is taught is most appealing to boys. In any case, for all of the reasons above, physics seems to be a subject offering content more relevant and more readily related to boys' interests and everyday life. For the same reasons, the subject and its content are also deemed to be more important to their future life.

Analysing the main effect of academic achievement reveals statistical significance on two out of five dimensions for this subject and a clear trend on the other three. Not surprisingly, these dimensions are level of interest ($F=4.77$, $df=2, 190$; $p < 0.01$, $r=0.22$) and level of difficulty ($F=8.04$, $df=2, 190$; $p < 0.01$, $r=0.28$). Estimated means for all dimensions are presented in Figure 5.9.

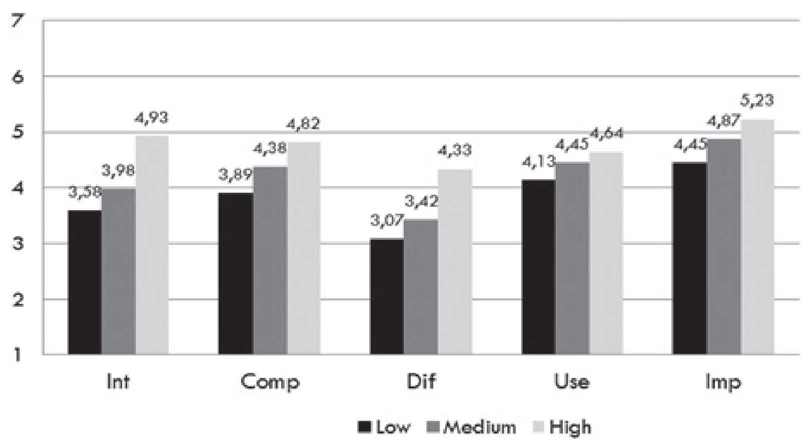

Figure 5.9: Estimated dimensional means for physics (Achievement comparison)

As with biology, these results are not surprising: higher achieving groups consistently proclaim physics to be more interesting and comprehensible, as well as less difficult. Duncan's post hoc tests revealed that, on the interest and difficulty dimensions, the high achieving group significantly differed from the two others. On the comprehensibility dimension, the statistical difference between the groups is due to large differences between groups of low and high achievers. On the dimensions of usefulness for present life and importance to future life, there was no statistically significant effect of academic achievement although the estimations grew linearly with academic achievement.

The qualitative data also suggested interesting group differences amongst pupils with varying levels of interest in science or religion. Specifically, the data demonstrated a tendency for participants from the higher scientific interest group, regardless of gender, to express the most enthusiasm for physics, even estimating it to be one of the best subjects in elementary education. Other groups did not differ substantially in their attitudes towards the subject. Further analysis also indicated differing approaches to learning this subject. Generally, participants from the group holding greater interest in science reported feeling that physics was an understandable subject for which they systematically prepared and studied. These learning strategies, however, seemed to come from their intrinsic interest in the subject, rather than school tasks or some other prescribed norm. This group of students stressed that one difference between physics and other subjects is that it imposes higher cognitive demands. This sentiment is illustrated in the words of these pupils:

'Physics is very useful and important because through it you develop logical thinking.'

And:

'For me, biology is the easiest to learn, because for physics you need some logics, and biology you just memorise.'

In contrast, pupils experiencing problems with the subject reported approaching the course material in an entirely different manner:

'I do not get most of it. And what can I do then? I just rota learn it before the test.'

5.2.2.2. General physics related estimates

General pupils' estimates for physics are presented in Table 5.7:

Table 5.7: General pupil estimates – physics

Grade	Subject content	Teacher		Number of hours
1 (Insufficient)	9.4	20.2	Lower	31.7
2 (Sufficient)	12.3	7.9	Keep the same	42.1
3 (Good)	33.5	22.2	Increase	15.3
4 (Very Good)	21.6	25.6	Eject	10.9
5 (Excellent)	23.2	24.1		

For gender, non-parametric testing indicated statistically significant differences in the assessment of content and teaching hours, where boys were more favourable towards the subject's teaching hours and provided substantially higher grades than girls.[53]

To illustrate this difference further, distributions of pupils' assessments on these two measures for each gender are presented in Table 5.8:

Table 5.8: General estimates for physics (Gender comparison)

Grade	Female	Male	Number of hours	Female	Male
1 (Insufficient)	13.7	3.5	Lower	37.9	23.3
2 (Sufficient)	12.0	12.8	Keep the same	40.5	44.2
3 (Good)	35.0	31.4	Increase	8.6	24.4
4 (Very Good)	24.8	17.4	Eject	13.0	8.1
5 (Excellent)	14.5	34.9			

The differences evident in the above results, in combination with the significantly higher estimation of this subject by boys, provide additional support for the hypothesis that boys' interest for physics is inherently different than that of girls.

[53] Gender: content (U=3884, z=2.87, p<0.01, r=0.21); teacher (U=4886.5, z=0.36, p>0.05, r=0.03); teaching hours (χ^2.=12.59, df=3, p<0.01, Cramer's V=0.25)
Academic achievement: content (H (2)=25.61, p<0.001); teacher (H (2)=17.05, p<0.001); teaching hours (χ^2=11.85, df=6, p>0.05, Cramer's V=0.17)

The analyses along the lines of academic achievement resulted in statistically significant differences for the assessments of content and teachers. Not surprisingly, groups with higher achievement levels give higher estimates, whilst pupils in the lower achieving group expressed a wish for teaching hours to be reduced.

5.2.2.3. Physics: A summary

The results from qualitative and quantitative data confirm the specific position of physics in Croatian elementary education. On the most general level, the subject is perceived as difficult, yielding lower levels of comprehensibility and pupil interest. Similarly, pupils awarded physics with medium level estimates on the dimensions of utility for present and importance to future life. Holistic estimates regarding the course content and subject teachers further confirmed these somewhat negative notions.

Although accurate, this representation is somewhat misleading since both quantitative and qualitative analyses suggested that physics is a subject that divides groups of pupils by gender and academic achievement. Pupils with higher achievement levels were consistently more positive about physics, an unsurprising finding for such a demanding subject. However, more interestingly, physics was consistently more highly estimated by boys on all dimensions. This finding was confirmed in the qualitative analyses, where boys' responses were almost unanimously favourable regarding the content and subject in general.

The qualitative data also allowed for an exploration of the foundations of these attitudes. Consistent with the findings for biology, pupils' problems with physics appear to be related to the abstract nature of some of the taught content, which proved to be the most difficult and problematic for pupils to comprehend. In addition, the intrinsic connection between physics and mathematics arose as a major barrier to positive attitudes, where difficulties experienced in mathematics were amplified and became even more evident in physics, thus making the subject seem more difficult, less comprehensible and less interesting. In addition to its high levels of abstractness and relationship with mathematics, pupils perceived little relevance of the subject to their everyday experience, a vital issue contributing to the formation of pupil attitudes. The data also suggested that this was especially the case for female participants who, for a number of hypothesized reasons, failed to see the relevance of the course content to their lives. Boys, on the other hand, perceived the subject as more relevant, salient and in tune with their general interests.

5.2.3. Chemistry

When asked to describe her subject, the chemistry teacher said:

'It is a very demanding subject. To the majority of pupils it is not understandable. They find it abstract, especially the part which deals with chemical equations and formulas.'

Later in the interview she added:

'One of the main problems is that the subject is not appropriately adjusted to the age of pupils. It is just too difficult and abstract. We start the 7th grade with a general introduction of chemistry, but as soon as we get to the chemical equations, problems start and motivation reaches the bottom. However, when they come back in the 8th grade some of these things settle for them and just clear up for them, like they have matured.'

This teacher's frank answers are indicative of the fundamental and grave problem faced by chemistry in Croatian elementary education. Pupils' interview responses confirmed the teacher's sentiments about the weaknesses and problems of this subject. As previously demonstrated, this negative estimation is also evident in the results from both quantitative data sets, where pupils' estimations for chemistry are the lowest amongst all four subjects on all dimensions.

Similarly, in the qualitative part of the study, almost all pupils expressed extreme reservations and severe criticism for the subject and none of the participating pupils expressed intrinsic interest for chemistry. In general, it was by far the least favoured of the four researched subjects:

'It's just boring, dull. The worst subject we have in school because it's difficult. You easily get a failing grade, so you need to study it but you cannot understand much of it.'

While this excerpt clearly illustrates this subject's position as it was established through quantitative analyses, what also becomes clear from the qualitative analysis is what might best be described as pupil resignation and a blanket rejection of the subject, as suggested by the following comments:

'Chemistry classes are boring, but I could not expect more from this subject. I would at least like it if we did more experiments.'

'I: Could you envisage chemistry to be different? How would you make it more interesting?
P: I don't know. It is just boring. There is nothing that could be done.'

This sentiment of resignation towards and subsequent rejection of chemistry is even evident in the responses of pupils from the group of higher scientific interest:

'Chemistry is medium difficult, but it's not particularly interesting, nowhere near physics. I find some things that we learn OK, but I have a problem with the equations. I think it may be important for someone, but I don't have a respect for it.'

This extremely negative position was further reflected in the fact that pupils were unable to clearly state reasons for the subject's inclusion in elementary education or to offer a general purpose for this subject, suggesting that they do not see any reason for its inclusion at all:

'I do not know why we learn it. I mean it is not like I, or anyone else, would need it. Maybe if someone wants to become a chemist, but in my class I seriously doubt that there is anyone like that.'

The negative position is also clearly reflected in diary entries, where pupils' described the differences between typical and ideal chemistry lessons:

'*A typical chemistry lesson is extremely boring (at least in my opinion), and it looks like this: we all enter the classroom, sit in our positions and get calm. We need five minutes for that and then the teacher examines 2 or 3 pupils. Then we start with the new material by first discussing it with the teacher and then copying things in our notebooks, which is quite boring if you ask me. Ideally, it would look like this: Our classroom would be a giant laboratory with assigned seats for everyone. Each lesson, the teacher would show us three or four experiments. We would work together. I think this would be fun, interesting and I even think, more useful for us.'*

Pupils' positive evaluations of the subject were reserved almost exclusively to parts of the course allowing for hands-on experimentation. In fact, experiments and practical work were the two primary attractors for this subject. The teacher also recognized this general feeling amongst her students:

'Kids like practical work and experiments. The times we do experiments are about the only time when I see interest in them, but you cannot do only experiments. Chemistry is more than just that and there are clear limitations to this. Firstly, there are material obstacles as our schools are inadequately equipped and secondly, there is a problem with pupils' discipline as some of them cannot behave in this situation.'

The qualitative data indicated several possible contributing factors for the negative position of chemistry. First, pupils repeatedly confirmed the sentiment that chemistry, in comparison to all other subjects, is a very difficult and incomprehensible subject with a highly demanding curriculum:

'Difficult and boring, but you can't fool around. You need to study.'

Because of its complexity, difficulty and incomprehensibility, pupils reported often applying rote memorisation as a study strategy, a behaviour completely discrepant to the nature of chemistry and science subjects in general and, arguably, not conducive to a deep understanding of the subject material. This problematic situation is frankly described in the words of one frustrated pupil:

'What can I do, as I do not understand it and I need to have a good grade? So I just memorise the theory, which is the easier part anyway, but I also memorise the calculations. Just memorise. We all do.'

While the above-mentioned factors undoubtedly contribute to the negative attitudes held by pupils for this subject, perhaps what lies at the core of this attitudinal framework is something more inherently connected with the nature of scientific disciplines themselves. Specifically, the responses of pupils and teachers alike indicated that, unlike biology and perhaps even more so than for physics, chemistry is predominantly abstract in nature. Again, this characteristic poses a significant problem for pupils, as the chemistry teacher explains:

'Most of it is abstract for them. I mean, when I was a university student studying both chemistry and biology, it was abstract for me too and I disliked it for that. They have problems with so many things in chemistry they cannot visualise, like the atom, its structures, molecules, ions and ionic connections. Of course you can give them models etc… but they cannot relate to it.'

In addition, pupils' responses revealed feelings of very little relevance of the course content to their everyday life:

'It is silly, we learn about all of these acids, molecules…and I don't know what to do with this knowledge. I mean where in my life are these non-metals, connections…I do not see them, it's all only in the books and on the paper.'

If the inherent abstractness of the covered material is considered in conjunction with pupils' reported inability to perceive any relationship between the taught concepts and their everyday experience, negative attitudes should not be surprising, a sentiment echoed by this pupil:

'Ok, I know what an atom is, but where the hell do I see this atom? Where is it?'

As was the case for physics, pupil attitudes towards chemistry are further undermined through its intrinsic connection with mathematics. Again, the potential for a transfer of difficulties in mathematics to chemistry is present due to the significant amount of symbolic representations, calculation and equations in the taught content, a condition explained by the chemistry teacher:

'Getting rid of the content on chemical equations is one correction to the subject curriculum that should be done immediately. Pupils already have problems with my subject and when you add mathematics, then pupils' attitudes should not be surprising.'

5.2.3.1. Group differences

Once again, MANOVAs were performed to investigate the influence of gender and academic achievement on pupil attitudes towards chemistry. On the combined attitudinal dimensions, MANOVA testing indicated statistically significant group differences for both gender ($F=3.17$; $df=5, 188$; $p<0.01$, Wilks' Lambda=0.92), where girls gave more positive estimations, and academic achievement ($F=2.42$; $df=10, 366$; $p<0.01$, Wilks' Lambda=0.88).

Analysing the main effect of gender revealed significant differences between boys and girls on three out of five dimensions: level of interest ($F=4.15$, $df=1, 192$; $p <0.05$, $r=0.15$), level of usefulness for present life ($F=14.28$, $df=1, 192$; $p<0.001$, $r=0.26$) and level of importance to future life ($F=5.37$, $df=1, 192$; $p< 0.05$, $r=0.17$). Estimated means for all dimensions in relation to the gender variable are presented in Figure 5.10.

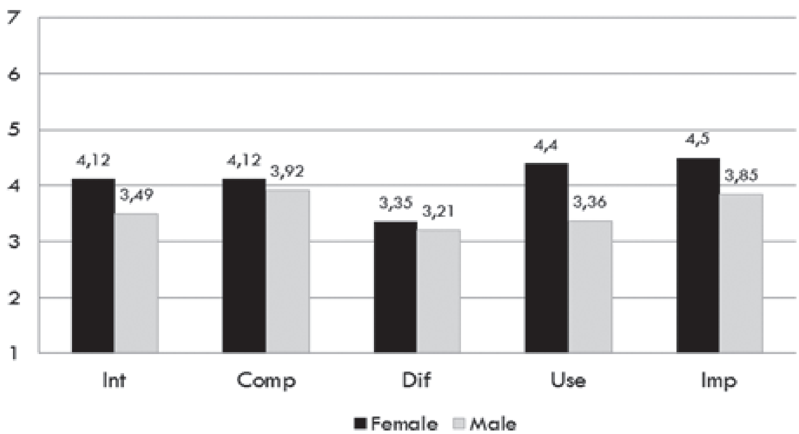

Figure 5.10: Estimated dimensional means for chemistry (Gender comparison)

Several features illustrated in this figure are informative in examining gender differences in attitudes towards chemistry. First, it is interesting to note a lack of statistical difference on the difficulty dimension, where both genders perceive the subject to be very difficult. Secondly, there exists no difference between genders on the comprehensibility dimension, with the estimations of both genders lingering around the midpoint value of the scale. Considered together, this data confirms that for both genders, chemistry represents a very difficult and non-comprehensible subject. On all other dimensions, girls provide significantly higher estimates than boys. However, this difference should not be overestimated, as even the highest estimates achieved overall – girls' estimation of the subject's importance to future life – is still quite negative in absolute terms and in comparison with other subjects. From this perspective, girls' estimations might best be characterised as less negative, rather than positive, in comparison to those of boys. It is also significant to note that, amongst boys, none of the estimated means reach the midpoint of the rating scale. So, although there does exist significant differences between the estimations of gender groups on several dimensions, the most compelling notion arising from the data is the overwhelming negativity of estimations from both genders. Further, while the gender effect in the case of physics was achieved due to real interest amongst boys, the gender differences here might more accurately be described as being due to a half-hearted response from girls.

An analysis of the effect of the academic achievement variable reveals statistically significant differences on all dimensions except that of usefulness for present life ($F_{int}=9.72$, df=2, 187, p<001, r=0.31; $F_{und}=8.62$, df=2, 187, p<0.001, r=0.29; $F_{dif}=7.79$, df=2, 187, p<0.01, r=0.28; $F_{imp}=4.04$, df=2, 187, p<0.05, r=0.20). In Figure 5.11, the estimated means for academic achievement groups on each dimension are presented:

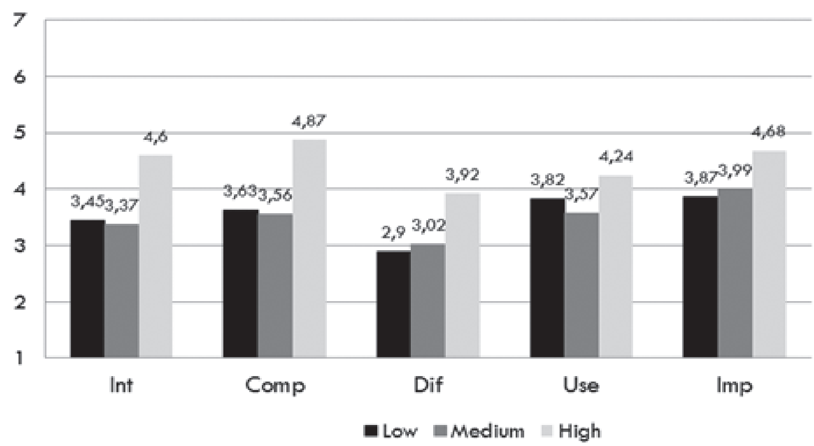

Figure 5.11: Estimated dimensional means for chemistry (Achievement comparison)

This figure reveals several interesting findings. First, even the highest achieving pupils estimate chemistry to be a very difficult subject where the estimated mean only reaches the midpoint of the rating scale on this dimension. Secondly, the lower achieving group provides higher estimates than the medium achieving group on some dimensions. Finally, there exists a striking similarity in the graphical curves for all dimensions, characterised by a relative flatness between the lower and medium achieving groups followed by a sharp rise for the high achieving group. This latter observation was confirmed via Duncan post hoc tests, which revealed that the high achieving group was significantly different in their estimations than their peers from the other two groups. This lack of differentiation between the two lower achieving groups further emphasizes the critical status of chemistry, where the majority of pupils perceive it negatively on all of the attitudinal dimensions.

5.2.3.2. General chemistry related estimates

General chemistry related estimates are presented in Table 5.9.

Table 5.9: General pupil estimates – chemistry

Grade	Subject content	Teacher		Number of hours
1 (Insufficient)	16.3	22.8	Lower	30.8
2 (Sufficient)	18.7	17.8	Keep the same	45.5
3 (Good)	25.1	17.3	Increase	7.4
4 (Very Good)	23.6	18.8	Eject	16.3
5 (Excellent)	16.3	23.3		

Gender grouping resulted in marginally significant statistical differences in the pupils' grades for subject and teachers with girls giving slightly higher estimations.[54] As evident from the frequencies presented in Table 5.10, a more dramatic difference is evident in the estimations assigned by the three academic achievement groups.

Table 5.10: General estimates for chemistry (Achievement comparison)

	Subject Content			Teacher		
Grade	Low	Medium	High	Low	Medium	High
1	24.6	21.0	5.6	35.4	27.9	5.6
2	30.8	16.1	8.3	24.6	13.1	16.5
3	26.2	29.0	20.8	10.8	24.6	16.7
4	9.2	25.8	34.7	9.2	16.4	30.6
5	9.2	8.1	30.6	20.0	18.0	30.6

54 Gender: content (U=4180, z=2.11, $p<0.05$, r=0.15); teacher (U=4311, z=1.68, $p>0.05$, r=0.12); teaching hours ($\chi^2=2.33$, df=3, $p>0.05$, Cramer's V=0.11)
Academic achievement: content (H (2)=35.69, $p<0.001$); teacher (H (2)=19.89, $p<0.001$); teaching hours ($\chi^2=23.64$, df=6, $p<0.00$, Cramer's V=0.25)

Here, it is confirmed that higher achieving groups exhibit a more positive perception of the taught content and teachers, whereas the two other groups are highly critical.

5.2.3.3. Chemistry: A summary

Sadly, pupils' attitudes towards chemistry can undoubtedly be described as negative and unenthusiastic. The quantitative data suggested that the subject sits at the problematic junction of extreme levels of difficulty and incomprehensibility, low levels of interest and inferior ranks of utility for pupils' present life and importance to future life. This negative position was confirmed by the low general estimates of subject content and teachers. Between-groups statistical procedures indicated significantly differing attitudes towards the subject according to academic achievement group. Here, only the responses from the participants in the high achievement group reflected somewhat positive attitudes towards chemistry. There was also a marginal statistical difference between genders, where girls held 'less negative' attitudes towards chemistry.

Qualitative analyses indicated that at the core of pupils' negative attitudes towards chemistry lies the abstract content, its relationship with mathematics and the low relevance of the covered content to pupils' everyday experience. All of these factors will be discussed further in the following consideration of the results for all three science subjects.

5.2.4. Attitudes towards science subjects: Integrating the results

From the previous discussion, pupils' heterogeneous attitudinal scheme for the three science subjects is evident. Quantitative and qualitative analyses indicated that biology is perceived most positively, chemistry unanimously evokes negative attitudes amongst most pupils, while physics falls somewhere in between these subjects. The three dimensions discovered through analyses have allowed for a 'modelling' of the influences on pupil attitudes based on subject traits. Namely, three dimensions influencing pupils' attitudes emerged from an in-depth exploration of the qualitative data: level of abstractness, relevance for and visibility in pupils' everyday life and mathematical foundation. The variations of the three science subjects along these dimensions are presented in Table 5.11.

Table 5.11: Subject comparison across dimensions of attitudinal influence

Dimension	Biology	Physics	Chemistry
Level of abstractness	Low/Medium	Medium/High	High
Relevance for and visibility in pupils' everyday life	High	Medium/Low	Low
Mathematical foundation	Low	High	Medium/High

Here, it is evident that biology holds the most positive combination of characteristics on the presented dimensions for promoting a positive attitudinal stance. Namely, most of its taught content is not abstract, has considerable relevance to pupils' own life and is directly visible in pupils' surroundings. Further, course content is not founded in mathematics, an element that proved to be highly influential in lowering pupil attitudes towards chemistry and physics. Physics fares much worse on these dimensions: it includes content holding significant levels of abstractness and that is strongly rooted in mathematics, thus demanding mathematical competence from pupils. Physics is divided along gender lines with respect to its relevance to pupils' life, where boys appear to perceive the subject as more relevant and useful. Finally, pupils find chemistry to be the most abstract of all three subjects and that which is most removed from their daily experience. Furthermore, most of the taught concepts in chemistry are not visible to pupils, a factor compounded by the scarcity of equipment for practical work and experimentation and which adds to the low relevance of this subject. Chemistry is also significantly founded on mathematical competence, which in itself poses a problem for a significant proportion of Croatian pupils.

5.2.5. Religious education (8th grade)

As previously stated, RE, with its distinctive content, delivery and mission, represents a unique subject in Croatian elementary education. This specific nature is clearly represented in the complexities of the attitudinal and experiential responses from both pupils and teachers. While the qualitative and quantitative data were complementary for the science subjects, allowing a triangulation that enabled solid conclusions regarding pupils' attitudes and experiences, data concerning RE from the two data sets did not allow for such conviction in the findings and in fact contradicted each other at times. This discrepancy was most apparent when one considered the generally favourable attitudes towards RE marked by the combination of medium levels of interest, usefulness and importance with extremely high levels of easiness and comprehensibility suggested by the quantitative data and the more critical stance arising from pupil and teacher responses in the qualitative data. This, in turn, suggests both significant problems and discrepant attitudinal patterns for RE, making this subject an interesting case for further discussion.

5.2.5.1. General RE related estimates

The general RE related estimates of 8th grade pupils are presented in Table 5.12:

Table 5.12: General pupil estimates – RE

	Subject' content	**Teacher**		**Number of hours**
1 (Insufficient)	6.9	10.3	Lower	25.4
2 (Sufficient)	5.9	8.4	Keep the same	52.0
3 (Good)	13.8	12.8	Increase	16.2
4 (Very Good)	26.1	26.1	Eject	6.4
5 (Excellent)	47.3	42.4		

Pupils gave relatively high grades to both the content and teachers of RE. Testing of the between-group differences for gender and academic achievement did not yield any statistically significant differences.[55] In general, the presented statistical indicators suggest that both RE and RE teachers generally occupy a positive position in pupils' attitudinal framework.

5.2.5.2. Qualitative findings

Contrary to these results, the reports from the older pupils in the qualitative phase of the research, although quite favourable towards their RE teachers, contained serious reservations about the contents and delivery of the subject:

'This subject is ultimate boredom. I mean I believe in God but I'm really not interested in some things that happened thousands of years ago that she tells us about.'

Or in the case of another pupil:

'It's hard to explain. Some pupils who have larger faith understand it better, and I understand some things, but some things are really hard to understand.'

Responses here clearly indicated that, for pupils, the level of subject difficulty is related almost solely to their achievement, as exemplified in the words of this pupil:

'It's by far the easiest subject in our school. It's easier than PE. I mean we do not study for it and everyone has an A. What better could you want?'

All other pupils similarly defined the subject in terms of its low demands for high achievement, a finding confirming those from the quantitative data.

55 Gender: content (U=5017, z=0.035, p>0.05, r=0.00); teacher (U=4175, z=1.94, p>0.05, r=0.14); teaching hours (χ^2=5.24, df=3, p>0.05, Cramer's V=0.16)
Academic achievement: content (H (2)=1.42, p>0.05); teacher (H (2)=2.61, p>0.05); teaching hours (χ^2=8.60, df=6, p>0.05, Cramer's V=0.15)

However, the findings did not reach this same level of compatibility on the second most highly estimated dimension – level of comprehensibility. In the initial interviews, pupils defined comprehensibility in terms of the academic demands placed upon them, as was the case for difficulty level. Here, RE was consistently identified as a very comprehensible subject. However, some pupils later expressed reservations regarding their own understanding of the subject's content, as illustrated in this early diary entry:

'It's comprehensible in terms of learning and demands because you don't need to study for it. But sometimes I cannot understand what the teacher says, or even more often I don't agree with what she says nor can I understand it. Now I have written this, maybe it is not so comprehensible.'

Most interesting here is the prospect of dissent contained in the words *'more often I do not agree with what she says'*, an emotion completely absent in the consideration of pupils attitudes towards and experience with science subjects. Of those who expressed difficulties comprehending the content of RE, a large majority was from the group of high science and low religion interest, signifying a possible discrepancy between two separate worldviews. This intersection between pupils' feelings about their understanding of topics covered in RE and a propensity towards interest in science will be further explored in the next chapters.

The qualitative data further indicated that parental influence had a direct impact on the perceived comprehensibility of the subject content:

'I talk about these things with my parents and they clarify things that do not seem so clear to me or that I have doubts about.'

As will be presented later in the text, the element of parental influence represented one of the major factors in shaping pupils' attitudes towards RE. A second main theme emerging in the early interviews was this subject's limited interestingness:

'To tell you frankly, during RE I bore myself and sometimes I'm dying out of boredom, because the themes are like 'arghhh'. I don't like this subject and I would kick it out of school if I could.'

This sentiment was echoed by a large majority of pupils in this cohort, who used words like '*dull', 'boring', 'doing nothing'* and *'during RE we prepare for other classes*' when speaking about RE. This confirmed pupils' generally low intrinsic interest in the subject, a sentiment more in line with the quantitative results on the attitudinal dimension of interest.

As might have been expected, many of the described features of pupils' attitudes towards RE were connected with the teachers' delivery of the subject. During the initial selection of participants and the first phase of data collection, the RE teacher participating in the research was a full-time teacher with 12 years of teaching experience. Midway through data collection, this teacher went on maternity leave and was replaced by a young teacher with 2 years of experience. As such, both teachers participated in the qualitative part of the research. During interviews, both teachers held similar views on their subject, but pupil responses revealed their teaching style and lesson delivery to differ quite significantly. According to pupils, the more experienced teacher often encountered problems controlling the class and establishing discipline, as explained by one pupil:

'During the whole class there's a lot of noise and shouting, stupid jokes and even ridiculing the faith. Then the teacher shouts and gets very nervous.'

This sentiment was repeated in the diary entry of another pupil:

'Sometimes, my problem with RE is connected with the fact that the teacher cannot get us to do something. This is especially the case with some of the pupils who, during lessons, do whatever they want.'

From the first interview, several pupils related the unfavourable teaching practices of this teacher, mentioning specifically that they did not bother preparing for RE because:

'There is no oral assessment in this subject, and for the written exams she gives us both the questions and answers in advance. So you just learn these answers and you get an A.'

This confession, repeated by all participants, suggests highly lenient, or in this case absent, assessment criteria. This notion of lenient assessment in RE is an issue influencing pupil attitudes that will be discussed at the end of this section.

In contrast, the younger RE teacher had a different teaching style, characterised by greater emphasis on discipline:

'We have a new teacher. She is stricter and teaches differently than the last one. We work more and there is less fooling around and more discipline.'

The most substantial change implemented by the younger teacher appeared to be a more dialectical approach to teaching, a change that was favourably accepted by pupils. However, while pupil responses during interviews revealed that this small but important change had a positive effect on perceptions towards their teacher and course delivery, it did not change pupils' somewhat critical stance towards the subject content and the Church in general:

'Now I find RE better because we discuss more and the teacher seems more open to listen to our views, although we know what she thinks.'

On the remaining two dimensions, usefulness and importance, one clear notion emerged from the qualitative data. Here, it became evident that the biggest influence on pupil attitudes on these dimensions was the level of and exposure to religiosity in the family. Specifically, pupils coming from more religious settings proclaimed the subject to be more useful and more important for them:

'It's important to me and my future life, because the faith makes us what we are. It is the same with my brothers and my parents…we go to Church every Sunday.'

In contrast, those coming from less religious settings were more negative about the subject's impact on their present and future life:

'It is for nothing. It doesn't help me in any way and I don't see the point in it.'

When discussing a typical RE lesson, most pupils confirmed the generally limited interest levels discovered in the quantitative data, a position especially characteristic for those coming from the high science-low religion interest group. This diary excerpt was recorded by a pupil in this group:

'RE is nonsense. It is such a boring, dull and stupid subject. We don't learn anything important and I don't think it should be taught in schools.'

This sentiment is even articulated by those holding a more positive attitude towards the subject, in an even more concrete manner:

'First we pray and then we do some stupid and boring lesson. At the end we pray again. Ideally, I would like to have these prayers, but that we do not do anything in between.'

Although criticism of the typical RE lesson was consistent across groups, pupils' visions of an ideal lesson in this subject differed substantially according to the interest group to which they were assigned. Those in the high religious-low science group reported preferring disciplined lessons with more structured content, as suggested by the following excerpt:

'My ideal lesson would consist of prayer and discussion on important Church questions and learning about our confession and its history.'

Those in the low religious interest group offered extremely critical responses:

'Ideal lesson in RE…does that exist? Maybe the ideal lesson would be if the teacher let us do whatever we want or read us some jokes. Maybe then I would plug in my brain, have some fun and maybe time would go faster than usual.'

'In the case of RE, there is no ideal lesson because I can't envisage what we would do in it (except if the teacher let us out to play football ☺)'

Some pupils envisaged other forms of RE:

'The ideal lesson of RE would be in Church (because I think RE should be taught there). It would be attended by those who wanted - that means it would not be obligatory. It would be considered an out of school activity. I think this would be much better.'

Regardless of the consistent criticism of typical lessons and the heterogeneity of views on the ideal lesson, pupils did report positively about one important and specific feature of this subject that differentiates it from all others in Croatian education:

'I like when we talk about issues. When we discuss and state our opinions. When RE lessons are more like discussions, I can say I like the subject although I do not necessarily agree with everything the teacher says. When we just learn the content, it gets very boring.'

This appreciation of a dialectic approach to teaching, and an expressed wish for more of it, was offered repeatedly by many pupils:

'I would like us to discuss more, like we sometimes do, about religious issues and others. But discuss and not to tell us 'this is like this, that is like that'. I don't like that. I hate when they (Church a.n.) state the rules, like they are the most important.'

From the above quotes, it is evident that pupils enjoy open discussion as an interesting, novel and beneficial element to school lessons, but one that is not prevalent in Croatian education. In contrast, the delivery of factual content seems much less appealing to pupils. It is also evident that pupils, in many cases, feel that RE is a subject that cannot be 'learned' in the traditional sense:

'There is nothing to be learned. I mean if we had some nun who would be very strict, then you would need to memorise everything, but how can you learn to believe.'

The qualitative phase of the research also examined pupils' perceptions on the rationale behind the inclusion of RE in Croatian education. On this issue, pupil responses differed significantly both individually and along the lines of the prescribed groups. Positive answers included statements such as '*in order to know our faith better*', *'to become better believers and individuals*', *'to get a closer connection with God'*, and *'to learn about our and other religions*'. In contrast, negatively framed attitudes were related in responses such as *'it should be kicked out of school'*, *'because Church said so'*, or *'I don't know'*: Perhaps the most compelling response illustrating a negative attitudinal stance towards the inclusion of RE in schools came from the following pupil interview:

'I: What would you say, why is RE taught in schools?
P: I don't know and I will never get it.
I: But you still attend RE classes?
P: Because of my parents, they told me to do it and that is what I do. Same is with Church where I need to go every Sunday.
I: Do other pupils think similarly?
P: Yes, a lot of them do. There is just a few of us from the class that regularly go to Church. Others do not seem to be interested.'

Clearly, the qualitative data revealed a number of complex and significant issues underlying pupils' attitudinal positions towards RE, which will be further examined and discussed later in the chapter.

5.2.5.3. Group differences

MANOVAs were performed to investigate the influence of gender and academic achievement on 8th grade pupil attitudes towards RE. MANOVA testing indicated statistically significant differences between genders ($F=5.61$; $df=5, 192$; $p<0.01$, Wilks' Lambda=0.87), with girls giving more positive estimations. The academic achievement variable ($F=1.29$, $df=10, 374$; $p>0.05$;

Wilks' lambda=0.93) did not show statistical significance on the combined dimensions of RE.

Girls gave higher estimations than boys on all dimensions. However, statistically significant differences amongst boys and girls were reached only for the comprehensibility (F=8.86, df=1,196, p<0.01, r=0.21) and difficulty (F=24.33, df=1,196, p<0.001, r=0.34) dimensions. Although the difference on both of these dimensions is highly significant, this significance is somewhat overshadowed by the extremity of the estimations for both genders on both dimensions. In other words, while girls' estimations on these dimensions are significantly higher, suggesting that they perceive the subject to be even more understandable and easy than boys, these estimations must be contextualised by the fact that boys similarly perceive the subject to be both easy and understandable. The reason for the difference is most likely due to the different response patterns between the two genders, where girls seemed to be generally less critical in their estimations. The estimated means of both genders for all attitudinal dimensions for RE are presented in Figure 5.12. While confirming the differences between boys and girls, this graph also exposes the striking divide between pupil estimations on two groups of dimensions. Namely, while RE is rated by boys and girls to be both easy and understandable, both groups rate the subject significantly lower on the other three dimensions, including importance and usefulness.

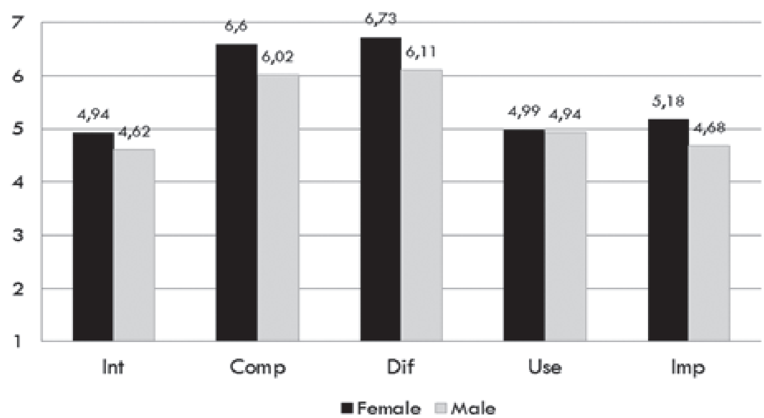

Figure 5.12: Estimated dimensional means for RE (Gender comparison)

As stated, there was no main effect for the academic achievement variable and univariate statistical significance was reached only on the interest dimension (F=3.16, df=2,191, p<0.05, r=0.18). The estimated means for all groups of pupils on all five dimensions are presented in Figure 5.13

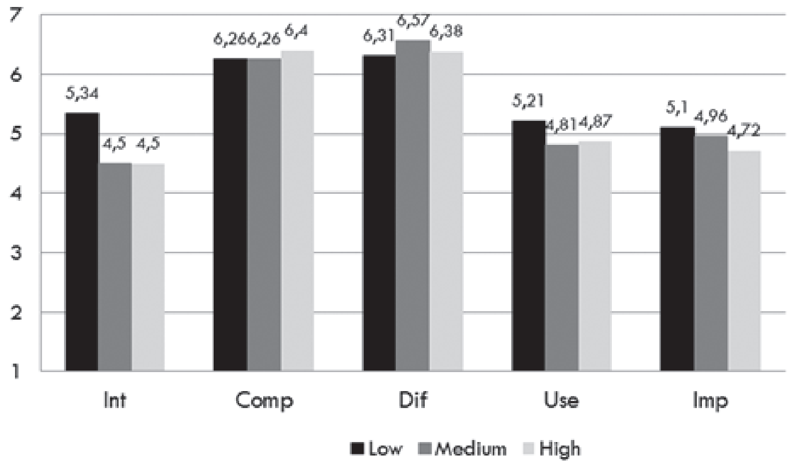

Figure 5.13: Estimated dimensional means for RE (Achievement comparison)

Here, Duncan's post hoc test revealed that the lower achieving group differs from the other two groups in their estimations of perceived level of interest, where the lower achieving group gave the highest estimates. There are several possible reasons for this difference, the most plausible one related to the lenient manner in which this subject is assessed. Arguably, RE is a subject that gives lower achieving pupils some confirmation of their academic abilities. It might further be argued that, under these circumstances, pupils make the implicit connection between the belief that *'I am good at RE'* and therefore *'RE is interesting for me'*. Another interesting, although not significant, feature is the higher estimates given by the low achieving group on the importance to future life and usefulness for present life dimensions.

5.2.5.4. RE: A summary

Quantitative data indicated that RE is perceived by 8th grade pupils as both very easy and comprehensible subject, yielding medium levels of interest, usefulness to present and importance for future life. Both data phases indicated limited gender differences and no difference in attitudes regarding academic achievement. There was a significant difference in attitudes towards the subject with respect to the science/religion profile of the pupils. While the attitudinal patterns of the three science subjects were conceptualised within a framework of influences due to abstractness, connection and relevance to pupils' everyday life and foundation in mathematics, the case of RE requires a different set of factors to understand and explain pupils' unique attitudinal patterns. Through a deep deliberation of the results, three factors emerged that might be argued to be at the foundation of pupils' attitudes towards RE and that could be directly connected with the apparent discrepancy of results emerging from quantitative and qualitative data sets. These factors are the lenient assessment criteria specific to RE, the foundations of pupil attitudes towards RE in paternal and familial influences, and the phenomenon of teenage rebelliousness and a questioning of authority.

Lenient assessment criteria

The presented qualitative and quantitative analyses suggesting elements of positive attitudes towards RE is perhaps most accurately considered in the context of the distribution of pupils' grades for this subject in the seventh grade (Table 5.13).

Table 5.13: RE grade distribution (7th grade)

Grade	Percent of pupils
Sufficient (2)	0.5
Good (3)	3.0
Very Good (4)	13.3
Excellent (5)	83.2

This table reveals the extremely skewed nature of grades, with nearly all pupils achieving the two highest possible marks. It might be argued that this distribution is indicative of, among other things, inadequate assessment practices in this subject or insufficient specification of outcomes that would enable better differentiation of pupils' achievement. What is certain, however, is the fact that the presented distribution is endemic in Croatian elementary education and completely incomparable with the distribution of grades for the three scientific subjects. Perhaps the most significant issue tied to this skewed distribution is the fact that, in calculating GPA, the achieved grade in RE is assigned equal importance to those grades from any other subject. It might further be argued that this situation contributes to a feeling amongst pupils that RE is *'an easy A'*, serving to enhance overall GPA, thus giving this subject instrumental value for pupils, primarily in relation to enrolling in secondary education. Pupils' responses in interview confirm these assumptions, as illustrated by the following comments:

'After all it's an easy A. Regardless of what you do, how you behave, if you really believe or not, you get an A.'

'I don't know anyone who doesn't have an A, I mean everyone knows he is going to get an A and it's already calculated in his GPA.'

This sentiment is also confirmed in the words of the first teacher:

'Most of the pupils have good grades. I mean it is not like mathematics, mother tongue or chemistry...We are instructed not to be strict about grading. But there is an opposite side to it, because everyone now expects to get an A and that might be a problem for us in the future.'

This notion of lenient assessment criteria is further amplified in the words of the second RE teacher:

'You know what would happen if I start giving 'real' grades? Riots. First pupils would go crazy, and then parents would say: Who do you think you and your sub-

ject are? But then curiously, also the Croatian Bishops Conference would say that this is negative for the Church's mission.'

When further probed about the influence coming from the Bishops' Conference, this teacher stated:

'As a teacher of Catholic RE, I can partially understand it, but as a teacher in general I think giving everyone an A is wrong and makes my work even harder. What can I say or do if I or pupils see Bishop X, the Director of Catechesis, on television saying that no pupil can have a negative grade in RE?'

It seems evident that permissive assessment criteria represent a positive element for a certain number of pupils. Furthermore, the sentiments expressed by both RE teachers suggest that this condition of lenient assessment is a decisive feature of RE recommended by the bodies that conceptualise and implement the subject.

Parental influence

Pupil attitudes towards RE are in many ways multifaceted and cannot be explained solely by its educational features. Unlike any other subject, confessional RE is inherently connected with the inclinations towards a religious worldview and the religious practices of a pupil's family. Arguably, exposure to Christian values and the practical aspects of belief have a direct influence on pupils' attitudes towards RE, a sentiment explained by the first RE teacher:

'Interest is mainly connected with the family. If the parents are religious, go to Church and respect tradition then the child will also be motivated to learn about his own religion and be more motivated and better in RE.'

For many parents, the incorporation of Christian values and the teachings of the Catholic Church to which they belong is an appropriate platform for their children's development. For these parents and their children, the connection between influences of the home and RE might seem like an appropriate reinforcing combination. While this notion of heightened parental influence on pupils' attitudes might be somewhat expected, more surprising are teachers' doubts about the impact of educational influence:

'Sometimes I wonder if I can change anything with my teaching. It seems that these things are set in advance and it is questionable what can be done through educational practice.'

Both increased paternal influence and the limited impact of educational practice pose grave implications for the delivery of RE, while also prompting wider societal questions. As stated, in Croatia, nearly 90 percent of the populace identify themselves as Catholic, a fact clearly reflected in the high attendance of confessional RE. These indicators of high affiliation and attendance are often used as support for the appropriateness of including confessional RE in mainstream education. However, responses from both RE teachers and pupil questionnaire responses reveal that religiosity and Catholic affiliation cannot be considered in the purely dichotomous terms of belief vs. non-belief, but rather that affiliation and belief vary substantially according to each person's level of religiosity. Thus, it should not be surprising that some pupils enrolled in RE are less or not religious at all or participate for reasons other than a concern for their religious and personal development in a specific confession. Indeed, parental influence on pupil attitudes can also occur in a negative direction, where parents hold no Catholic belief but nevertheless enrol their children in RE[56]. As one RE teacher comments:

'Parents enrol their children in the first grade in RE because they are some kind of Catholics, because all other pupils are attending and they are afraid that their child will be stigmatised if he or she does not attend…but it is very questionable what kind of believers they are and what kind of behaviours and values they themselves show to their children. You know, nowadays everyone states he is a Catholic, but at times I wonder if that is true.'

56 This prompts the even more complex question of the rationale of these parents, who have neither belief nor respect for the teachings of the Catholic Church, to enrol their children in confessional RE.

Teachers further reported they experienced difficulties motivating pupils from such families. In general, both pupil and teacher reports seem to confirm the crucial influence of parents on not only the nature and intensity of pupil religiosity, but also on pupils' attitudes towards RE.

Adolescent questioning of authority

Throughout the qualitative data, there were also clear indications of pupil rebelliousness towards the teachings of the Church, a factor that undoubtedly exerts an influence over attitude formation:

'I care about God and I do believe in him, but the Church and this stupid RE I cannot stand. I ask her why I can't watch a movie that speaks critically about God and she answers because it's a sin. What sin is it to watch a movie? Who determines that? It is all so stupid.'

This notion of rebelliousness and confrontation with authority was reiterated by one of the RE teachers:

'When they are young, like 5th or 6th grade, then they are so much better and it is easier for me to teach. Later, already in the 7th grade, when they start to question things, then it is much more difficult. They are all about how the Church is lying. How could this priest be rich and preach something else? Why is God not helping people in need? They become much more doubtful and in many ways negative.'

While lenient assessment criteria and paternal influence on pupils' religiosity can potentially contribute to an affirmative stance towards Catholic RE, this teacher's description of pupil attitudes towards RE, the Church and its teachings offers a more critical perspective. These points will be further considered in the next chapter in a discussion on the nature of pupils' belief and religiosity. To summarize, the attitudes and experience of 8th grade pupils towards RE seem to be defined by three separate elements coming from different sources. The first and primary influence is the exposure to religious sentiment and values from their families. Secondly, pupil attitudes are affected by their own personal development and a growing ability to critically observe the world around them. Finally, the methods through which RE is delivered and assessed also serve as strong contributor to pupils' attitudes. However, although this influence can modify pupils' attitudes and experience, it seems that the other two elements are dominant.

Another goal of the present research was an exploration of the attitudes and experience of 6th grade pupils towards RE and nature, together with their preconceptions of chemistry and physics, subjects to which they will be introduced in the 7th grade. This data was also used to compare the attitudes and experiences towards nature/biology and RE between both cohorts. As indicated, nature, a subject attended by 5th and 6th grade pupils, is predominantly composed of concepts and materials further elaborated in biology in the 7th and 8th grades. These subjects are also connected by the fact that, in nearly all cases, they are taught by the same teacher. This was also the case in the school participating in the qualitative phase of the research. As such, it seemed appropriate and worthwhile to compare attitudes towards nature and biology as part of an examination of the differences between cohorts. Finally, the 6th graders' preconceptions of chemistry and physics were compared with the attitudes towards these subjects of 8th grade pupils. This comparative analysis will be preceded by an in depth consideration of 6th grade pupils' attitudes and experiences towards nature and RE, as well as a deliberation of group differences and pupils' general estimates of these two subjects. This will be followed by a comparison of attitudes towards nature/biology and RE between cohorts. Finally, the substantial discrepancy between younger pupils' preconceptions of chemistry and physics and the attitudes of older pupils towards these subjects will be discussed.

5.2.6. Nature

'Nature, hmm nature has some good and some bad sides too. Sometimes (dependant on the content), it's not difficult at all but at times it can be boring, regardless of the difficulty of content. I think that, without considering if it is good or not (let's leave aside now that half of it does not interest me) we must know this content (now in the 5th grade) because it is general knowledge, but it should be shortened and made more simple so those with lower grades can get better grades. This will for sure change once we get to higher grades as there will be even more 'unnecessary' content.'

This research diary excerpt came early in the research when pupils were in the 5th grade, and reveals a reserved stance towards nature. As the research progressed and pupils moved to the 6th grade, the subject evoked more positive reactions from pupils:

'Nature is not difficult, nor easy. There are some things that we need to study, but there are also things we can remember during the actual class. I personally find it interesting, as I think many in my class do.'

Pupils' responses in both qualitative and quantitative data sets revealed highly homogenous attitudes towards nature. Qualitative data suggest that pupils held a generally positive view of both the subject and the respective teacher, where responses often resembled those from their older colleagues regarding biology. The quantitative data triangulated with these findings, as is indicated by the means of pupil responses on the five attitudinal dimensions presented in Figure 5.14.[57]

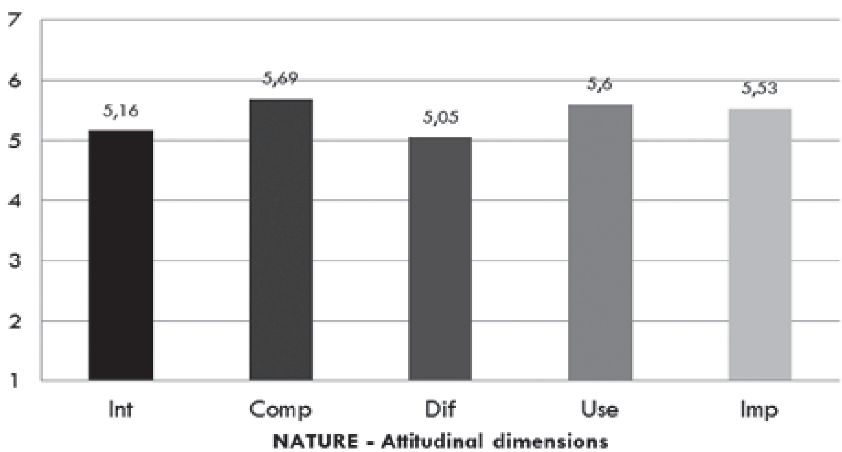

Figure 5.14: Dimensional estimates for nature by 6th grade pupils

[57] Once again, it needs to be emphasised that this and other figures are just for illustrative purposes and serve as an organising device for the reader.

As with biology, the results in this graph depict a positively perceived subject on all researched dimensions. Namely, nature is perceived as an interesting, comprehensible subject that still incorporates significant elements of demand on pupils. Furthermore, pupils believe the subject to be considerably useful for their everyday life as well as important to their future life.

This attitudinal pattern was confirmed by the qualitative data, which also allowed for a deeper exploration of the particular fields of pupils' interest, as well as the rationale behind their attitudes. Although pupils seemed to find nature interesting in general, they varied in which particular aspects were central to their interest. Initially, pupils gave dichotomous answers when asked about the content they find most interesting, as illustrated by these two contrasting positions:

'There are some boring parts, for example, when we learned about the petal and root. I didn't find it very interesting, but I liked when we learned about humans and our body. It was more about me.'

'I did not like it when we learned about the human. It was difficult and I thought that it was more interesting when we learned about the flower.'

As interviews progressed, and most especially when participants entered the 6th grade, the appeal of content about their own body became even more prominent. Perhaps the reason for the apparent discrepancy in initial interests was connected with the developmental stage of pupils in the 5th grade, where pupils entering adolescence and puberty are more likely to be interested in content concerning their own body and its changes. This is best explained in the diary entry of one pupil:

'For example, I find the content on puberty extremely useful for us, because some are approaching this period and some are still not there but soon will be. Still I do not get why we need all that knowledge on stem, root, petal…'

Regardless of the focus of pupil interest, two extremely positive notions emerged from the qualitative data. First, it seems pupils approach nature in a systematic manner and study its content in a more meaningful way than is the case for other subjects:

'Technical education and mother tongue you need to learn by heart and just memorise and mathematics you can't really rote learn. Nature is different in that if you pay attention it is easier to understand and learn.'

Others expressed a similar sentiment stating that the subject is *'comprehensible'*, *'you can learn it during the lessons'*, and *'it's interesting, so it is easier to learn'*. This characteristic is directly connected with the subjects' elevated levels of comprehensibility.

A wish to search for additional information on what has been learned in nature is the second positive notion drawing directly from the one presented above. According to pupils, nature is one of few subjects in which they proactively search for further information on the content they have covered in school:

'Sometimes when we learn about animals in school, when I come home I want to know more about it. Then I read my encyclopaedia or talk to my Mom about it.'

However, despite these positive attitudes, pupil responses also include certain negative elements. First, it seems that younger pupils experience difficulty with the scientific terminology on which this subject relies:

'In nature there are lots of strange terms that I find hard to understand and that confuse me. Mom, at home, makes all these much clearer for me. She explains it all to me like some story and then I understand more and it's easier to memorise.'

This sentiment was echoed in the answers of other participants and was named as a central negative point that consequently lowers interest in the subject, raises its difficulty and, most importantly, changes pupils' learning approach. Namely, due to the incomprehensibility of the covered terms, pupils report being forced to rote learn the definitions of the taught concepts:

'When she tells me that the intestinal system of the cow consists of this, this and this…then I need to know it. And then you have to study and memorise.'

The second problematic characteristic emerging from pupil answers is a narrow articulation of the rationale for the inclusion of nature in the curriculum. When asked to offer an opinion on why nature was taught in the 5th grade, responses were generally quite limited:

'I guess so that we get to know the human body and plants around us.'

'In order to become more expert in this field, so that is easier for us…e.g. when we go hiking to recognise plants and know which plant or mushroom is poisonous.'

Other answers also confirmed this very practical orientation of participants:

'For work, if you are going to be a forester or lumberjack and so you know something about nature and not to be like some weirdo or something.'

Some responses revealed that pupils did not always see any rationale behind the inclusion of this subject in the curriculum:

'I don't know. Especially you do not need it if you are not living in a village.'

The majority of the above responses are a direct effect of the specific subject content in the lower grades, which focuses on plants and animals. By the 6th grade, pupil conceptualisations concerning the inclusion of nature in the school curricula become more complex. However, regardless of the specific content, pupils' inability to contextualise subject content into the framework of personal relevance and instrumentality might restrict the development of positive attitudes towards nature.

When reflecting on teaching practices, participants indicated generally positive feelings regarding both the teacher and course delivery. In their comparisons of typical and ideal lessons, they largely reported the existing lessons to be close to ideal:

'My ideal lesson is exactly like the typical one we have in our school. We have fun and we learn some things. Before the test we revise.'

However, pupils stated two elements for improvement. Somewhat expectedly, pupils expressed a wish for less examination, as illustrated in this research diary entry:

'In nature most of it is ok, but if only she would not assess so much.'

Secondly, like their older colleagues, 6th grade pupils voiced a wish for more experimentation in lessons:

'Our typical lesson is: learn new lesson, fill in the workbook, sometimes we do an experiment. My ideal lesson would be: learn new lesson, discuss the new lesson, do several experiments. The difference is in the fact that there would be more experiments.'

5.2.6.1. Group differences

As with the older cohort, a MANOVA was conducted in order to determine the effects of the gender and academic achievement on 6th grade pupils' attitudinal framework towards nature. MANOVA procedures did not result in statistically significant effects for gender ($F=2.15$, $df=5, 206$, $p>0.05$, Wilks' Lambda=0.95) and academic achievement ($F=0.833$, $df=10, 402$, $p>0.05$, Wilks' Lambda=0.96).

The estimated means for both genders are presented in Figure 5.15.

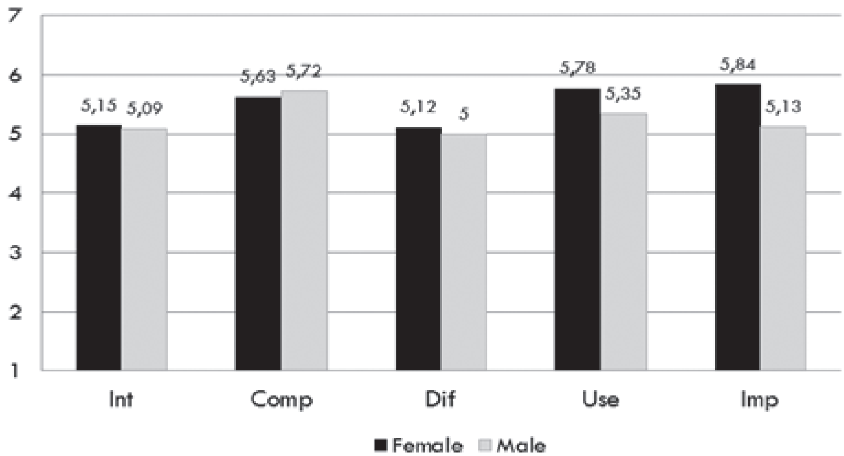

Figure 5.15: Estimated dimensional means for nature (Gender comparison)

Univariate ANOVAs for each attitudinal dimension revealed that the only significantly differing estimate between genders is on the importance to future life dimension ($F=8.696$, $df=1,202$, $p<0.01$, $r=0.19$), where girls perceive the subject to be more important than boys. The only other dimension with a clear pattern of difference was girls' higher estimations of the usefulness for present life. The estimations between genders for all other dimensions did not yield any trends or statistically significant differences. Pupil responses from the qualitative part of the research suggest various possible explanations as to why nature seems more salient for girls at this stage. Namely, the perceived importance of the subject might be connected with the aforementioned difference in interest in learning about the human body, which was more characteristic of girls participating in the qualitative phase of the research. It seems that girls, entering puberty somewhat earlier than boys, perceive the subject content dealing with these topics to be more relevant and salient:

'It is important because we learn some things that are happening to us and all these changes we are going through. That is why I think it is maybe more important than some other subjects.'

Perhaps more noteworthy is the finding that groups of differing academic achievement levels did not differ in their expressed attitudes towards nature, as illustrated in Figure 5.16.

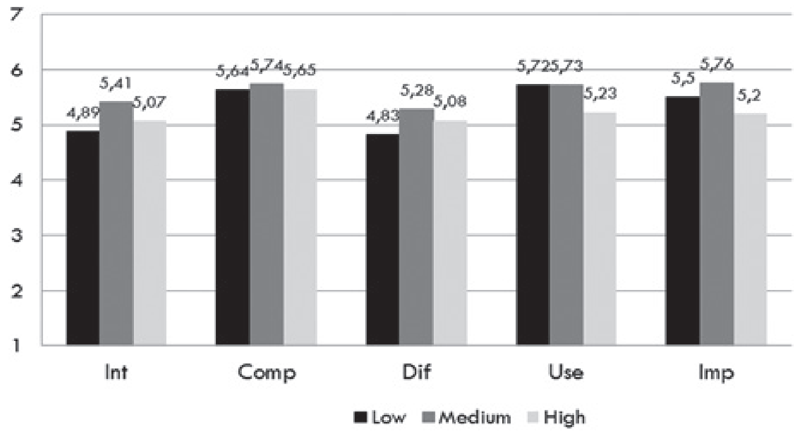

Figure 5.16: Estimated dimensional means for nature (Achievement comparison)

This is especially surprising in light of the fact that nature retains a certain level of cognitive demand, as expressed by pupils' estimations of subject difficulty. As such, the absence of any significant differences on this variable is a strong indicator of the generally positive position of nature in pupils' attitudinal schema.

5.2.6.2. General nature related estimates

General nature related estimates are presented in Table 5.14.

Table 5.14: General pupil estimates - nature

Grade	Subject content	Teacher		Number of hours
1 (Insufficient)	3.3	14.0	Lower	29.6
2 (Sufficient)	7.4	14.0	Keep the same	46.8
3 (Good)	23.2	13.9	Increase	13.9
4 (Very Good)	36.3	21.4	Eject	9.7
5 (Excellent)	29.8	36.7		

There were no statistical differences in pupils' estimation of the subject content, teachers and number of teaching between genders and groups of academic achievement, confirming pupils' generally positive perception of nature established through attitudinal measures.[58]

5.2.7. Religious education (6th grade)

'There are things that are interesting, but most of the time it is not sooooo interesting. Most of the things we learn I get immediately, but there are also some parts which you can't get instantly. Most of all it's an easy subject where you do not have to study. I find it useful for my present life and important for my future life because it is good to believe in God.'

The above diary excerpt captures the attitudes of younger pupils towards RE as expressed in the qualitative data. Analysis indicated that pupils generally perceive RE in terms of two characteristics: level of demand and its mission and purpose. The former, which characterises RE as a dominantly easy subject, was also present amongst the older participants. What became more apparent in this cohort was the highly homogenous views on the rationale for including RE in the school curricula and the personalisation of pupils' choices for attending RE, both of which had an impact on expressions of the personal relevance of RE:

'I think it is an important subject because you need to know how to pray and our faith in God makes our lives more beautiful.'

'For me it is important to get an honest, sincere relationship full of love towards God and other people because a good is returned with good.'

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58 Gender: content ($U=5261.5$, $z=1.15$, $p>0.05$, $r=0.08$); teacher ($U=5436.5$, $z=0.74$, $p>0.05$, $r=0.05$); teaching hours ($\chi^2=3.61$, $df=3$, $p>0.05$, Cramer's $V=0.13$)
Academic achievement: content ($H\ (2)=6.65$, $p>0.05$); teacher ($H\ (2)=6.54$, $p>0.05$); teaching hours ($\chi^2=5.88$, $df=6$, $p>0.05$, Cramer's $V=0.12$)

Questionnaire responses of 6th grade pupils similarly revealed a positive attitudinal scheme towards RE, as presented in Figure 5.17.

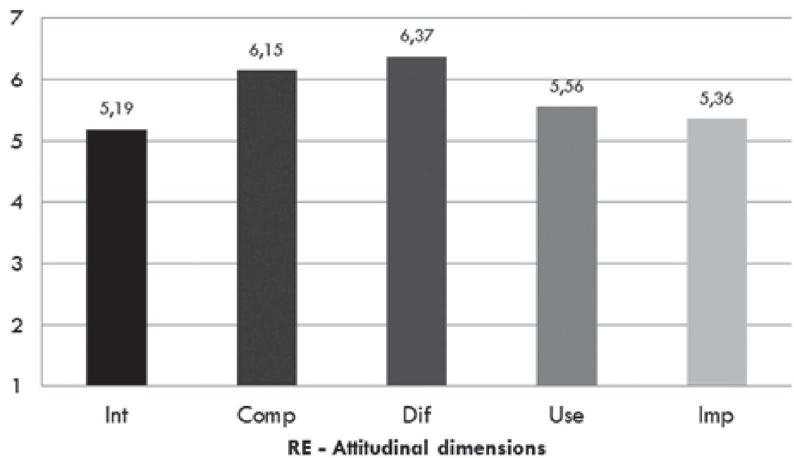

Figure 5.17: Mean dimensional estimates for RE (6th grade)

RE is predominantly evaluated as easy and comprehensible. Pupils also perceive it to be useful for present life and important to future life. In addition, it is perceived to be moderately interesting, even though the mean estimate is lowest on this dimension. Qualitative analyses confirmed the notion of low demand placed on pupils, illustrated in the words of this pupil:

'I mean, it's really stupid to have anything less than an A in RE. I don't know anyone who has less than an A, but he or she has some serious problems.'

This idea, repeated by a large majority of participants, was amplified by a confirmation of the lenient assessment criteria and questionable assessment practices of the first RE teacher:

'She gives us both questions and answers and never asks orally, so whoever can't get an A, in my opinion, is an idiot.'

The significance of this lenient assessment became even more apparent when, in the 6th grade, the second RE teacher introduced a stricter work ethic and more realistic assessment. Most of the pupils from the younger cohort reacted with passion, as indicated by the following interview excerpts:

'Who does she think she is, a math teacher? I mean, c'mon it's RE'.

'She is nuts, she gave us a 5 minute test for nothing. That could not be possible with the old teacher and now we do not have as much fun as before.'

This collective shock, lasting several weeks, resulted in a sudden dissatisfaction with the subject:

'If this lasts a bit more I will quit, I swear. No more RE for me then.'

However, this resentment was short-lived: once pupils adjusted to the practices of the new teacher, they agreed that the level of difficulty had not changed substantially:

'She's OK now, we behave a bit better and she doesn't give us these blitz tests and everyone has an A.'

Unlike the perceived level of difficulty, a more discrepant feature of the two data sets was pupils' assessment of the comprehensibility of RE. At first, as was the case in the older cohort, pupils related comprehensibility with reduced levels of demand, thus proclaiming RE to be very understandable. Soon after, however, pupils discussed specific concepts and elements of the content that they found difficult to comprehend. In the fifth grade, one element clearly posing a problem for some pupils was the historical perspective of the subject content. Here, students expressed difficulty in properly envisaging the topography and chronological timeline of the materials covered in RE:

'RE has Before Christ and After Christ, it has Old Testament and New Testament. I don't know, it seems a bit complicated.'

And,

'RE is comprehensible because there is not so much philosophy there. Although it is hard to know when and where someone was born, where things happened, etc...'

Other pupils discussed more substantial and complex elements as challenges to their understanding:

'I: Is there anything in RE which is not comprehensible to you?
P: Yes. For example how was the world created? It's all very weird to me that you get something out of nothing.'

This is repeated in the words of another pupil:

'I never really believed in the story that a man was created suddenly and that God took a part of him and created other things. And where is this Garden of Eden? And one more thing, I do not want to ask RE teacher anything because she acts like she has the collected brains of the entire world.'

These excerpts seem to suggest that, at the core of this incomprehensibility lies an inability to either understand or accept the teachings of the Catholic Church in literal terms. Both of these ideas are crucial to the present work and will be covered in the following chapters.

It was also evident from the interviews that, although younger pupils perceived it as easy and personally relevant, this subject did not yield equal levels of interestingness:

'Most themes are not interesting, very rarely there is something which I am really into.'

The answers of other pupils also suggested somewhat limited interest in the covered themes, which included statements such as *'I feel bored with the content'*; *'it is OK if we do not read from the textbook'* and *'it is only interesting* *when we discuss*'. In direct connection with the occurrence of incomprehensibility and limited interest is the notion that pupils have diverse interests in the materials covered in RE. Interviews clearly suggested that the main attracting point of the subject is the teaching about Jesus Christ:

'I especially like when we learn about Jesus and his actions and I do not like so much to learn about other apostles and religions.'

Most other pupils confirmed this notion, expressing an intrinsic and direct connection with the concept of Jesus. Other materials covered in RE seemed of less interest, which was especially evident in the teaching of other religions:

'It's OK when we learn about our religion because you need to know what you believe in, but why do we have to learn about other religions.'

Pupils' offered various reasons for why RE is relevant and salient to them. The most repeated answers were: *'it's a part of general culture'*, *'to know about your own religion and something about the others'* or *'to know who we are'*. In addition to these more collective determinants, some offered more content-based answers:

'We study RE in order to know how Jesus spent his days and what happened when he lived.'

Finally, several pupils explained the rationale for RE in terms of the personal benefits of faith:

'It is always good to believe in something because faith gives us hope in difficult moments.'

And:

'It is very useful for me because I pray when it is hard for me.'

It is interesting to note that, when this group discussed RE, most explanations were void of the criticism and personal voice characteristic of the older cohort. As such, their explanations for the relevance and salience of the subject more closely resembled the programmed message communicated to them through the course content or the attitudes of their parents than their own voice. This was especially apparent when topics out of the educational context were discussed.

5.2.7.1. Group differences

MANOVAs did not yield statistical significance for the main effects of gender (F=1.79, df=5, 205, p>0.05, Wilks' Lambda=0.96) and academic achievement (F=0.84, df=10, 400, p>0.05, Wilks' Lambda=0.96) on 6th grade attitudes towards RE. Additionally, none of the univariate ANOVA's produced statistical significance on any of the dimensions for gender. The mean estimates presented in Figure 5.18 confirm this point.

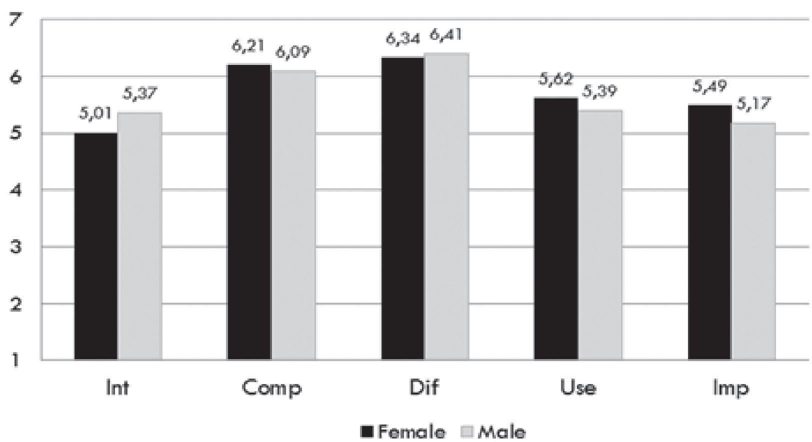

Figure 5.18: Estimated dimensional means for RE (Gender comparison 6th grade)

Here, the very limited difference between girls' and boys' attitudes towards RE is readily apparent. The same is observable in Figure 5.19 for the three academic achievement groups.

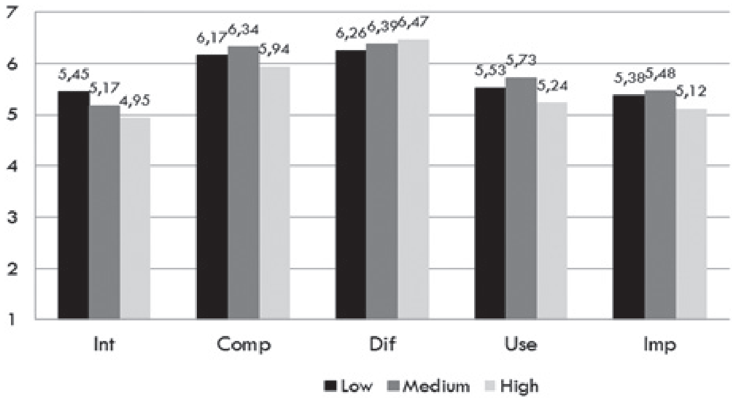

Figure 5.19: Estimated dimensional means for RE (Achievement comparison 6th grade)

Once again, there were no statistical differences between all three academic achievement groups on any of the attitudinal dimensions regarding RE.

5.2.7.2. General RE related estimates

General RE estimated means are presented in Table 5.15:

Table 5.15: General pupil estimates – RE (6th grade)

Grade	Subject content	Teacher		Number of hours
1 (Insufficient)	2.8	6.0	Lower	22.0
2 (Sufficient)	9.8	13.0	Keep the same	50.9
3 (Good)	11.1	13.9	Increase	20.1
4 (Very Good)	29.8	19.4	Eject	7.0
5 (Excellent)	46.5	47.7		

Presented frequencies indicate pupils gave the subject's content and teachers considerably high grades. On none of these estimates was there a significant difference between genders and academic achievement groups.[59]

[59] Gender: content (U=5395.5, z=0.87, p>0.05, r=0.01); teacher (U=5364, z=1.05, p>0.05, r=0.04); teaching hours (χ^2=4.25, df=4, p>0.05, Cramer's V=0.13)
Academic achievement: content (H (2)=3.81, p>0.05); teacher (H (2)=0.30, p>0.05); teaching hours (χ^2=4.40, df=8, p>0.05, Cramer's V=0.14)

5.2.8. Comparison of RE and nature amongst 6th grade pupils

The results presented in Figure 5.20 depict dissimilar features in the patterns amongst the estimations of 6th grade pupils on all researched dimensions for RE and nature.

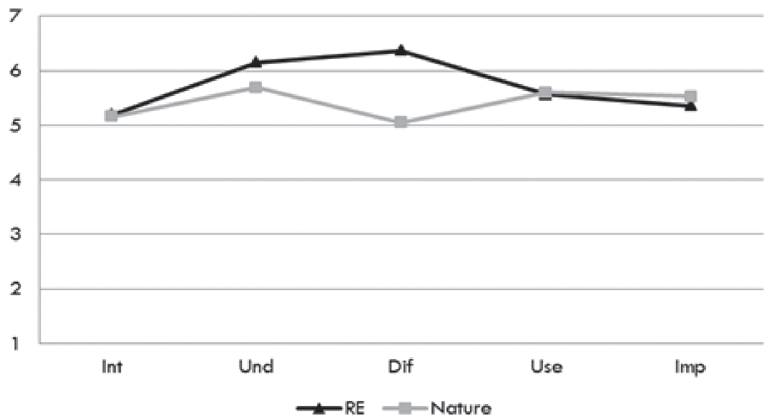

Figure 5.20: Comparison of dimensional estimates: RE vs. nature

Here, the non-parametric procedure of Wilcoxon signed rank test was applied. Expectedly, RE is perceived to be significantly more comprehensible ($z=2.53$, $p<0.01$, $r=0.15$) and less difficult ($z=8.14$, $p<0.01$, $r=0.40$) than nature. On all other dimensions, there were no statistically significant differences.[60] This further confirms pupils' generally positive attitudes towards both subjects and is in stark contrast to the paired comparisons in the older cohort, where biology was perceived significantly more positively than RE on all three other dimensions. In the following section, the difference in the perceptions and attitudes of the two cohorts on all subjects of interest will be discussed.

60 Interest ($U=21892$, $z=0.50$, $p>0.05$, $r=0.03$); Usefulness ($U=21237$, $z=0.69$, $p>0.05$, $r=0.03$); Importance ($U=21543$, $z=1.47$, $p>0.05$, $r=0.07$)

5.3. COMPARING ATTITUDES BETWEEN COHORTS

A comparison of the two cohorts' attitudes towards school subjects will be presented in three parts. First, the differences in attitudes towards biology and nature will be presented and discussed. This will be followed by a consideration of the discrepancies in perceptions towards RE. Finally, the difference between the attitudes of younger pupils towards chemistry and physics prior to experience with the subjects and the views of older pupils' views after a year and a half of experience with these subjects will be reviewed.

5.3.1. Comparing biology and nature

Some interesting results arise when the perceptions of 8th and 6th grade pupils towards biology and nature are compared. Figure 5.21 indicates cohorts differ significantly in their perceptions concerning the comprehensibility ($U=18252.5$, $z=3.24$, $p<0.01$, $r=0.16$) and difficulty ($U=18117$, $z=3.28$, $p<0.01$, $r=0.16$) of these subjects.

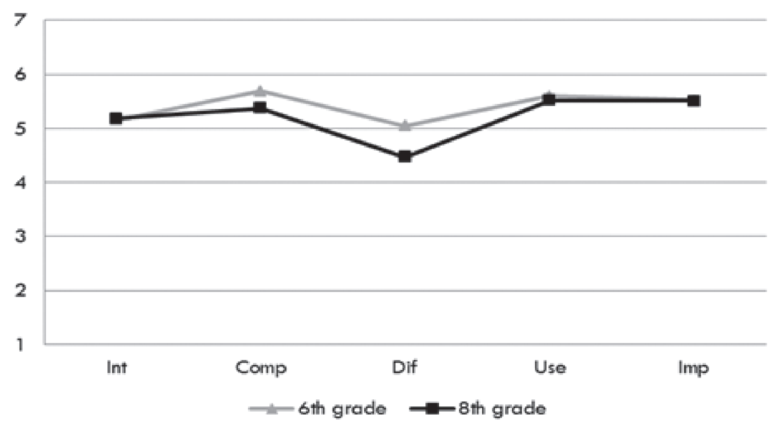

Figure 5.21: Comparison of dimensional estimates: 8th grade biology vs. 6th grade nature

Specifically, 8th grade pupils perceive biology to be more difficult and less understandable than do 6th grade pupils of nature. Although both subjects are similar in their aims, biology is more specific in its content than nature, probing more complex issues and, as such, posing a greater challenge to pupils. However, this difference should be considered with caution in light of the fact that no further statistically significant differences occurred for all other dimensions. In addition, there were no significant differences in pupils' general estimates of the subjects (z=0.973, ns, r=0.04) and teachers (z=1.06, ns, r=0.05). Furthermore, pupils' estimates of the number of teaching hours devoted to each subject suggest that it is in fact older pupils who hold a more positive perception of biology than do younger pupils for nature, as chi square testing revealed a statistically significant difference in attitudes towards teaching hours (χ^2=11.72, df=3, p<0.01, Cramer's V=0.24). Specifically, a greater percentage of older pupils hold the opinion that the teaching hours devoted to biology should remain the same or be increased, further affirming the positive position of the subject.

The suggestion of a more positive attitude amongst the older cohort towards biology than that of their younger colleagues towards nature is confirmed in the qualitative data, where the responses of older pupils revealed higher levels of enthusiasm for biology than younger pupils' views of nature. Among the multitude of factors that might have influenced this difference, the specific content covered in biology appears to be better fitted to the interests and experiences of pupils, thus contributing to more highly positive attitudes amongst the older cohort. This is confirmed in the words of the biology teacher:

'To me, biology seems better adjusted and tuned than nature. In nature there is a lot of emphasis on Botany and Zoology, which can at times be too much for younger kids. As a teacher, I also prefer to teach the curricular content of the 7th and 8th grade and I think pupils absorb it better.'

5.3.2. Comparing attitudes towards RE

A comparison of the quantitative estimates of 6th and 8th grade pupils reveals a complicated and very interesting picture regarding the cohort difference in attitudes towards RE, as illustrated in Figure 5.22.

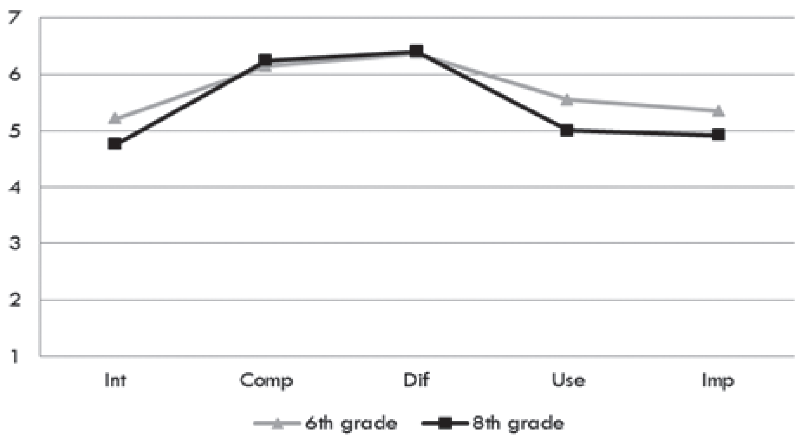

Figure 5.22: Comparison of dimensional estimates for RE – both cohorts

First, the cohorts did not vary in their general subject estimates.[61] Secondly, a comparison of both cohorts' estimations on the dimensions of comprehensibility and difficulty did not yield statistical significance. This is especially interesting with regards to the fact that the most extreme estimations from pupils were achieved on precisely these two dimensions, thus confirming the consistently low demand placed on pupils in all grades. More importantly, the results suggest that older pupils perceive RE to be significantly less interesting ($U=18649$, $z=2.03$, $p<0.05$, $r=0.10$), less useful for present life ($U=18175$, $z=2.81$, $p<0.01$, $r=0.14$) and less important to future life ($U=18996$, $z=2.46$, $p<0.05$, $r=0.12$) than their younger colleagues. In combination, these three elements suggest a drop in positive attitudes towards RE and in the intrinsic value of the subject among the older cohort. Indirectly, these results suggest that the dimensions most responsible for the overall grade of RE and its respective teachers are pupils' estimations of subjects difficulty and comprehensibility.

Various factors might have contributed to this cohort difference in attitudes. While the present research design has controlled for the variable of instructor as, in all cases, both cohorts inside a single school received RE lessons

[61] Subject content: $z=0{,}53$, $p>0.05$, $r=0.03$; RE teachers: $z=0{,}62$, $p>0.05$, $r=0.03$; teaching hours $\chi^2=1.08$, $df=1$, $p>0.05$, Cramer's $V=0.08$

from the same teacher, the elements that would seem to most significantly contribute to this observed difference are the curricular content at the two educational levels and the developmental stages of pupils. In the case of RE, an analysis of the curricular content for each cohort did not suggest the existence of any drastic divergence in the fit between content and grade.[62] Moreover, the responses from some of the older participants suggest that course content has generally stayed the same:

'In RE, I feel that every year we learn the same things over and over again.'

In addition, lenient assessment criteria and parental influence, as elements contributing to pupil attitudes towards RE, are equally present in both cohorts. As such, the primary element contributing to the cohort difference might be the differing level of pupils' cognitive, moral and emotional development. Indeed, the responses of the younger pupils often did not possess the personalised, and at times rebellious, perspective on RE present in the older cohort. Rather than channelling their own perspectives on the subject, this group offered responses more in line with what was expected from them. As the discussion in the following chapter will indicate, this is reflected not only in their attitudes towards RE but also in the nature of their own religiosity.

5.3.3. Physics and chemistry: Comparing preconceptions and experience

'I: Now in 5th grade you have nature. Do you know what you will have in the 7th grade?
P: Yes, chemistry I think and physics or something.
I: And what do you know about these subjects?
P: Not much, just that you do experiments, like in chemistry. And my sister in the 3rd grade of secondary says they are not easy. But I'm not afraid of these subjects.

62 The elements of this analysis are presented in Chapter Seven.

I: And how do you think these subjects will be?
P: I think chemistry will be difficult but fun and physics I don't know much about.'

In both research phases, the expectations and preconceptions of 6th grade pupils' towards physics and chemistry were assessed and compared to the attitudes of the older cohort towards these subjects. Arguably, the somewhat problematic situation depicted by the older pupils' attitudes towards subjects made this comparison even more necessary and interesting. In the quantitative phase, pupils attitudes were assessed on dimensions of perceived interestingness, comprehensibility, difficulty and importance, while the qualitative data allowed for an in depth exploration of the foundations of specific attitudes towards subjects. Arguably, without any direct educational experience with these subjects, pupils' conceptualisations and attitudes are based on information gathered through other formal or informal means. While such means often lack the systematisation characteristic of formal education, pupils' preconceptions represent an essential precursor to their reaction to these subjects once they are introduced to them in the classroom. In fact, it might be hypothesised that pupils' preconceptions would reflect those of the older cohort, where higher demand and lower comprehensibility yield limited levels of interest and importance. However, the results presented below suggest that this hypothesis is mostly incorrect.

5.3.3.1. Physics

The preconceptions of younger pupils towards physics could best be defined by a triad of perceived difficulty, limited knowledge and elevated interest. As such, pupils define physics as *'a difficult subject, much more difficult than the ones we have now'*, *'more difficult than chemistry because of all the formulas'* and *'a difficult subject which is connected with mathematics'*. In addition to being perceived as difficult, physics is also *'very interesting and fun'*, *'difficult but interesting (unreachable)'* and *'I hope that in physics we will learn something fun'*. Interviews and research diaries also indicated that most preconceptions are formed via older siblings, and more rarely through the media. As such, pupils in this group have a very limited knowledge of the subject upon which to base their opinions.

Quantitative results confirm the preconception of physics as a very difficult, incomprehensible but interesting and important subject to pupils' future life. A comparison of 6th and 8th grade pupil attitudes in Figure 5.23 reveals intriguing, though not completely unexpected, findings.

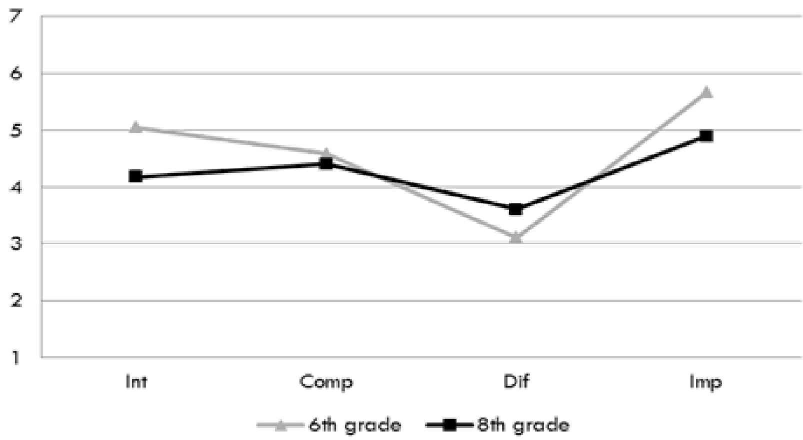

Figure 5.23: Comparison of pupil attitudes and preconceptions towards physics

Here, younger pupils perceive physics as more interesting ($U=16982$, $z=3.73$, $p<0.01$, $r=0.18$), more difficult ($U=17988$, $z=2.69$, $p<0.01$, $r=0.13$) and more important to their future life ($U=15537$, $z=4.47$, $p<0.01$, $r=0.24$). An analysis of the effects of academic achievement and most especially gender on 6th grade attitudes, which contributed greatly to differences among the older sample, revealed a lack of any differences on all researched dimensions[63].

These findings reveal several interesting points. First, they indicate that pupils hold generally positive preconceptions of physics prior to its introduction into systematic institutionalised teaching. Namely, they perceive it as an

63 Gender ($F=0.32$, $df=4, 197$, $p>0.05$, Wilks' Lambda=0.99)
Academic achievement ($F=1.15$, $df=8, 394$, $p>0.05$, Wilks' Lambda=0.96)

interesting and important subject, albeit extremely difficult. Secondly, and more surprisingly, there exists no gender difference amongst younger pupils, a feature that greatly marked the attitudes towards the subject amongst older participants. Finally, there is no difference in attitudes towards physics between pupils in different groups of academic achievement. As we will see, all of the aforementioned tendencies are even more evident in the case of chemistry.

5.3.3.2. Chemistry

'In chemistry we will conduct experiments and I can't wait 'til we get it.'

The above excerpt from a pupils' research diary might sound like a misquote after all the previous negative reports on the subject. Yet, the general sentiment arising from the qualitative data was that younger pupils held very positive preconceptions of chemistry. While it was predicted to be a demanding subject, it consistently appealed to pupils who made statements like *'I think it will be fun'*, *'I expect a lot from chemistry'* and *'I think this will be a good subject for me'*. The elements generating these positive preconceptions are clear and could be best defined in terms of pupil expectations for experimentation opportunities. This element, innately connected with chemistry, is graphically illustrated by the following research diary entry:

'Chemistry will be fun and interesting because of the chemical apparatus with liquids, and if you mix it wrongly then it will be boooooooooooooommmmmmmmmmm!'

Quantitative results depicting younger pupils' attitudes are even more surprising; suggesting that pupils predict chemistry will be an extremely interesting, important and comprehensible subject while also being highly demanding. As with physics, there are no statistically significant differences in pupil attitudes according to gender and academic achievement variables.[64]

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64 Gender (F=0.77, df=4, 196, p>0.05, Wilks' Lambda=0.99)
Academic achievement (F=1.07, df=8, 392, p>0.05, Wilks' Lambda=0.96)

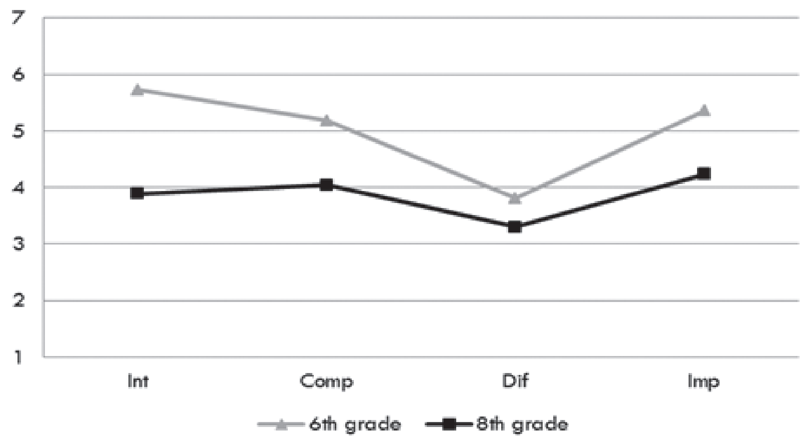

Figure 5.24: Comparison of pupil attitudes and preconceptions towards chemistry

A comparison of pupil estimates from the 6th and 8th grades provided in Figure 5.24 portrays a drastic and astonishing cohort difference. Here, younger pupils perceive the subject to be far more interesting ($U=10665$, $z=8.92$, $p<0.01$, $r=0.44$), more understandable ($U=15137.5$, $z=5.17$, $p<0.01$, $r=0.26$), less difficult ($U=17775.5$, $z=2.79$, $p<0.01$, $r=0.14$) and more important ($U=13323.5$, $z=6.31$, $p<0.01$, $r=0.31$).

The sheer magnitude of this difference demands special consideration. It has been previously argued that younger pupils' conceptions of chemistry should be taken somewhat cautiously in that they are most likely founded on ideas stemming from family, media, or cartoons. In fact, in the case of some pupils, this concept is completely non-existent. However, whatever the source and nature of the concept, perhaps most striking is the finding that the introduction of formalised education transforms attitudinal optimism, present in the 6th grade, into near despair in the 8th grade. Indeed, the questions that arise surpass the boundaries of the national educational context and border questions on the educational endeavour itself. Whatever the reasons for this attitudinal adjustment, and regardless of the nature and accuracy of concepts that pupils hold, such positive attitudes should be a starting point for teaching chemistry.

There are various possible contributors to such disparate views about chemistry and physics between the two cohorts. Firstly, there is the basic notion of experience, which would suggest that younger pupils have only limited experience with these subjects, whereas 8th grade pupils deal directly with all that is positive and negative about chemistry and physics on a twice-a-week basis. Secondly, and intrinsically connected with the first factor, is the limited knowledge with which younger pupils conceptualise these subjects. Thirdly, and most importantly, these results suggest that pupils' initially positive attitudes are diminished once they have actual experience with the subjects. Among other things, this plunge in enthusiasm might be indicative of problems with two educational fundaments: curricular content and the methods, techniques and practices used in teaching physics and chemistry. Arguably, the recorded attitudinal drop might indeed be due to inappropriate content in both subjects that fails to build upon pupils' enthusiasm along with the use of inadequate teaching methods which diminish rather than foster pupils' pre-established interest.

In this chapter, a thorough exploration of pupils' attitudes and self-expressed experiences towards school subjects has been presented. The results indicate complex attitudinal schemata both between, and even more so within, the two intellectual domains. Pupils' evaluations vary significantly with respect to cohort, gender and achievement. In the following chapter, pupils' conceptualisations, understandings and attitudes towards the more general concepts of science and religion will be examined.

CHAPTER SIX: PUPILS' CONCEPTUALISATIONS AND ATTITUDES TOWARDS SCIENCE AND RELIGION

The results and discussion presented in the previous chapter centred on pupils attitudes and experiences with school subjects. As such, the focus was on the educational context and issues associated with each respective subject. This chapter is devoted to an in-depth exploration of pupils' attitudes and understandings of the concepts of science and religion, individually and in relation with each other. As stated, some of the general aims of Croatian science and religious education are the development of an understanding and appreciation of respective domains. Through school subjects, the more general concepts of science and religion should arguably become tangible, comprehensible, attractive and transparent to pupils.

Due to several factors, it might be hypothesized that the two cohorts differ in the complexity and elaboration of their understandings and conceptualisations of these concepts. First, one would expect the older participants to be at a higher cognitive level than their younger colleagues, which would in turn contribute to the more complex nature of their attitudes and responses. Secondly, educational factors might also be expected to play a role in differing levels of pupil conceptualisations and understanding, most particularly in the case of science. At the time of the research, the older cohort already had a year and a half of experience with three separate scientific disciplines, where subject curricula incorporated lessons in which each individual scientific discipline was positioned into the wider scientific framework. In contrast, the younger cohort was being taught the generalist subject of 'nature'.

Although the concept of religion should be transparent to both cohorts, with younger pupils already having attended RE for five years, one educational element potentially contributes to a more elaborate understanding of the concept of religion in the older cohort. Specifically, in the 7th and the 8th grade, pupils are preparing for the important Christian sacrament of Confirmation and, as such, the content of RE here aims to extensively focus on the internalisation of religious teachings.

An even bigger difference in pupils' conceptualisations and attitudes could be expected between groups of participants divided according to their interest in either science or religion. Here, it could be hypothesised that those who are more inclined towards a specific worldview would have more elaborated and complete conceptualisations of, as well as more positive attitudes towards, either religion or science. The discussion in this chapter will focus first on pupils' conceptualisation and attitudes towards science, which will be followed by a consideration of the conceptualisations of pupils' religious experience and attitudes towards various facets of religion.

6.1. PUPILS' EXPERIENCE OF SCIENCE

In this section, the discussion will begin with a consideration of qualitative data with respect to three elements: pupils' definition of the concept of science, their understanding of what constitutes the holistic concept of science, and the sources informing these conceptualisations and understandings. The second section will focus on pupils' attitudes towards the concept of science through a discussion of the relevance of science established through quantitative analysis of the 'Utility of Science' and 'Negative Aspects of Science' factors. These findings will then be triangulated with the qualitative data. Finally, the results on the scale of 'Scientism' will be discussed, followed by an integration of the presented issues.

6.1.1. Conceptualisation and understanding of science

Although there are numerous definitions of the term science that vary in depth and complexity, the decision was made to use the most general definition provided by sources such as the Merriam Webster collegiate dictionary (2005) and Encyclopaedia Britannica (2003) for the purposes of research with relatively young participants. From these sources, the definition of the term 'science' can be summarised as a **system of acquiring knowledge** that uses **observation and experimentation** to **describe and explain natural phenomena**. In addition, science also refers to the **organized body of knowledge people have gained using that system**. In more colloquial terms, the word science is often used to describe **any systematic field of study or the knowl-**

edge gained from it. In the most general terms, the purpose of science is **to produce adequate and useful models of reality** and, in doing so, most scientific investigations apply **some form of the scientific method**.

Whilst being considerably brief and universal, this definition offers the multifaceted elements of the concept of science that might not always be transparent, understandable or coherent to elementary pupils. Thus, it was important to determine those elements from this definition that are incorporated into pupils' conceptualisation and understandings of science. Pupil knowledge of the branches of science was also examined to determine whether pupils identified scientific disciplines outside of the school subject framework. Finally, an attempt was made to uncover the educational, personal and societal sources from which pupils' conceptualisations of science develop.

6.1.1.1. The younger cohort's perspective

The conceptualisation and understanding of the term *'science'* amongst younger participants might best be described as limited and considerably naive. Predominantly, offered explanations are often brief and void of detailed articulation or personal attachment. In general, pupil responses ranged from the very vague, such as:

'P: …science is when people do something…
I: What exactly do you mean by doing something?'
P: …I'm not sure but whenever I hear about science, it's about they (scientists a.n.) did this or that…'

to the more specific:

'P: …I connect science with exploration. Scientists discover things.
I: Can you tell me what exactly do they discover?
P: Everything…All around us.
I: Such as?
P: ...like some medicines. For AIDS and such…'

In addition, pupils often defined science in terms of *'knowledge about some area'* or *'…I don't know, observing nature, people, animals, stars and planets.'* Most statements contained words such as *'exploration', 'something new'* and *'discovery'*. The use of these terms suggests a highly general understanding, with pupil conceptualisations of science primarily connected with the acquisition of knowledge through exploration and its relationship to novelty. Additionally, some responses suggested an association of science with *'something hard and that you need a lot of time to learn'* and *'you need to be smart in order to do science'*. This connection arguably latently reflected pupils' perceptions of the high levels of difficulty and demand of elementary science subjects.

When asked to name scientific disciplines, the responses from the younger cohort corresponded largely to school subjects, as evident in the following interview excerpt:

'I: Is there only one thing called science, or are there different branches of science?
P: I think there is not only one science, but many.
I: For example, which sciences do you know?
P: Hmmm…nature is science?
I: You mean the subject nature?
P: Yes, but not only. There are different sciences too that we will get in the 7th grade. Physics and chemistry…
I: Do you know of any other sciences?
P: Mathematics is science too, isn't it?'

This excerpt, characteristic of almost all participant responses, suggests rare mentioning of other scientific disciplines or the more subtle divisions of science outside of what is offered by the official curriculum. When specifically asked to think of scientific disciplines not taught in school, participants offered answers such as *'medical science'* or more often *'science for medicine'* or *'science in order to discover new treatments, like for cancer or AIDS'*.

A probe into the sources influencing pupils' conceptualisations of *'science'* revealed the educational context to be the primary resource. However, the educational setting often seems to be misleading for this cohort: while many pupils conceptualised science within the framework of school subjects, the major subject in which they learn about natural sciences is called 'nature' and not 'science'. When asked if they learn about science in school, several participants responded negatively and suggested they learnt about nature. It is only when questioned about the school subjects to which they would be introduced in the 7th grade that they talked about science in terms of chemistry, physics, and biology. In the words of one female participant:

'I: Do you learn about science in school?
P: We mentioned it somewhere, I think. Yes, we talked about sciences.
I: Can you tell me in which subjects?
P: In technical education.
I: Anywhere else?
P: In nature.
I: Do you know what does nature become in the 7th grade?
P: Biology, chemistry and physics. I am not sure what they are like, but they must be difficult.'

The second main source of information for this cohort comes from the home via parents and, in many cases, older siblings:

'P: My brother told me. He is in the 8th grade. It's all some kind of experiments and tangent and something.
I: Can you tell me what does tangent mean?
P: I don't have the slightest clue.'

Or in the words of one male participant:

'P: Scientists discover some things. Mainly new ones. Like inventions and stuff, at least my father told me that.
I: You speak about these things?
P: Yes, sometimes when we watch some kind of movie with these topics.'

The third main influence on pupils' conceptualisation and understanding of science was the media, where pupils reported two streams of information influencing their understanding. First, pupils discussed developing knowledge of science through mainstream media covering scientific discoveries and topics in a perhaps negative manner, often abusing the terms 'science', 'scientists' and 'scientific discoveries':

'P: Have you heard about science somewhere?
I: Hmmm…I know I've seen it on the RTL television show 'Explosive'.
P: But this is a show about show business, music and movie stars…
I: Yes, but they said scientists have discovered a way for skin to stay young.'

The other media sources influencing pupils' understanding of science are cartoon series and animated films. Several participants mentioned the cartoon show 'Dexter's Laboratory' in their description of science and scientists:

'P: So where did you hear about the science?
I: I don't know if it counts, but I like Dexter.
P: Dexter's laboratory, the cartoon?
I: Yes. I'm a big fan and I like when he does his experiments and everything goes boom.'

6.1.1.2. The older cohort's perspective

As expected, the conceptualisation and understanding of the term '*science*' among the older participants proved to be more inclusive and comprehensive. Understandably, the vocabulary used by this cohort in order to depict their understanding of science was more complex:

'It is something that can be researched, complemented and developed. It's not static and it continuously changes.'

Some of the participants even discussed the use of scientific method as a distinctive feature of the scientific enterprise:

'They (scientists) approach things differently. You have to try something many times in order to understand and make a conclusion.'

Or, in another case:

'You can't just say that it is it. This is not how science works. You have to have a system and apply it in order to get to the result.

Additionally, some participants questioned the ethics of the scientific effort and scientists, positioning the scientific endeavour in a wider social sphere:

'P: …they discover things, but it is all connected with interests.
I: Can you tell me what do you mean by interests? Whose interests?
P: They take money from someone and they do the research. It's all for money.'

Much like their younger colleagues, participants from this cohort discussed the various branches of science in terms of their school subjects. However, unlike the younger cohort, pupils additionally mentioned other scientific disciplines such as '*genetics*', *'botany'* and *'zoology'* and, in the words of this pupil:

'I: What sciences, or scientific disciplines, are you aware of?
P: Microbiology, biology, chemistry, physics. Then we have a different branch of sciences.
I: Which ones?
P: Social sciences, like history and geography.'

As with their younger colleagues, pupils identified the educational context as the main source informing their understanding of science. However, there was also a more prominent mention of the media as a relevant source of information for their conceptualisation of science. As with younger pupils, the main media sources for information were television and film. However, there was more specific mention of television series focused on the medical profession and forensic sciences. Perhaps more positively, pupils also reported acquiring knowledge about science from television programmes specialising in natural and scientific themes.

'…maybe more than movies I like watching documentaries about animals or natural disasters, or how people went to the Moon.'

Finally, there was repeated mention of specialty science magazines for pupils, such as 'Knowledge Tree', and more mainstream magazines, such as 'National Geographic' and 'Geo', as sources informing pupils' understanding of science.

6.1.2. Pupils' attitudes towards science

In addition to illustrating the existence and nature of pupils' conceptualisations and understanding of science, the previous analysis also helped to inform the development and selection of questionnaire items for the quantitative part of the research aiming to investigate pupils' attitudinal patterns towards science. Specifically, two emerging pattern orientations were identified. The first, characterised by a positive attitude towards science, was based primarily on perspectives of the relevance and utility of science established through scientific discoveries and applications of science in everyday life, for society and throughout history, as typified by the following interview excerpts from the older cohort:

'Without it there would not be much really. I mean science is behind cars, Playstations and most of the things we own and use.'

'It (science) is a very good thing. What would we be without science? Still in a cave, without a light…'

The second emerging attitudinal orientation was concerned with certain negative aspects of science and scientific discoveries in general. Here, the emphasis was on the role of science in environmental issues, conflicts, wars and arms development, as one younger pupil explains:

'P: They have discovered many good things, but there are also some not so good. Like all these factories that pollute the air.
I: Can you think of anything else where science or scientists made mistakes or were wrong?
P: Hmmm…they discover more powerful weapons. That's not good.'

These early tendencies informed the choice of the items for the scale examining the relevance of science. As presented in Chapter Four, factor analysis resulted in two factors named *'Utility of Science'* and *'Negative Aspects of Science'*. In the case of both factors, results emerging from the analyses of qualitative data served as a complementary source of information. The following sections will consider each of these two factors, along with the findings from the scale of scientism, in turn using both quantitative and qualitative data.

6.1.2.1. The utility of science

In the qualitative data, pupil articulations concerning the purpose of the scientific endeavour, as expressed by the perceived utility and relevance of science and scientific discoveries, indicated a difference between cohorts. Younger pupils' responses suggested a limited awareness of the purpose of the scientific endeavour. In cases where a purpose was articulated, it was mainly expressed in the most practical and utilitarian terms and was primarily linked to medical and technological applications:

'I: Can you tell me why do we need science?
P: To discover things.
I: Which things exactly?
P: Like medicines or something.'

Or, expressed in broader terms by another participant:

'P: …it (science) is an exploration, an attempt to make something new.
I: Can you be more specific?
P: Everything from medicine to the television.'

In contrast, the responses from some of the older pupils defined the purpose of science within the context of wider social spheres and economical development. This difference between cohorts is clearly exemplified by the following two excerpts from 6th and 8th grade pupils, respectively:

'I: What are the positive sides to science?
P: I don't know. They have discovered television, fridges and stuff like that which are useful for living.'

'I: What do you think why we need science?
P: Without science there would not be economy.
I: What exactly do you mean by that?
P: All the factories need science, and then they produce more, work better and employ people.'

While the qualitative data suggested both cohorts held a general understanding of the utility of the scientific endeavour as a positive feature of science, it was evident that responses from the two cohorts differed in their depth and content.

In the quantitative data, when the cumulative score of the three questionnaire items forming this factor was computed and placed on a scale from 3 to 12, the resulting scores revealed that both cohorts held positive attitudes towards the Importance and Utility of Science, as represented in Table 6.1.

Table 6.1: Cohort difference on the Utility of Science factor

Utility of Science	M	SD	t	df	p	r
6th grade	9.95	1.61	2.29	413	0.02	0.11
8th grade	9.59	1.62				

Here, the means for both cohorts suggests consistently positive attitudes on this factor. However, a t-test revealed a statistically significant difference between the cohorts, with more positive estimations from the younger pupils. This difference should not be surprising in light of the simpler conceptualisation and understanding of science amongst younger pupils, which might have contributed to a less critical view of science. This is in line with the qualitative analysis suggesting a predominantly practical orientation to the conceptualisation of science in the younger cohort, which similarly could have positively influenced responses on this dimension. In contrast, a more informed and complex understanding of science amongst the older participants might have contributed to a more balanced view of the importance and utility of science.

A series of statistical procedures were carried out in order to determine differences between the responses of various groups of participants on this factor, where gender, academic achievement, achievement in science and pupil response to a questionnaire item probing self-reported religiosity were used as independent variables.[65] Results of the analyses on the aforementioned variables are presented Table 6.2.

Table 6.2: Group differences – Importance and Utility of Science factor

Variable	**6th grade**			**8th grade**		
	value	**df**	**r**	**value**	**df**	**r**
Gender	**t=3.80***	**200**	**0.26**	t=0.82	179	0.06
Self-Reported Religiosity	F=0.49	2,194	0.05	t=0.50	191	0.04
Academic Achievement	F=0.29	2,196	0.04	**F=8.82***	**2,188**	**0.29**
Achievement in Science				**F=6.79***	**2,191**	**0.26**

* p< 0.01

In the older cohort, t–tests indicated that gender and self-reported religiosity did not yield a statistically significant effect. In contrast, ANOVAs dem-

65 Although results and discussion on pupils religiosity and attitudes towards religion are still to be presented, the concept of self reported religiosity will be used in this section for the purposes of examining its connection to pupil attitudes towards science.

onstrated statistically significant effects for academic achievement. Post hoc analyses using the Duncan post hoc criterion for significance indicated that, in the case of both variables, estimations were significantly lower for the group of pupils with lower achievement levels, suggesting pupils in this category held less positive attitudes than those in medium and high achievement groups on both variables. These are important findings as they suggest a relationship between overall and scientific subject attainment and positive conceptualisations of science. The implications arising from these findings are noteworthy: lower achievers might not only hold more negative attitudes of science subjects in school, but also have less affirmative attitudes towards the positive aspects of science and the scientific endeavour in general.

In the younger cohort, academic achievement and self-reported religiosity variables did not yield statistically significant difference. However, a t–test for gender demonstrated a significant difference in attitudes expressed on this factor, where boys held significantly more positive attitudes than girls. Arguably, the discrepancy between this finding and that for the older cohort might be attributed to the more practical and utilitarian conceptualisations and understandings of science in the younger cohort. Here, the tendency to define science mostly in terms of its applications in technology is perhaps more prevalent amongst boys.

Analysis of the responses in the qualitative data from groups of pupils with differing interests in science and religion surprisingly did not suggest any substantial differences in both cohorts. Namely, participants from all three groups perceived science as a very useful and important endeavour. However, it seems that the participants from the group with higher interest in science offered more articulate answers than those in the remaining two groups.

6.1.2.2. Negative aspects of science

When the cumulative score on the three variables forming this factor was computed, forming a scale ranging from 3 to 12, the resulting scores revealed that both cohorts held attitudes positioned between the low and middle points of the rating scale of Negative Aspects of Science, as presented in Table 6.3.

Table 6.3: Cohort difference on Negative aspects of science factor

Negative aspects of science	M	SD	t	df	p	r
6th grade	6.41	2.17	2.29	402	>0.05	0.09
8th grade	6.78	2.03				

No statistically significant difference exists between these groups, suggesting that participants from both cohorts do not hold differing attitudinal patterns. In comparison to results on the previous factor, these results further suggest that negative features are considerably less prevalent than perceptions of the 'Utility of Science'.

Results of the analysis of the between-groups differences for the 6th and 8th grade cohorts are presented in Table 6.4.

Table 6.4: Group differences – Negative Aspects of Science factor

	6th grade			8th grade		
Variable	**value**	**df**	**r**	**value**	**df**	**r**
Gender	t=1.61	200	0.11	t=0.26	193	0.02
Self-Reported Religiosity	F=0.77	2,194	0.09	t=1.36	191	0.10
Academic Achievement	F=0.15	2,196	0.02	F=0.18	2.188	0.04
Achievement in Science				F=1.51	2.191	0.12

Here, analyses did not yield any statistically significant differences between groups, suggesting generally homogenous attitudes on this dimension across cohorts, genders, achievement levels and reported religiosity.

In addition to the items included in the attitudinal scale, participants from both cohorts were asked to respond to an additional item probing their attitudes towards the overall contribution of science. This item posed the question '***In the long term, would you say that science and scientific discoveries have done to humanity and to the world...'*** and then offered respondents four response choices. These response options and the percentages of responses on this item are presented in Table 6.5.

Table 6.5: Pupil responses to item probing scientism

Response	6th grade	8th grade
More harm	3.8*	4.4
Equal harm and good	42.2	53.2
More good	37.9	30.6
I can't tell	16.1	11.8
Total	**100**	**100**

*Numbers represent percentages of pupils who responded.

Chi-square testing for response differences between cohorts was not statistically significant (χ^2 (3, 414)=5.75, p>0.05, Cramer's V=0.12). However, visual inspection of the distribution of pupils' answers suggests a somewhat larger percentage of older participants possess a more balanced view about the role of science and scientific discoveries, characterized by a perceived parity between both positive and negative effects of science. It might be argued that this balanced position most closely resembles scientific postulates themselves, established through the use of rational thinking, evidence gathering and arriving at a balanced and informed view.

As stated, qualitative analyses indicated that, for both cohorts, pupils conceptualisations of science featured several negative characteristics, most often in relation to ecological issues such as air, water and ground pollution from industrial production, global warming and issues connected with the application of science in conflicts, war and military industry. Interviews revealed these elements penetrated pupils' cognition both through educational pathways and less formal sources of information, such as family and media. Pupil responses confirmed that the curricula dealing with these topics both in science and other subjects, such as history and geography, give a reasonably balanced view of the role of science both presently and in historical terms:

'They (scientists) do both good and harm. For example arms are bad, but it is good when they discover medicines and cure people, or Nikola Tesla and the discovery of electricity.'

Explanations from younger pupils about the negative aspects of science with respect to environmental impacts ranged from:

'P: …scientists discovered the ozone hole and people paid more attention to it. They discover things we need, making things easier for us like factories and such, but all of this has a negative effect.
I: What do you find negative here?
P: All those factories, perfumes - they are damaging the ozone layer.'

To the following:

'As science goes forward there are more weapons and bigger wars, but at the same time people are developing and they are more aware of environmental problems and can help more than in the past.'

A similar sentiment was also characteristic in the responses from participants in the older cohort, as one pupil explains:

'It's a double sword. Sometimes all of these discoveries will do much harm to the environment, but on the other side science will try to protect nature.'

While excerpts from both cohorts reveal a balanced view regarding the effect of science on environmental issues, pupils were much more critical in their responses concerning the role of science and scientists in conflict, war and arms development, as one younger pupil explains:

'Sometimes I feel we would be better without science because if it was not for science there would not be war. Everything would be better and there wouldn't be the atomic bomb, even if that means we would live like cave men.'

This quite radical sentiment was shared by other pupils, albeit in a somewhat less personal form:

'I: Do you think there is any connection between science and war?
P: A big one, because the Chinese need knowledge to make all of those arms. It's not just three Lego blocks.'

Or in less satirical terms:

'In order to go to war, you need to make weapons and have an arms industry. And each State needs to have scientists to make this, for big rockets and such…'

As with environmental issues, responses from the older cohort seem to convey the same message.

'Well, war is one of the shameful points of science. If there was no science, weapons would not be so destructive and some people would be more reserved in using them.'

Participants from the three interest groups gave somewhat differing answers in their depiction of the negative aspects of science. In both cohorts, those with higher interest in science gave very balanced answers, firmly identifying both areas in which science contributes as well as those where it has been negative or misused.

'Sometimes I feel that for every step forward there are two backwards. Like scientists invent something and everyone says it's great, but soon you see it is not so great and that maybe it should not have been invented. It seems there are two sides of a coin.'

In contrast, responses from participants in the other two interest groups contained less engagement with the dual role of science and more commonly were concerned with topics already presented in the text associated with ecology, conflict and arms development.

6.1.2.3. Scientism

Scientism explored older pupils' perceptions towards the position of science as a fixed, unquestionable and superior endeavour. While aiming for balance, science curricula developed specifically for elementary education pupils is necessarily a simplification of often quite complex issues and topics in science and scientific work. This has the potential to contribute to the development of oversimplified and overly positive attitudes towards scientific activity and science in general, thus making the inclusion of this dimension reasonable in the current investigation. Quantitative data indicate that 8th grade pupils do not hold a dogmatic view of science, where the mean estimate on a scale from 3 to 12, was 6.63 (SD=1.95) for this dimension.

The results of between-group testing on the dimension of scientism are presented in Table 6.7.

Table 6.7: Scientism – Group differences

Variable	value	df	r
Gender	t=0.38	195	0.03
Self-Reported Religiosity	t=0.35	193	0.03
Academic Achievement	F=2.21	2, 190	0.17
Achievement in Science	**F=3.55***	**2, 193**	**0.20**

* $p< 0.05$

On this dimension, the only statistically significant difference amongst pupil responses is yielded for the achievement in science variable. Duncan's post hoc tests revealed that, in general, the group with the lowest achievement provided the highest estimates on this dimension, with the group of medium achievers giving the lowest estimates. In fact, statistical significance is achieved due to the difference between these two groups alone, while the estimations of the high achievers do not differ significantly with either of the other two. This result is perhaps most interesting in its suggestion that pupils who are least successful in science are also those possessing the most dogmatically oriented attitudes towards it.

A large disparity is also evident amongst groups of pupils with differing interest on the science/religion continuum with respect to the superiority of the scientific worldview, as the following excerpts from the high science group indicate:

'It is superior… there is evidence, which you do not see in religion. If you ask me, I would always prefer scientific explanation to a religious one.'

'In science you need to prove something. That's the key – to prove, not to say, not to believe but to prove.'

One member of the high religion group offered a contrasting view:

'You know, there are just so many things you can rationally observe. There are questions of faith that people in science can't even touch.'

Although these interview excerpts primarily indicate an inclination towards a specific worldview and a specific way of thinking, a topic that will be elaborated further later in the text, they also arguably signify elements of dogmatism.

6.1.3. Integrating the results: What do pupils say about science?

In general, the findings presented in this section indicate that pupils in both cohorts hold certain conceptualisations and understandings of science as a holistic concept, although in most cases they are not overly elaborate. The conceptualisations of the younger cohort are simpler and characterised by a predominant connection to the concepts of discovery and novelty. The younger pupils were less eloquent and less personal in their responses describing science and generally identified it in connection to school subjects. The older cohort appears to hold a more complex and articulate conceptualisation, mentioning a wider range of elements such as experimentation, method and falsification, and was more aware of the various divisions of science and scientific disciplines. Both cohorts stated educational influences as the main source informing their understanding of science, followed by personal sources, such as parents and older siblings. For both cohorts, the third main source of information was the wider media.

Pupils' attitudes towards science have been considered on three separate elements. Analyses on the *'Utility of Science'* factor indicated that the two cohorts have qualitatively different considerations of science's purpose and utility. Statistical analysis indicated that younger pupils gave significantly higher estimates on this dimension than their older colleagues. In the older cohort, those with lower achievement levels gave significantly lower estimations than the other two groups. In the younger cohort, boys gave higher estimates on this dimension than girls.

On the *'Negative Aspects of Science'* factor, there were no differences between cohorts or among groups of participants in each cohort. While both cohorts seem aware of sciences' negative aspects, this was not a predominant feature of their attitudes towards the concept of science. Participants from both cohorts emphasised the role of science in ecological issues, wars and arms development as its main negative features. Qualitative data indicated that those with a prevalent interest in science gave a more balanced view of the positive and negative aspects of the scientific endeavour.

Results for the '*Scientism*' factor revealed lower levels of scientism amongst 8^{th} grade pupils, prompting the positive suggestion that older pupils begin to conceptualise science as an entity which is not fixed, nor absolute but evolving and ever changing.

The cohort differences are substantial, where the generally less informed conceptualisations of younger pupils contributed to a more naïve understanding and more optimistic view of science. These differences reflect not only a difference in the amount of exposure to science in the educational context, but also one of differing personal development. Arguably, the more balanced and elaborated view of older pupils comes from their ability to take differing points into consideration and form a more personal stance on the issue.

At first glance, these results indicate a positive picture of affirmative and balanced views on the importance and utility of science in the absence of dogmatism. However, the general feeling emerging from interviews, in contrast to pupils' attitudes towards science subjects, is a relative lack of engagement and personal connection with the concept of science. While pupils perceived science in a positive manner, this position could best be described as a detached and uninformed affirmativeness.

In light of the results presented in the previous chapter, these findings hint at a more complex consideration of this issue by raising the question to what extent are pupils' positive attitudes towards science formed by actual educational practice in science subjects. Presumably, modern approaches to teaching science aim to present science in a relevant, understandable and attractive manner that would eventually result in improved pupil understanding of and attitudes towards science. Furthermore, they aspire to promote pupils critical consideration of science by presenting balanced information and the limitations of the scientific endeavour. In addition to a well-developed science curriculum, it would be expected that a high standard of science teaching would foster such a position. Arguably, pupils should be encouraged to develop scientific thinking skills characterised by knowledge building through experimentation and the constant iteration of complex systems of theory and data. This, in turn, would result in the adoption of a pattern of thinking and corresponding worldview founded on the collection of evidence in order to achieve certain conclusions and the continuous examination of existing solutions.

However, based on the previously presented discussion on pupils' attitudes towards science subjects, the respective teachers and their practices, it is evident that science instruction in Croatian elementary education is far from the above presented ideal. As mentioned previously, the science curricula are characterised by a relatively early division of science into specific subjects and a strong orientation towards content and knowledge acquisition, rather than on the development of scientific reasoning. Furthermore, financial and infrastructural obstacles disable any significant orientation towards experimentation and inquiry learning. Arguably, these characteristics of the science curricula and the system itself limit the potential for presenting science as a holistic concept which, in turn, results in incomplete pupil understandings of science and a detached personal stance. Furthermore, the teaching of science focused on content knowledge from an early age has the potential to undermine the development of scientific thinking and the adoption of a scientific worldview.

The previously described situation of highly demanding, incomprehensible subjects might be especially critical and alienate some pupils from both science subjects and a scientific worldview. Presented analyses indicated that pupils, and most especially those with low achievement levels, do not always perceive science affirmatively or with intrinsic relevance. Traces of these concerns are evident in excerpts from teacher interviews, as exemplified by the following quote from the biology teacher:

'There are always pupils who show interest in science and show, to put it this way, this kind of thinking characteristic of scientists. But these are very few, and a majority of pupils are not so interested. They just want to get a good grade'

This sentiment of limited pupil interest is shared by other teachers, as explained by the physics teacher:

'I would say that there are few really talented pupils, maybe five percent in each generation or even less, one or two.'

The crucial piece in these statements is the use of the words 'few' and 'selected'. In each generation, there are likely pupils with higher cognitive abilities or inclinations towards science and scientific thinking, but their existence and affinities seem to have little to do with the science education that should foster these characteristics. Furthermore as teachers state, there are many more pupils who are not interested in science. It seems that, for these pupils, the present approach to the teaching of science is failing to encourage any scientific interest or make science more acceptable to them.

6.2. PUPILS' EXPERIENCE OF RELIGION

For a number of reasons, it would be reasonable to presume that the concept of religion evokes a reaction amongst participants dissimilar in its elaboration and intensity than that for the concept of science. First, for most pupils attending elective formational Catholic RE, religion presumably represents a more personally important and affectively saturated concept than science. As explained previously, religious influence stems largely from the family home, making pupils conceptualisations of religion more founded on sources outside of formal education than was the case with science. Secondly, the important role of the Catholicism in the described social context of Croatia might similarly contribute to more complex reactions to the various aspects of religion and Church activities. From an educational standpoint, the nature of RE in Croatia, characterized as *'teaching into the Catholicism',* would further result in multifaceted but generally positive conceptualisations of the concepts embedded within religion.

All these factors imply that the discussion on pupil conceptualisations of and attitudes towards religion cannot be constructed in the same manner as that for science. It can further be presumed that pupils already have an elaborated concept of religion, characteristic of the Catholic confession, which is at the same time personal and communal. This delicate distinction requires a special approach to the discussion of the results in this section, which will be carried out in three major parts: Belonging, Believing and Doubting.

In the first section, discussion is centred on pupils' sense of belonging to the Catholic confession and perceptions of the delineation between Catholicism and other confessions. The second section focuses on pupil beliefs, first through a discussion of differing levels of religiosity and then through a consideration of their objects of belief, followed by a consideration of pupil attitudes towards Christianity as analysed through the quantitative data. The third section considers elements and causes of pupils' doubts regarding their beliefs. In addition, pupils' attitudes towards the Catholic Church, as the developer and implementing body of RE, and its role in the lives of believers and Croatian society will be presented. Finally, the integration of the results and the influence of RE on pupils' conceptualisations, understandings and adoption of religion will be presented.

6.2.1. Belonging

While the nature and intensity of one's faith can be considered a personal endeavour, the decision to attend confessional RE, the collective nature of these classes, as well as certain characteristics of Catholicism and the specificity of its existence in the Croatian context, might all contribute to a certain uniformity in the understanding of religious belonging and its distinction from other confessions among pupils. Within its curriculum, RE covers material on other Christian confessions and major world religions. As such, in the qualitative research, it was important to first probe whether pupils declare a religious belonging to the Catholicism and in what manner they construct and understand its relation to other confessions.

As expected, participant responses from both cohorts indicated that all pupils clearly expressed belonging to the Catholicism, in most cases firmly placing it in the wider context of Christianity. The older participants were able to almost unanimously list other streams of Christianity, naming mostly Protestantism and Orthodoxy as other Christian confessions. The younger participants were somewhat less knowledgeable, with a few pupils unable to state any other confessions inside Christianity. When asked about other world religions, pupils were mostly able to name the major world religions of Islam, Judaism, Hinduism, and Buddhism and offered general information such as the name of the divinity, but their knowledge lacked any level of specificity. Again, the older pupils appeared more informed, with a few pupils from the younger cohort expressing difficulty in differentiating other religions, as illustrated by the excerpt from one participant:

'I: Which other religions are you aware of?
P: Well, I know Muslims and, hmm…Jews?
I: Are these different religions?
P: I think so, although I think they believe in the same thing.
I: Can you please explain that?
P: I mean…like they have the same God. Actually they are the same.'

Participants from the two cohorts did not only differ in their knowledge about other confessions but also in their interest in learning about them, with a significant number of participants from the older cohort expressing an intrinsic interest in learning more about the teachings of other confessions. In some cases, this arose at the expense of any interest in learning about their own confession:

'P: You know what I really can't get? Why do we learn so much about our religion, and so little about the others?
I: Would you like to learn more about the others?
P: Well, that's about the only interesting thing for me in this subject.'

In general, the older participants were more interested and less discriminative towards other beliefs or religions.[66] In contrast, younger participants seemed less interested in lessons on other religions:

'P: I like when we learn about Jesus Christ, but there are also some boring parts.
I: What exactly do you dislike?
P: I do not know why we have to learn about those Jews and Muslims. I mean, what will I do with that?'

This position, evident among several of the younger participants, is suggestive of a stronger sense of belonging to and identification with one's own religion and, in some cases, a firmer distinction of one's group from the others. This appeared to be linked to pupils' opinions of the teaching of their own religion as truer, more correct or in some way superior to those of other confessions, which may have resulted from reduced interest in and knowledge about the religious beliefs and practices of other confessions.

While the answers of older pupils indicated a consistent level of tolerance and respect for the teachings of other religions, younger pupils' responses

66 This wish to discover more about 'the others' is perhaps expected in this later stage of cognitive and personal development, and in many ways should be fostered by the educational endeavour, although this position might seem somewhat less favourable from the perspective of confessional RE teachers.

suggested a clear division among pupils. The more tolerant perspective was characterised by the view that, in general, different religions and faiths provide equally correct answers, as illustrated by the following excerpt:

'I: Which religions do you know?
P: That is easy: Islam, Buddhism, Hinduism, Judaism…
I: Would you say that followers of these religions have the same or different objects of worship?
P: Same, but they use a different name for it and have different symbols.
I: What or who is the thing they worship?
P: Some kind of supernatural force.
I: Would you say that the Catholic, or any other religion, is more correct in the interpretation of their worship?
P: They are all equal.'

Responses from other participants in this group confirm this sentiment with statements such as '*they're all equally correct*' and '*…it's all just one God, but with other names. I don't think my belief is more correct than the others*' and:

'Our religion is not more correct. Some things we think are true, believers of other religions may find false. Everyone has their own opinion and all the opinions are equally correct.'

This position was clearly contrasted with the attitudes of other 6th grade pupils:

'P: …Muslims believe in Jihad, they think that war will get them to heaven, and we think that you need to be good in order to get to heaven.
I: Would you say that the Catholicism is more correct than the others?
P: If you ask me, then the answer is yes. But if you ask someone else, his own religion is the best. I think ours is better than the others.
I: Why?
P: Because some religions say you need to kill, for example Islam.'

Unlike those from the first group, this excerpt clearly indicates a divisive *'us versus others'* sentiment as well as a conviction of the superiority of one's belief to that of others. Pupils' responses indicate that Islam is not the only example of an *'inferior other'*, as the following comment illustrates:

'We are Catholics, aren't we? So why do I have to learn about some Jews, like Abraham and such.'

Or in the case of Orthodoxy:

'I: Would you say the Catholicism is more correct?
P: Yes, teaching on Jesus is true and correct.
I: So Catholics and Orthodox are equally correct?
P: I don't think so, Orthodox are Serbs …they attacked us and destroyed some churches. They cannot be equally correct as us.

These excerpts suggest that pupils' positions are clearly influenced by Croatian history and its specific geopolitical position, as well as the religious affiliation of neighbouring nations. The position of Croatia, bordering both Serbia and Montenegro with predominantly Orthodox populations, and Bosnia and Herzegovina, where Muslims are a relative majority, might have had a direct influence on the participants' knowledge and attitudes towards these two religions. In addition, recent wars in ex-Yugoslavia have contributed to divisions along ethnic and religious lines. Finally, the troubled relationship of the Croatian statehood with its Jewish minority during the Second World War adds to the complex religious and national mix. However, it is somewhat surprising that pupils' distinctions and judgements are also made about confessions with which they would have had little experience. For instance:

'…after all this is all one God, but they speak differently about it. Only Buddhists don't have a God, and I have to say that is stupid and I do not like it.'

6.2.1.1. What informs pupils' stance about 'others'?

Although the sources for knowledge about, interest in and positions towards other confessions are most likely multiple, pupils' responses indicate two clear patterns of influence in the development of these attitudes. As with many other variables dealing with RE, religiosity and attitudes towards religion, the pupils' home represents one of the major influences on attitudes and understanding. As one pupil explains:

'My Mom told me that in the Koran it is written that Mohammed said things about the holy war Jihad. And that is what is happening. Muslims attacked USA because they have followed their own religion, which is not right because many people died.'

Or in the case of another pupil:

'Croatia was in the war with Serbs who are Orthodox and my father fought against them. How can they be as correct as us?'

The opposite position is similarly fostered by family influences, as illustrated by the following interview excerpt:

'In my family, parents tell us to respect everyone regardless of their race, ethnicity or belief…you know we are all equal, or at least we should be.'

Regardless of its direction and nature, the multifaceted influence of parents' beliefs on pupils views should not be considered as a systematic and uniform influence in a specific direction.

The other stream of influence emerging from pupils' responses is perhaps even more relevant for the present research and stems from the educational context and practice of RE. This often intangible influence became apparent in the statements of some pupils:

'My RE teacher says that Christianity is the most correct out of all religions, but I do not think this is true, as we are all equal.'

An older pupil also shared this sentiment:

'I think our teacher thinks that our religion is superior to the others, although she hides it well.'

At the core of this influence lies the fundamental problem of if and how confessional RE should cover the teachings of other confessions and its position towards Catholicism. As one of the goals of confessional RE is teaching into a specific religion, it becomes almost questionable if the curriculum holds the presumption of equality between different confessions. Arguably, from the perspective of elective formational education into a specific religion, the question could be posed if it should. Equally, it seems doubtful whether teachers, confirmed by the CBC and with 'missio cannonica', could and should avoid the presentation of the dominance and superiority of their own confession in comparison to others. Due to its very nature, RE should stress the particularities of its confession and teachings, thus propagating the dominance of its respective beliefs, codes and values. However, an ecumenical message should also be present, with time devoted to the adequate coverage of the positions of other confessions, with special emphasis on the commonalities between religions. This apparent inconstincency becomes even more complex in its interaction with pupils' cognitive, emotional and moral development. Indeed, the somewhat discrepant duality of these two goals of RE may serve as a systematic influence on pupils' attitudes towards their own and other religions.

6.2.1.2. Belonging: Additional factors

Besides RE attendance, there are additional aspects of pupils' activities signalling religious belonging. Indeed, it would be expected that RE in schools and pupils' participation in Church activities, such as regular masses and other Church organised events, should complement each other, resulting in a more complete experience of and intrinsic relation towards Catholicism. The following sections will present both quantitative and qualitative data exploring pupil participation in Church attendance and the elicited satisfaction from such attendance, pupil responses towards the receiving of the sacrament of

Confirmation as a sign of their belonging and the influence of parent and home on the development of feelings of belonging.

Pupils' Church attendance

The results in Table 6.8 suggest relatively high levels of Church attendance in both cohorts, with more than two thirds of the older and over half of younger pupils stating they attend Church services at least once a week.

Table 6.8: Pupils' reported frequency of Church attendance

How often do you attend Church service	6th grade	8th grade
Never	1.9*	2.5
Few times in a year	15.7	9.9
At least once a month	26.4	18.2
At least once a week	51.4	64.0
More than once a week	4.6	5.4

*The numbers in this and future tables in this chapter represent percentages of pupils responding, unless otherwise indicated.

There is a statistically significant difference between the two cohorts ($U=19071.5$, $z=2.58$, $p<0.01$, $r=0.13$), with the frequencies suggesting that older participants report more frequent attendance. This finding should be considered in light of the fact that 8th grade pupils are, as a part of their formative RE, preparing for the sacrament of Confirmation. This means that, in addition to their usual RE classes, they are required to attend classes and other services in Church on a regular basis, which in turn could significantly affect their Church attendance.[67]

In the older cohort, there is a statistically significant difference between girls and boys ($U=4162.5$, $z=2.46$, $p<0.05$, $r=0.17$), with the former reporting more frequent attendance. In the sixth grade, there was no statistical

[67] As such, grouping of participants on this feature in additional analysis is questionable in that it is clearly influenced by the aforementioned fact regarding Confirmation.

difference on this dimension (U=5433, z=0.91, p>0.05, r=0.06). Grouping on variables of academic achievement in both cohorts did not result in statistically significant differences.

Pupils' level of satisfaction with Church attendance

One might pose the question whether frequency of Church attendance is reflected in elevated levels of satisfaction elicited by Church attendance. The rationale behind the inclusion of this measurement is the assumption that satisfaction is a valid reflection of the importance and intrinsic value elicited by Church related activities. Indeed, due to the plethora of familial and educational influences, some pupils may feel 'obliged' to attend these activities and, as such, data on pupil attendance alone holds only limited informational value. For these reasons, pupils expressed satisfaction might serve as additional insight on both attitudinal patterns and intrinsic sense of belonging. Pupils' responses are presented in Table 6.9.

Table 6.9: Pupils' reported satisfaction from Church attendance

Elicited level of satisfaction from Church attendance	**6^{th} grade**	**8^{th} grade**
None	5.6	15.9
Small	11.6	13.4
Medium	24.2	36.1
Considerable	35.3	27.7
Large	23.3	6.9

There was a statistically significant difference between the two cohorts on this dimension (U=15224.5, z=5.46, p<0.001, r=0.27), with younger participants reporting significantly higher levels of satisfaction. This finding is in line with both the literature and the consistently less critical estimations from participants in the younger cohort. Even more illustrative are the somewhat lower levels of satisfaction in the older cohort, where nearly two thirds of respondents report medium or lower satisfaction levels. This is especially crucial in light of preparation for the receiving of the sacrament of Confirmation. As such, pupil views on the personal value of this sacrament were explored in qualitative interviews.[68]

What does Confirmation mean to you?

The Confirmation is a sacrament in which, according to Catholic doctrine, the Holy Ghost is given to those already baptized in order to make them strong and perfect Christians and soldiers of Jesus Christ (Catholic Dictionary, Stravinskas (ed), 2002). As such, it is a particularly important event in the lives of believers and the Church itself, incorporating a strong sense of religious belonging. In the 8th grade, RE is symbolised by the preparation of pupils for this sacrament, which is expected to be accompanied with strong religious sentiment and intrinsic identification with the teachings of the Church. However, pupils' responses from the qualitative part of the study suggest that, amongst most 8th grade pupils, this is not the case. In fact, analysis indicates that the receiving of presents from extended family, an event that has become the norm in the Croatian religious tradition of Confirmation, seems to be the most prominent signpost and motivator for pupils:

'I: What does Confirmation mean to you personally?
P: Presents.
I: That is it? Nothing else…
P: We learned that Confirmation should be the receiving of the gifts of Holy Ghost and getting closer to God, but I don't perceive it and experience it like that. Most of others do not feel it but see it through presents.'

This is mirrored in the answer of another pupil to the same question:

68 For the purpose of further between-group statistical analysis, pupils' results were categorised in the following manner. In the younger cohort, two groups were formed: lower levels of satisfaction (none to medium) and higher levels of satisfaction (considerable and large) with 41.4 and 58.6 percent of the participants, respectively. In the older cohort, three categories were formed: lower (none and small – 29.2 percent), medium (36.1 percent) and higher (considerable and large – 34.6 percent) levels of elicited satisfaction.

'You know it, don't you? It's presents. Everyone in the class, me included, is happy because of the money they are going to receive.'

Or similarly:

'P: It is great that I will get presents.
I: What about the meaning of Confirmation itself?
P: That is really not important to me.'

Some pupils also expressed confusion about the meaning of the event in their life:

'I: Are you looking forward to the Confirmation?
P: Nothing special. I do not get it, teacher says you are connecting with God and I don't get it because I don't feel any connection.'

While this sentiment seemed to be present in the majority of participants, some pupils, primarily girls, declared they were not so interested in presents. However, their answers also lacked any indication of an intrinsic religious connection to the receiving of the sacrament:

'P: I mean you believe in God and that's like a confirmation that you are part of it all. My granny is very religious, so for me it is more important because of her. And to tell you frankly I would also like to get confirmed and I do not care about presents like 90% of my friends. If I have other sacraments, I should also get confirmed.
I: Do you feel it is like getting closer to God or just one of the events?
P: More like an event, as you know I am not quite a church type.'

The same sentiment is expressed in the words of another pupil:

'It is important because I believe in God, but it is not very important because I do not feel it has such significance in life. However, there are no reasons that I should not get confirmed.'

In fact, within the entire qualitative group, only one pupil, a boy, expressed a pure intrinsic interest in Confirmation:

'P: It means really a lot. I feel it is one of the more important events in my life as a believer, but in general also. I feel very close to my religion and my Church and this makes me happy.
I: Do other pupils have similar feelings?
P: Of course not. The talk is only about the presents and sometimes I wonder why, at all, do they attend RE and go to Church.

These findings hold great importance in our consideration of pupils' sense of belonging as they signify a lack of intrinsic connection to the receiving of the important Sacrament. The importance of the event is viewed through the receiving of material gifts and money, a sentiment diametrically opposite to the nature and meaning of the Sacrament. Those who claim not to be motivated and interested in the material gifts accompanying Confirmation express their motivation in the more traditional and external terms of getting the Sacrament, rather than through what it means for their existence and belief. This problem was confirmed by an RE teacher, who stated:

'You see how few of them come to Church after the Confirmation, they just want to get the Sacrament and presents and that is it.'

Indirectly, pupils' views on Confirmation reveal RE's failure in internalising the religious message behind the Sacrament and motivating pupils to perceive it as an important event in their life and religious and personal development.

Pupils reports on the frequency of parental Church attendance

Alongside educational influences, the intensity of religious affiliation and feelings amongst parents, the frequency of their Church attendance and the resulting exposure to religious influence at home represent a significant and direct influence on pupils' religiosity and attitudes towards religion and the Church. It was presumed that estimating parent level of religiosity would be a difficult task for pupils, thus risking somewhat skewed answers. Instead, pupils' estimations of the frequency of their parents' Church attendance was examined. The rationale for the inclusion of this item was that it represents an elegant, although indirect way of assessing the importance placed upon religion, religiosity and attendance of Church ceremonies in pupils' families. The frequencies of pupils' responses on this item for each cohort are presented in Table 6.10.

Table 6.10: Pupils' reported frequency of parental Church attendance

How often do your parents attend Church services	6th grade	8th grade
Never	12.7	16.3
Few times in a year	27.2	39.1
At least once a month	15.5	13.9
At least once a week	34.3	26.7
More than once a week	10.3	4.0

There was a statistically significant difference in the estimations of the two cohorts, with older pupils giving lower estimations ($U=17670.5$, $z=3.27$, $p<0.001$, $r=0.16$). This finding might be attributed to the generally less critical mode of responding in the younger cohort.[69] From the data, it is evident that pupils' estimations of their parents Church attendance differ significantly from their own (Wilcoxon signed rank test; 8th grade: $z=9.01$, $p<0.001$, $r=0.45$; 6th grade: $z=5.30$, $p<0.001$, $r=0.26$). Namely, parents appear to attend Church services less frequently than their children, with more than half of 8th grade pupils and two fifths of 6th grade pupils reporting that their parents attend services up to few times a year only.[70]

69 For the purposes of the further between group statistical analyses, in the case of both cohorts, pupils' answers were categorised in two groups: less frequent parental church attendance (never to a few times a year) with 39.9 percent of younger respondents and 55.4 percent of older respondents and more frequent parental church attendance (all other categories) with 60.1 percent of younger and 44.6 percent of older pupils.

70 The estimations of Church attendance of pupils and their parents are significantly positively correlated in both cohorts (r (6th grade)=0.580, df=213, $p<0.001$; r (8th grade)=0.365; df=202, $p<0.001$). The lower correlation in the case of the older cohort might be attributed to inflated Church attendance due to activities associated with Confirmation.

The difference between the estimations of Church attendance in the case of the 8th grade cohort is graphically in Figure 6.1.

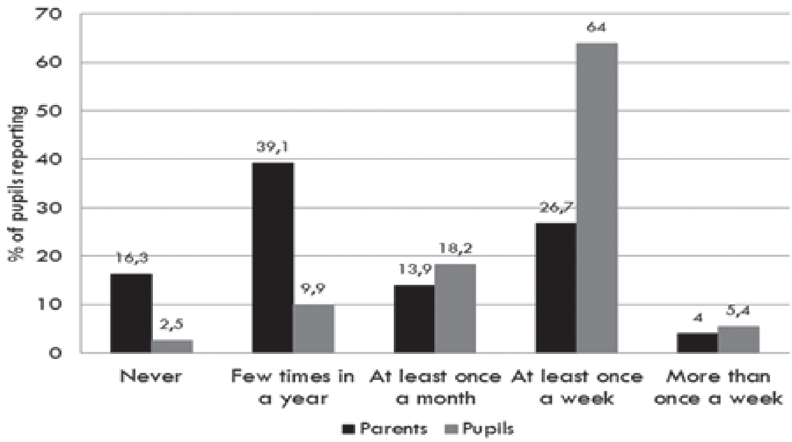

Figure 6.1: Comparison of pupil estimates of self and parental Church attendance

A number of factors might have contributed to the apparent discrepancy between these two estimates. First, higher attendance among pupils is somewhat expected due to their position on the path of insertion into the Catholicism through Confirmation. Secondly, since pupils are taking part in confessional RE, it seems logical and natural that they need to complement religious teaching and experience from both classroom and Church. Thirdly, lower parental attendance of Church services could be attributed to a more traditional form of belonging to the Catholicism characteristic for Croatia that implies less practical forms of religiousness amongst certain strata of believers. In both cohorts, there was no difference in estimations according to gender and academic achievement.

The discrepancy between parent and pupil Church attendance was also evident in the responses from the qualitative part of the research, as indicated in the response matrix presented in Table 6.11. In this part of the research, pupils' responses similarly allowed for the examination of parent religiosity and Church attendance, as well as further exploration of the relationship between familial influence and pupil profile.

This illustrative data indicates several interesting patterns. First, it triangulates with the finding from quantitative data that suggests parents attend Church services less often than their children. Secondly, it seems that, in both cohorts, fathers attend Church services much less frequently than mothers. Although it would be inadequate to presume that familial influence directly determines pupil profiles with respect to scientific/religious worldview, and indeed the familial setting could foster both worldviews at the same time, the data does suggest the following:

- In the High Religion profile, pupils depict parents as more religious and attending Church services more frequently.
- In the middle group, there is no clear pattern with respect to parents' Church attendance.
- In the High Science profile, at least one parent never goes to Church in most cases. In several cases, pupils declare at least one of their parents to be an atheist or agnostic. This absence of parental religious feelings and attendance seems more prevalent in the older cohort.

These results indirectly signify that, although the categorisation of pupils into worldview profiles by their teachers should be considered a coarse and unrefined process, an important element of the ascribed worldviews stems from parental influences.

Table 6.11: Interview responses from pupils regarding familial Church attendance

		Mother Attendance	Father Attendance	Illustrative quotes
6th grade	High RE Low Sci Profile	Every Sunday	At Christmas	
		Every Sunday	Regularly	We go to Church every Sunday, only my father misses sometimes because of work.
		On religious holidays	On religious holidays	Whenever they can they go and we always say a prayer at the table.
		Every Sunday	Every Sunday	We talk about religious issues especially around Easter and Christmas.
	Med RE Med Sci Profile	Yes	Sometimes	Mom and sister go to Church and my father only sometimes. They are believers but they do not obey all the rules.
		Only on religious holidays	No	My dad is not really religious. When he comes to our house, the priest always preaches to him. Mom also does not have time so she just goes during holidays. We do not talk about religion much at home.
		At Christmas	At Christmas	They believe in God but do not go to Church.
		Every Sunday	Never	
	Low RE High Sci Profile	Every Sunday	Atheist	My Mom has had a hard life so she goes to Church often and my Dad does not believe in God.
		Often	Often	We go to Church together and discuss issues when, for example, someone lies about something.
		At Christmas	Never	They believe in something but they do not go to Church.
		Often	Never	Mom prays a lot and frankly it is boring sometimes.
8th grade	High RE Low Sci Profile	Monthly	Monthly	
		Regularly	Regularly	They are believers, but I go more often to Church than them.
		Often	Often	They go to Church regularly. They are much more religious than me.
		Regularly	Regularly	We all believe in God.
		Every Sunday	Every Sunday	We often go, every Sunday. There are six of us in the family and religion and Church are very important for us.
	Med RE Med Sci Profile	Often	On religious holidays	Mom always forces me to go to Church because my sister goes. My father does not go that often. Sometimes Dad starts discussing with my Mom if all of that exists and if Jesus has resurrected …We are always on Mom's side, we believe.
		Rarely	Rarely	I discuss things with my brother who is a historian and it gets quite fierce.
		Sometimes	Almost Never	Both of them are religious but mom goes to Church more often. I am a bigger believer than both of them.
	Low RE High Sci Profile	Agnostic	Atheist	Both of my parents are not believers. Dad is an absolute atheist and Mom is more like me, she is just not sure.
		Monthly		My Mom divorced and she thinks it is in order and nice to go to Church. She believes God exists and has quite traditional attitudes towards religion. I am much more critical.
		Once a week	Twice a week	My Dad is very religious and Mom a bit less. He goes to Church twice a week and she manages only once as she has to take care of us. There are six of us in the family.
		Atheist	Atheist	We talk rarely as they do not know much about Church or Jesus, but they support me in attending RE.
		Never	Never	My Mom has not been baptised because my Grandpa was an atheist and my father is baptised but they never go.

6.2.1.3. Belonging: A summary

Pupils from both cohorts clearly state their affiliation with the Catholicism and Catholic Church, a finding both expected and natural due to their choice to attend formational teaching into the Catholicism. Although participants from both cohorts were aware of other Christian confessions as well as major world religions, specific knowledge and its accessibility seemed higher among the older participants. Identification with the Catholicism seemed more prevalent among younger participants and was directly connected with a distinction from other confessions. This conceptualisation appeared in one of two major positions amongst this group: one proposing the equality of confessions and the other expressing a view of *'inferior others'*. The external influences on this position come from dual sources - parental and educational, with pupil responses indicating that the educational influence latently suggests the superiority of teachings of a specific confession to those of others. From the quantitative data, it is evident that pupils frequently attend Church services. The attendance is more frequent in the 8th grade as they prepare for the important sacrament of Confirmation. Data on the elicited satisfaction from Church attendance indicates higher levels of satisfaction in younger participants, while the responses from older pupils reveal significantly lower levels of satisfaction. The qualitative data suggests that pupils place a generally low intrinsic and religious value on the receiving of the sacrament, with material gifts and money as main motivators. Pupils' answers also indicate significantly lower levels of Church attendance amongst their parents, a finding confirmed by the qualitative data, which further suggests that attendance is especially low amongst fathers.

Undoubtedly, RE informs pupils' sense of belonging to the Catholicism and their knowledge and attitudes towards other religions. Arguably, however, it fails in different manners in each cohort. While the younger cohort exposes higher levels of identification with their own confession but lower levels of tolerance and interest in learning about the others, the older cohort seem more interested in others and less intrinsically connected with their own religion. A lack of intrinsic relation is especially evident in the context of receiving the sacrament of Confirmation, where pupils seem motivated by material and financial gifts. This situation is clearly triangulated in the differing levels of satisfaction elicited from Church attendance. Another vital issue arising from all measures of belonging is the importance of parental influence on all aspects of pupils' religious life.

The fact that pupils attend confessional, formational RE in schools and attend Church services may lead us to the conclusion that the content of their faith is uniform and exclusively defined by their Catholic belonging and the teachings of the Catholic Church. However, further qualitative analysis indicates vast differences amongst pupils in the ways they define the object and nature of their own belief. This crucial element in pupils' conceptualisation of religion will be discussed next.

6.2.2. Believing

The choice to attend confessional RE might often be seen as a direct indication of pupil and parent religious affiliation. Although this simplified fact has certain informational value regarding belonging, it is often misused and does not provide sufficient insight about the nature of an individual's belief. Religious affiliation and personal belief are complex and inherently individual endeavours, thus it would be misleading to conclude that belonging to a certain religion exclusively determines in what and with which intensity one believes. At the age and developmental level of the participants, one could assume that this personalisation of belief would generally be at the beginnings of its development. Furthermore, the nature of formational RE conducted in the communal settings of both classroom and Church might contribute to a dominance of the agreed-upon universal teachings of the Catholic Church, thus resulting in more uniform patterns of belief. In interaction with parental influence, this might result in various manifestations of belief in pupils' cognition.

As such, it was important to determine whether pupils' belief could be scaled with respect to reported levels of religiosity. In order to examine participants' level of religiosity, a self-report item worded: 'If you consider carefully, how religious are you?' was included in the questionnaire. The response options and frequency of answers from participants in both cohorts is presented in Table 6.12.[71]

Table 6.12: Pupil responses on level of self-reported religiosity

Level of self reported religiosity	6th grade	8th grade
Not religious at all	2.4	5.5
Somewhat religious	26.1	39.8
Religious	52.6	49.2
Very religious	18.9	5.5

A Mann Whitney test ($U=16163$, $z=4{,}580$, $p<0.01$, $r=0.24$) indicated a statistically significant difference in self-reported religiosity between the two cohorts, with younger participants giving higher estimates. These results, in line with previously reported findings and the literature, might be attributable to a number of reasons. First, as the literature on religious thinking presented in Chapter Three indicated, the age of participants in the older cohort could be characterised as being at the beginning of a period of critical examination of concepts such as religion and Church and of an overall rebellion towards authority. As such, the more reserved positioning on the scale of religiosity from the older cohort would not be surprising. Secondly, the fact that one fifth of the younger cohort describe themselves as *'very religious'* might be indicative of a less critical attitude among 6th grade pupils, a finding in line with their generally less critical reporting on most items.

Regardless of the reason, these results present an interesting platform for further discussion. For a substantial number of pupils, the predominant, and on many occasions only, interaction with Church teaching is through formational Catholic RE, a condition which makes pupil responses on this item somewhat unanticipated as one of the main goals of the subject is to cultivate

71 For the purpose of the further between group statistical analyses, the responses from the younger cohort were categorised into three groups: lower (not religious at all and somewhat religious – 28.5%), medium (52.6%) and high (18.9%) self reported religiosity. In the case of older cohort, pupils were divided in two groups: lower (not religious at all and somewhat religious – 45.3%) and higher (religious and very religious – 54.7%) self reported religiosity.

a true and intense relationship with the teachings of the Church. Approximately one third of the younger cohort and nearly half of the older participants gave a reserved estimation of their religiosity, characterised by *'not at all religious'* and *'somewhat religious'* responses. This is especially central in the context of the older cohort's preparation for Confirmation, which should have found them at the 'peak' of their religious development. Furthermore, this is an important and slightly worrying finding for the developers of the confessional RE curriculum and its respective teachers. It is also interesting to note that, among the older participants, the categories *'not at all religious'* and *'very religious'* yielded equal frequencies.

Additional testing for statistical significance between gender and academic achievement groups revealed no effect of any of these variables in both cohorts. The lack of difference on the achievement variables should not be surprising as the literature does not suggest such a difference and, in the Croatian case, this seems even more logical when one considers that all participants chose to attend RE classes. However, the lack of difference between genders might be more surprising, especially when the literature suggests higher levels of religiosity amongst females. The lack of difference on this variable may be attributed to the aforementioned social circumstances, but even more so to the formational nature of Catholic RE in Croatian education.

Pupils self reports of religiosity are significantly correlated with other indicators of Church belonging, as the correlations presented in Table 6.13 suggest.

Table 6.13: Correlating self-reported religiosity with other indicators of religious belonging

	Church attendance	**Parents' Church attendance**	**Satisfaction with attendance**
6th grade Self-reported Religiosity	0.408 211, p<0.001	0.378 208, p<0.001	0.435 210, p<0.001
8th grade Self-reported Religiosity	0.429 201, p<0.001	0.422 200, p<0.001	0.507 200, p<0.001

Not surprisingly, all correlations in this Table are positive and statistically significant. Furthermore, the appropriateness of using parental Church attendance as a coarse estimation of parental influence on religiosity seems to be supported by the statistically significant correlation between this variable and self reported level of religiosity. It is interesting to note that this correlation is higher in the case of the older cohort. However, as correlation analysis does not allow for causal reasoning it is impossible to determine causality amongst these variables.

In the following sections, discussion will be centred on pupils' descriptions of their objects of belief and the ways in which they communicate with them.

6.2.2.1. Object of belief

When asked about the object of their belief, almost all participants from both cohorts state they believe in God. However, the stated complexity of their conceptualisations and explanations of what God is for them differ significantly.

Younger participants express their belief in God in anthropomorphic and exclusively monotheistic terms. For them God is *'only one, and not many of them'*, *'Christian God'* and *'Almighty'*. Very rarely did pupils in this cohort stray from this somewhat simple, albeit accurate (from the Catholic standpoint) understanding of the object of their belief. Faith itself was connected with the general and positive ideas of being good, helpful, loyal and trustworthy. In contrast, the answers of pupils from the older cohort were much more complex and revealed a transition to a more personal understanding of religion and their own beliefs:

'I believe in God, but through my consciousness. He gives us our inner I. I also believe in miracles, but one needs to be careful about these.'

Another example of more personalised belief:

'I believe in God, but I do not believe in the Bible and all those stories. Actually, it is hard for me to believe in something that does not have any proof. My teacher says that for belief one does not need any proof, but I disagree.'

Although this excerpt includes themes that will be covered later in the text, such as doubt and one's personal relationship with objects of belief, it is evident that the understandings of older participants extend beyond the presented conceptualisation provided by RE lessons. Their responses indicate an augmented personal engagement with the covered issues as well as differing points of the formation of an individual position.

Surprisingly, if we simplify pupils' conceptualisations to anthropomorphic and non anthropomorphic conceptualisations of the Supreme Being, the quantitative data does not reveal any difference between the two cohorts (χ^2=4.69, df=2, p>0.05, Cramer's V=0.11), as indicated by Table 6.14.

Table 6.14: Pupil conceptualisations of the Supreme Being

I envisage the Supreme Being as:	6th grade	8th grade
Man	40.9	40.2
Woman	0.5	2.5
Supernatural force without particular shape	40.9	44.2
Something else	17.7	13.1

The frequencies in this table indicate that participants in both cohorts are split between anthropomorphic and non-anthropomorphic conceptualisations of God. Between-group testing on variables of gender, academic achievement, achievement in science, categorised religiosity, Church attendance and satisfaction as well as parents' Church attendance did not yield any statistical differences. The present research does not offer any answers as to what lies behind pupils' dichotomous conceptualisations.

Characteristics of God as an object of belief

As stated, a large majority of younger respondents from the qualitative study envisage God in anthropomorphic terms, a finding in line with those from the literature. For those that envisage God as human, He is exclusively male, usually with a long beard and hair and blue eyes:

'I envisage Him in a robe with a beard and long hair. He is good, honest and would help anyone.'

For the minority of pupils that do not envisage God anthropomorphically, the concept of God is defined in more abstract terms as *'goodness'*, *'triangle'* or *'love'*, with some pupils visualising God in terms of religious vocabulary as a *'spirit'* or an *'angel'*. For example:

'I don't think of God as a human. It is something that thinks, but does not have a physical appearance or body.'

Amongst the older cohort, an anthropomorphic description was less prevalent and more complex conceptualisations of God appeared. Even when they did describe God in anthropomorphic terms, older participants were less concerned with His physical appearance, as articulated by one pupil:

'He is normal, like any other human. He knows everything and he is kind, but I doubt that he has never sinned.'

Older pupils more often did not use human characteristics to describe their conceptualisations of God, for instance:

'P: Almighty Supreme Being which knows man's present, past and future.
I: Can you describe its characteristics?
P: It is very good. It loves sinners too and it just wants that the sinners redeem themselves and confess.'

Or in the words of another participant:

'I believe in God but I do not envisage his appearance. It is something superior, higher, good and full of mercy and helping.'

Regardless of appearance, God is associated with extremely positive connotations and characteristics for most participants in both cohorts. For them, God is *'good', 'full of justice', 'graceful'* and *'powerful'* and is associated with *'love'*, *'goodness'* and *'peace'*. These characterisations are hardly surprising and embed the positive aspects of believing and association and a personal communication with something that pupils' perceive as valuable and dear.

6.2.2.2. Communicating

One of the important features of pupils' religious beliefs is the nature and means of personal communication with their object of belief. Although pupils state several methods of communication, it is mostly through prayer that they communicate with God. For both cohorts, this is almost consensually determined, with participants defining their communication in terms of daily activities and personal situations, as well as the time of day. For most pupils, communication appears through evening prayer just before going to bed or during RE classes and Church services. The content of communication seems to be almost entirely determined by three contextual elements: personal situation, school activities and duties and sport activities. Many participants reported communicating with God before tests or important sport matches:

'I usually talk to God in the evening when I pray, or before we have important tests in school.'

Or in the case of another pupil from the younger cohort:

'I speak to him during prayer, when I do not understand something or… when I have to memorise a poem to do it as quickly as possible, or when I shoot a ball, that it goes through the hoop.'

Some pupils, mostly girls, express the context of their communication in terms of personal situations or emotional states:

'I talk to him in times of worry or when I am sad, for example, because of my brother and his illness.'

Or in the words of another pupil:

'I pray when I think of my uncle who has cancer and for others who are ill. I also pray when I think of another relative that killed himself, so I pray to God to save or cure someone.'

As these quotes illustrate, communication with God is, for most pupils, defined in concrete terms and strongly embedded in the context of their everyday lives and activities. Although this more instrumental communication could be understandable from the point of view of pupils, it might pose a serious problem for both their belief and attitudes towards RE. Pupil responses often indicated that they find themselves in a conflicting situation after that which they prayed for did not turn out as expected.

'I: So you pray before a test, and what happens if you do not get the grade you have expected?
P: That's a problem. I start to question if He exists, for example I think I will get at least B when she (teacher) examines me and I get C or D. Then I get angry.'

Or in the case of an older participant:

'I start doubting when, for example, we have a test and I did not understand the material though I have really studied. And then I pray for a better mark and I get D.'

Behind these simple words lies another serious problem, characterised by the practical needs of pupils' prayers in light of their participation in formational, confessional RE and its existence in the school setting. While the main goal of RE should be to foster pupils' belief in the Catholicism and promote adequate communication, on a spiritual and abstract level, to serve the needs of the believer, this is often not possible for various reasons. Namely, the younger cohort appears to be at a cognitive level that does not enable them to grasp these issues in more abstract terms, potentially leading to the depiction, definition and instruction of communication in more practical terms by RE authorities and teachers. However, by doing so, they raise the potential for the instrumentality of communication for pupils, while at the same time jeopardising the spiritual aspects of communication and exposing pupils' communication to potentially dangerous attribution patterns. This might be the case especially in the older cohort, who is both more critical and able to grasp religious spheres more abstractly.

6.2.2.3. Attitudes towards Christianity

One of the important measures in the present research was an estimate of pupils' attitudes towards Christianity (Francis et al., 1991). Descriptive statistics for the data derived from this scale as well as between-cohort statistical testing is presented in Table 6.15.

Table 6.15: Statistical description of pupil responses on the scale of attitudes towards Christianity

	M	SD	t	df	p	r
6th grade	24.19	4.03	6.35	400	0.000	0.30
8th grade	21.36	4.88				

The results suggest that both cohorts hold very positive attitude towards Christianity: where the maximum possible score is 28, the younger cohort had a mean score of more than 24 and older pupils scored over 21. This positive attitude is not surprising due to the nature of confessional RE and the wider social and educational issues related to religion, the Catholic Church and this subject. There is a statistically significant difference between the two cohorts, with a considerable effect size in the direction favouring more positive attitudes amongst younger pupils. This finding triangulates with the literature and previous results and is suggestive of a decrease in positive attitudes towards various aspects of religion with maturation. In addition, these results seem consistent with the overall trend towards less critical estimations by the younger cohort. There is no difference in attitudes between genders in each of the cohorts and there is no significant interaction effect between cohort and gender ($F=2{,}383$, $df=1, 402$, $p>0.05$). A consideration of the differences between cohorts for each gender reveals an interesting finding in which, for both genders, the cohort difference is statistically significant, yet the effect size of the difference amongst male participants is much higher than is the case for the female participants (r boys=0.40, r girls=0.23). This suggests a bigger drop in boys' attitudes towards Christianity as they progress to higher grades than for girls.

Table 6.16: Attitudes towards Christianity – Group differences

Variable	value	df	r	value	df	r
Self reported religiosity	**F=42.88***	**2, 199**	**0.55**	**t=8.35***	**188**	**0.52**
Parental Church Attendance	**t=5.19***	**202**	**0.34**	**t=6.00***	**191**	**0.40**
Satisfaction with Church attendance	**t=10.25***	**201**	**0.58**	**F=56.59***	**2; 191**	**0.61**
Gender	t=0.56	205	0.04	t=1.51	193	0.11
Academic Achievement	F=0.74	2; 200	0.08	F=0.98	2; 188	0.10
Achievement in Science				F=1.73	2; 191	0.13

* p<0.01

The findings presented in Table 6.16 indicate that gender and achievement variables did not yield any significant difference, whilst grouping of pupils on the other three variables resulted in statistically significant differences. Post hoc testing and comparisons of means suggested clear patterns: in both cohorts, those who report higher levels of religiosity and higher levels of satisfaction from Church attendance have more positive attitudes on the scale. The same can be said about those whose parents attend Church services more often.

6.2.2.4. Believing: A summary

The presented data indicates that pupils reported religiosity levels decreases with age. The same can be said about attitudes towards Christianity which, although generally positive in both cohorts, are significantly lower in the older cohort. In both cohorts, there were no between-groups differences in any of the applied measures, suggesting a homogenous stance across genders and academic achievement levels. Furthermore, pupils in both cohorts predominantly defined God as their object of belief. However, conceptualisations of God differed in complexity, with younger pupils conceptualisations being simpler and predominantly anthropomorphic. Together, these findings suggest that the personalisation of belief appears and increases with age and maturation. It also confirms the basic argument that a sense of belonging does not necessarily determine the nature and intensity of one's belief. As will be presented in the next chapter, the manner in which RE is conceptualised throughout elementary education might have contributed to these cohort differences, as the way RE is taught does not always complement and follow this developmental progression.

The inclusion of the present form of RE in mainstream education becomes particularly problematic in light of the negative attribution patterns arising from pupils' communication with objects of belief concerning school tasks and duties. Arguably, the responses from the older cohort, despite the effects of maturation and the development of a more critical stance, once again point to the inefficiency of RE to engage pupils in the religious aspects of their life by making its teachings and message meaningful and important for them. For some pupils, this lack of intrinsic involvement may lead to a rejection of religious teaching and respective worldview. Along this vein, the following section will discuss the expressions of doubt amongst participants.

6.2.3. Doubting

The discussion in the two previous sections demonstrated that, although pupils clearly articulate a sense of belonging to the Catholic Church, their specific beliefs gradually personalise as they progress through their education. For some pupils, this personalisation includes the development of certain elements of doubt in their beliefs and the teachings of the Church, as they are presented in RE. The qualitative data indicates that traces of doubt, differing in both their nature and intensity, exist amongst participants from both cohorts.

Most participants from the younger cohort rarely express serious doubts about their belief, even when their prayers and demands are not fulfilled:

'I: So for example, in the cases when your prayers are not completely fulfilled, do you ever doubt in God?
P: No never. He doesn't always fulfil what I demand, but that is not happening every time, maybe just once in five times.'

Or in the words of another participant:

'Sometimes I doubt, like when my prayers are not fulfilled, but I know He is here with us.'

In other instances, the instrumental value of prayer and other communication patterns appear:

'No....Well sometimes in the match when I do something well, but I still do not score.'

Or in the case of pupils with more general concerns:

'Sometimes I doubt, because good poor people are living on the streets and greedy bastards are rich.'

These excerpts suggest that the emergence of doubting amongst younger participants is characterised by the instrumental and practical value assigned to their communication. Even when pupils explained their doubts in beliefs or objects of belief, it is largely framed within the concrete terms of unfulfilled expectations. Rarely do these doubts touch upon topics such as God's existence or other core elements of their belief. As such, these doubts do not seem to present a problem for RE teachers and classroom practice, as one RE teacher explains:

'Younger pupils seem to be more religious and there is no disorder in the classroom or this irritant doubting and criticism present in the older grades.'

Amongst older participants, expressions of doubt include sentiments similar to those of their younger schoolmates, but are additionally more elaborate and cover wider aspects of religiosity, Catholicism and the Church. Even amongst pupils who report not having any feelings of doubt, participants use words indicating an ability to consider and accept the possibility of doubt:

'I believe God exists and I never doubt, like some others. I think He is among us, that He is present.'

Reasons for doubting, as expressed by pupils themselves, range from uncertainties about religious dogmas, miracles and other aspects of Church teachings to overall reservations about the existence of the Supreme Being and, most especially, the role of Church in society and the life of priests. These sources for doubt range from a questioning of particular ideas:

'Some things are weird for me. For example, I do not know whether to believe in the appearance of Mary.'

To expressions of doubt concerning wider concepts:

'I believe in most things, but I seriously doubt in life without sin. I do not believe that the priest or my teacher is without sins, nor was God or Jesus Christ.'

Several pupils expressed doubt about more fundamental religious teachings:

'I doubt in miracles, in some presumptions that cannot be understood or proven, for example the Adam and Eve story. That just doesn't go in my head.'

Or in the case of another pupil from the older cohort:

'I believe in God and his existence, but I think that the Bible is completely false. It is made up - just a book. People wrote it not to be bored.'

Some pupils expressed uncertainty about the existence of God:

'You know what…I often wonder if there is anything in all these stories. If God existed he would not make my life and the world like this.'

All excerpts indicate the existence of a critical stance towards certain teachings of the Catholic Church. For some, this scepticism reaches a level approaching, or already arriving at, a rejection of their Catholic beliefs. In fact, these excerpts seem to suggest that confessional RE has not succeeded in its aim to shape pupils in the worldview of a specific confession. Participants expressing doubt, ranging from small traces to potential rejection of religious teachings, are present in all three categories of interest in science and religion. Interviews carried out over the course of one year indicated that the development of doubt appears in both directions, and in different forms and rhythms. Some pupils initially portrayed their belief in terms of traditional religiosity, but later expressed serious doubts and traces of rejection as rapport between pupil and researcher was established. In contrast, one participant, who expressed a blanket rejection of Catholicism in the initial interviews, came closer to a personally defined religious position by the end of the interview process.

In general, three patterns of these processes arose in the qualitative cohort. These patterns will be presented as mini cases, with interview excerpts from three participants in the older cohort used to illustrate these patterns. At the beginning of the research all three participants identified feelings of Catholic belonging and a non-anthropomorphic belief in the Supreme Being. The first case, Zrinka, is a female pupil from the Lower Religion interest group. Her case serves as an example of a pupil who was already very critical and unsure about her own religiosity at the beginning of the research process and whose pattern of attitudes and beliefs did not change as the research process progressed.

BOX 6.1: ZRINKA

Zrinka resembled a typical high achieving pupil who, at our first meeting, firmly stated that, aside from school, she was also occupied by attending swimming lessons, language classes and ballet. She also reported being obsessed with a German boy band and stated that boys teased her and her friends for listening to this music. She appeared to be an independently-minded girl, who teachers described as *'bright but tough'*. She thought of RE as an easy subject, although adding that, when she personally considered some of the covered topics, they sometimes seemed difficult to comprehend. Specifically, Zrinka expressed a problem in grasping the catechetic stance on life after death and the position of atheism in Christian theology. In later interviews, it emerged that both of Zrinka's parents declared themselves not to be very religious, her father an atheist, and that she had recently lost a close relative. During initial interviews, when asked about her own beliefs, Zrinka stated:

Z: Sometimes I feel something and sometimes nothing. It depends on the situation. When I need something, or when I am alone I do feel; but when I am angry I do not.
I: Would you say faith is important to you?
Z: No, not very, on a scale from one to five, probably less than three. I think that at my age I should not be occupied with these things.

As the year passed on and various topics of conversation emerged, Zrinka further elaborated her position:

Z: I am a believer, but I do not believe in those stupid things about Adam and Eve. I believe more in science. I like when there is some evidence about things you are saying. It is easier to believe when there is evidence.
I: Do you ever have doubts about what the RE teacher tells you?
Z: Almost always, I mean why would I believe in some bullshit from 1000 years ago!
I: How about what your science teachers tell you?
Z: No, you know it can all be proven.
I: So when did you start having these doubts about things taught in RE?
Z: I think already in the fifth grade when we started seriously covering this material.

Though critical about some of the teachings of the Church, Zrinka was positive about both RE and her RE teacher:

'I like the teacher. Although I do not agree with what she says, she listens and discusses things with us.'

At the end of the research process, and in light of the forthcoming Confirmation, her religious stance held the following form:

Z: I guess I am happy because of Confirmation. After all you can marry in the Church, be someone's godfather or maid of honour. That is also a part of religion as when you are confirmed you are somehow a better believer.
I: So how would you describe now your beliefs?
Z: I do not mind God, but I seriously dislike the Church. They determine rules and have an influence on people. I have a problem with that. They are here to help people and not to dictate the rules to people.
I: Do you think you will take RE in high school?
Z: I do not think so, because in RE each year you seem to learn the same thing.

The case of Tonka, a female pupil placed in the Medium Religion/Medium Science interest group, is also very illustrative. Although Tonka clearly identified herself with the Catholicism, she expressed an inability to internalise and rationalise the materials covered in RE.

BOX 6.2: TONKA

Like Zrinka, Tonka does well in school and enjoys popular music, but in interviews she appeared more insecure, at times almost frightened. As an illustration of her shyness, she was the only participant refusing to appear in the group photo at the conclusion of the research. Tonka stated that her parents were religious, but that they did not go to Church every week although her mother went more often than her father. Tonka's position on religion could best be described as confused, with the school catechesis arguably serving as the main contributor to her confusion. Initially, Tonka described RE as an easy subject, but her words revealed that this sentiment was only within the context of assessment:

'It is easy. Everyone has an A but it is also boring. I do not understand these topics. Today we covered Virtues in the Catholic context. I find it stupid. I am upset that the teacher says that we should not watch Da Vinci Code because it is a sin, and she herself has not seen it or read the book.'

As interviews progressed, Tonka came back to her religious doubts:

'I: How important is your faith to you?
T: Not as much as our teacher wants from us, not even half. She herself can't explain and understand well these things – miracles, the Creation, Adam and Eve…She says it is all symbolic, but I don't know what to believe anymore. How could children of Adam and Eve make their own children?'

Tonka's thoughts indicated that, while she does not have a problem with believing, she experienced difficulty rationalising catechetic teaching despite her efforts to make the presented material coherent. She explained her feelings about one fundamental problem embedded in the RE material:

'They told us that the thing of Adam and Eve is just a story and it should not be taken literally and I get it because their actions would be incestuous…I understand what symbolic or metaphoric means but why did they lie to us for so long telling us that it actually happened?'

The interviews with Tonka ended on a similar note, with the catechetic teachings failing to serve as a clarification of her belief, but as an element of further confusion.

I: Are you looking forward to Confirmation?
T: Not especially. Frankly I do not get this, as the teacher said you are connecting to God, but I don't feel anything.
I: How do you envisage this connecting with God?
T: I don't have a clue, the teacher says a lot of things, but I've never seen or heard anything. It is all confusing for me. I do not know what I feel, if it is God or nothing.
I: Tell me Tonka, how would you describe yourself as a believer?
T: I believe in God, but I am not sure if I am a believer if I do not feel this connecting with God. I think I am, I am going to Church, I pray and I believe in God, but this connecting is completely unclear to me. It is all so complicated; everyone offers their own explanations which are all full of presumptions and unknowns.

Jasna, the third case, is a female pupil placed in the High Science group. This is an example of a pupil who was extremely critical of her belief and the Church from the beginning, but who arrived at a different point by the end of the research process.

BOX 6.3: JASNA

Jasna did not achieve the same high grades as Zrinka and Tonka because, in her words, *'I just slack too much'*. This sentiment was shared by her teachers who thought highly of her abilities, but much less of her working habits. With her parents divorced, she lived just with her mother, who she reported to be traditionally religious. In the initial interviews, Jasna was keen and interested in discussing issues on science and religion. In her first interview, she was very critical of the Church:

'I think God exists, though I am not completely sure, and it's OK there is organisation that takes care of that, but I really think Church exaggerates. They are very restricting to the behaviour of people'.

And in our second meeting:

'I believe God exists, but not as it is written in the Bible. I think the Bible is completely made up but I do not discuss it with my teacher. What should I tell her, who is all about the Bible, with my attitudes that it is fabricated and made up?'

Jasna was similarly critical of RE, a subject she proclaimed to be uninteresting, unimportant and, surprisingly, difficult to understand:

'How can this be understandable if it is based on something that does not have any proofs, all those biblical stories…'

She later elaborated:

'I think it should not exist because if you believe you don't need a subject to tell you that. I don't want to be offensive, but all these stories about how it is good for your connection with God, how it enriches your belief…all of this is illogical and stupid.'

For Jasna, things changed in the second phase of the qualitative study, mainly due to a change of RE teacher. She reported becoming more interested in classes and, in her words:

'I find RE slightly better than last year, mostly because of the teacher. The one from last year was OK, but this one seems more liberal and open as she does not impose the opinions of Church'.

Overall, this seemed to result in a generally more positive attitude towards religion. Jasna seemed to demonstrate a reconciliation of her previous criticism towards the Church with the benefits of her own faith, as her answer clearly depicts:

'I am still bothered with some Church stances and opinions as I find them stupid, for example sexuality, contraception and abortion, but I have came to a point when I realise I do not have to be some super believer to have a good relationship with God. I simply think that this year God and I have it better than the last year.'

From these three mini cases and other qualitative data, it was possible to identify three elements that appeared to contribute to pupils' doubts and the potential rejection of the religious teachings presented in RE. These are:

- Parental influence
- Pupils' cognitive development
- Critical attitude towards the Church

Parental influence

As already discussed, pupil reports seem to suggest that the development of doubt and the potential for rejection is more probable amongst pupils whose parents do not place an emphasis on religion and Church attendance. In contrast, those exposed to religious influence in the home, as well as in school, are more likely to integrate Church teachings and accept elements of religious worldviews. Both RE teachers were aware of the importance of this influence:

'This change starts happening in the 7th grade, but I have a feeling that the problem is in parents. They are not religious and they do not attend Church services.'

The complexity of this influence was further expressed in the words of this RE teacher:

'You know when parents criticise the Church, priests, the Church's material assets, or question why new Churches are built instead of giving money to different causes, then it is no surprise that pupils adopt this attitude.'

Pupils' cognitive development

Certain elements of pupils' cognitive development also have the potential to challenge acceptance of the material presented in RE classes. Arguably, the ability to deal with more abstract materials alongside the emergence of critical thinking and the ability to hold and evaluate contradictory assumptions represent one of the major challenges of confessional RE in Croatia. Indeed, the teaching and contents presented in the catechetic nature of confessional RE often have problems in bridging these transitional points of pupils' cognitive development. This is most evident in the case of the teaching and learning of creation. As will be elaborated in the next chapter, it is only in the 8th grade that pupils are instructed that the story of creation should be understood in more symbolic, rather than literal, terms.[72] Problems arise when the very same educational material, such as the story of creation, has been for years explained by the same teacher in more concrete terms. With the development of critical thinking skills, pupils are in a position to challenge this sudden switch in teaching, which in turn becomes additional fuel for the critical stance towards this standpoint and the Church as the provider of these teachings.

Pupils' critical attitude towards the Church was one of the most prevalent sentiments appearing in the qualitative part of the research. As a discussion on parental influence was already presented in several parts of the text and a discussion on the influence of pupils' cognitive development on the acceptance of RE material will follow in the next chapter, a more detailed analysis of the factors informing pupils' critical attitude towards the Church will now be presented.

6.2.3.1. Pupils' critical attitude towards the Church

'They are very conscientious of priests. They have their own little stories about those priests who live apocryphally and they mention this as their obstacle for going to Church because you can't preach one thing and live something else.'

These words from the RE teacher reveal just one of the problems she and her colleagues have when trying to motivate teenage pupils to attend religious services and to internalise RE teachings. In conjunction with the factors of parental influence and cognitive development, the critical stance of pupils towards authority in general, and to the Church specifically, is one of the main obstacles for a more successful adoption of a Catholic religious worldview.

72 Thus, in the earlier grades, the story of creation was not metaphoric, but a concrete story with real characters and a set of actions. From a developmental point of view, this is arguably understandable as the most of the younger pupils could not absorb and adequately understand the incorporated metaphor.

Much of this criticism is connected with the role of the Catholic Church in Croatian society, as one RE teacher explains:

'The negative aspects are always emphasised in the media, but the Church also does so much good. I am sure it is a positive force in society, but they are especially interested in the lives of priests, richness of the Church…'

As stated in the second chapter, the Catholic Church clearly has an important historical, traditional and political role in Croatian society and education. This influence is evident and permeates through most aspects of Croatian life and, as such, it would be expected that pupils have an established opinion regarding issues on which the Church puts forward an opinion. Qualitative interviews uncovered a range of topics and issues in which pupils are critical of the Church's influence. From these, three main themes were isolated as indicators of pupils' stance towards the Church's opinions. These were:

a) Stance of the Catholic Church towards the book and movie 'Da Vinci Code'

This book and subsequent movie have attracted the attention of the public due to its interpretation of certain historical facts about the teachings of the Church. Various confessions throughout the world have emphasised the inaccuracy of the statements and hypotheses presented in the book. The Catholic Church was particularly vocal in its criticisms and recommended its followers not to read the book nor watch the film. At the time the research was being conducted, the film was in cinema distribution in Croatia, which gave rise to a debate in the media and general society concerning the film and the Church's position and was a topic that arose in pupil interviews.

b) Stance of the Catholic Church towards sexuality and contraception

Certain elements of the Church stance on issues concerning sexuality seemed difficult for many pupils to accept. For example, the RE curriculum in the 7th grade includes a segment entitled *'Dignity of the human body and marriage purity'* and states as one of its aims:

'Critically expose the most common anomalies in the field of human sexuality: obscenity, prostitution, paedophilia, rape, pornography, but also masturbation and homosexuality.'

In addition, the RE curriculum for both 7th and 8th grades includes a recommendation to RE teachers to emphasise the Church's negative stance towards the use of contraception.

c) Stance of the Catholic Church on a Non-Working Sunday

On the 10th of September, 2006, the Croatian Archbishop Josip Bozanić stated: *'As both Christians and a Church, we are not satisfied with the unsolved issue of working on Sundays and we will continue to warn against the insensitivity towards the humane, social, cultural and religious value of Sunday. We are continuously receiving cries from those who are underprivileged in their accomplishment of their human right.'* Opponents of the Church's position have put forward an argument that the right to work is one of the crucial human rights and that the Church should not force their stance. Reflections of this debate were evident in pupils' responses.

In Table 6.17, the position of 8th grade pupils on the Church's stance on all three issues is presented according to pupil groupings in the religion/science interest groups. Here, the most personal issue for pupils seems to be the Church's stance towards sexuality, while the other two issues reflect pupils' responses to the involvement of the Church in wider social issues. Although these three topics cover different spheres and levels of both social and personal life, thus evoking differing reactions, it is clear that, regardless of profile, most attitudes are in opposition to the Church's stance towards these issues. In general, this oppositional stance towards the Church's teaching is suggestive of the formation of an individualised critical positioning towards social spheres, but also of the failure of the RE curriculum to present the Church's stance in a manner that would be understandable and acceptable for pupils.

Table 6.17: A depiction of critical attitudes towards the Church: Pupil interview responses

PROFILE	'Da Vinci Code'	Sexuality and contraception	Non-Working Sunday
High R Low S	AGAINST I have watched it and it's very strange. I don't get all the fuss around it but I think Church doesn't have a right to say do not watch it as everyone should make a decision for himself.	AGAINST Church says that it is a sin to have sex before marriage but I think people should act upon their feelings.	
	AGAINST I find stupid what Church said about that. If my faith is strong nothing will separate me from my beliefs.	AGAINST It is too old fashioned. Church needs to get in tune with how young people think and what they do.	AGAINST I think people should be allowed to work on Sundays. Maybe God wants us to work on Sunday if we need money to feed families…
	AGAINST I don't think it was ok to tell us not to watch a movie. It is a movie after all.	AGAINST For me it is OK to do it before marriage.	AGAINST People should work if they want.
	UNDECIDED They have a right to say what to think but I think they should not ban things like movies. These opinions are counterproductive as they just raise the popularity of it.	UNDECIDED The Church should say what they think, like with the same sex relationship where I support them completely…Regarding the premarital sex I am a bit undecided. Maybe they have exaggerated a bit but who knows if they said it is ok to do it before marriage, maybe it would be even worse.	UNDECIDED Well, maybe the Church has gone a bit too far. In a city of this size you need to have places to buy the goods even on Sunday.
	AGAINST I think they should be more concerned with faith and not what movies people watch.	AGAINST That I really cannot accept.	AGAINST It is silly. For me Monday is same as Sunday.
Med R Med S	AGAINST	AGAINST Sex before the marriage? Why not. I think that Church is not right. I don't know why they are against that. Same thing about contraception, because how are we going to protect ourselves.	AGAINST
	AGAINST I think it is completely unjustified that Church forbids believers to watch a movie. I watched it and I don't think now I believe less.		
	AGAINST I don't believe that it is a sin to watch a movie. Nobody can claim that he or she knows what happened to Jesus regardless of what has been written in the Bible.	AGAINST	AGAINST

PROFILE	'Da Vinci Code'	Sexuality and contraception	Non-Working Sunday
Low R High S	FOR I have heard about the book and a movie and I know what they say. I think that what is said is not truth. I will never believe in that.	FOR I think those (who have sexual experiences before marriage) people are wrong. First marriage then sexual relationship.	AGAINST
	AGAINST Think about it. It is a sin to watch a movie. Hey, how stupid is that?		AGAINST There are a lot of believers in Croatia and Church makes an influence on them. I am bothered with that because they are here to help people not to tell them what to do and when to work.
	AGAINST I liked a movie, it would be good to know the truth…but Church always complains about things. They raised publicity of the movie so everyone went out to see it.	AGAINST It is stupid to ban anything. If someone likes something he can act accordingly	AGAINST That is particularly stupid. In the whole neighbourhood you can't buy bread and milk because it is a Holy day for them.
	AGAINST They have a right to express their opinion but they can't say it is a sin to watch a movie. It is a similar reaction to the one of Muslims because of those cartoons.	AGAINST Church's rejection of premarital sex and same sex relationships I find stupid.	AGAINST If people want to work they should be allowed.
	AGAINST Everyone should make a decision for themselves on what to watch.		

6.2.3.2. Doubting: A summary

Unsurprisingly, the intensity and nature of doubting in the two cohorts differ substantially, where the older cohort is more prone to a deeper examination of their own beliefs and RE teachings. The doubts of younger pupils are mostly rudimentary and characterised by less frequent probing of the fundamental concepts of their beliefs and Church teachings. Older pupils' patterns of doubt cannot be singularly described. Analysis indicates that doubting primarily comes as a result of home influences upon which RE can have very little influence. The second stream of influence comes from pupils' personal development to which the conceptualisation of the subject does not seem to be adequately attuned. The third element influencing processes of doubt comes from pupils' criticism of the Church that, although already present in society and amongst their parents, is augmented by pupils' cognitive development. Here, RE should take a more prominent role in explaining the Church's views on differing aspects of social life by presenting arguments acceptable to pupils. The present results indicate that RE has failed in this task. As such, it could be concluded that the way in which RE has been conceptualised and taught does not diminish prospects of doubting amongst pupils and in some ways, as will be presented in the next chapter, contributes to its development.

6.2.4. What do pupils say about religion? Integrating the three dimensions.

In both cohorts, there are limited between-group differences on all measures of pupils' religious attitudes and practices. The factor most influential in group differences, primarily apparent in the responses of pupils from differing interest profiles, is parental influence. This lack of differentiation within cohorts is more than compensated for in differences between cohorts, as summarised in Table 6.18.

Table 6.18: Summary of pupils' positions along three attitudinal dimensions towards religion

Dimension	Concept	6th grade stance	8th grade stance
Belonging	Belonging	Clearly expressed	Clearly expressed
	Identification with the Catholicism	Higher. Intrinsically interested in its teachings.	Lower, especially in light of Confirmation
	Knowledge and interest in other religions	Lesser knowledge and interest	Higher knowledge and interest.
	Satisfaction with Church attendance	Higher	Lower
Believing	Self reported religiosity	Higher	Lower
	Attitudes towards Christianity	Higher	Lower
Doubting	Character of doubts	Rudimentary, often practical	Deeper, probing own beliefs and Church's teachings
	Criticism towards Church	Non existent	Strong, elaborated and diversified

This summary of the findings from previous sections makes it apparent that younger pupils expose higher levels of belonging and believing and lower levels of doubting than older pupils. This confirms the hypothesized change in the form of pupils' religiosity and attitudes towards religion with maturation and cognitive development. These results triangulate with younger pupils' higher estimations of RE, as presented in the first analytical chapter. Together, findings indicate that the mission and content of Croatian RE seem better adjusted to the younger cohort. This was confirmed in interviews with RE teachers, as one teacher explains:

'As they progress into higher grades, the attitude that religion is not modern, that their parents do not believe so why would they, becomes more prevalent. Some pupils publicly start expressing the attitude that all of this has been made up, that they do not believe. However, they still attend the classes.'

Incorporating elements of the wider social climate towards religion, parental influence and the specific problems connected with participation in Croatian RE, this complex statement also confirms serious problems for the delivery of RE in the higher grades. This teacher further elaborated:

'Fifth graders accept everything and you can work well with them. I have to admit that sometimes I have problems with older pupils.'

The same sentiment is shared by the other teacher:

'It is so much easier to work with younger pupils. They seem more religious and they are not so stubborn or egocentric like 8^{th} graders who, sincerely, at times can be obnoxious.'

This teacher seems to refer to the religiosity of younger pupils in terms of their greater willingness to accept the programmed message communicated to them through the subject's catechetic curriculum. However, instead of outright rejection, the responses from all pupils point to a personalisation of religious belonging and believing alongside the necessary ingredient of doubting. This raises questions about the nature of a subject that does not take into account these elements of pupils' religious, moral and personal development as well as their critical consideration of the presented material and the world around them. Indeed, the failure of RE to follow pupils' cognitive and personal development and the teachers' resentment of these processes and subsequent inability to build upon them and thus foster pupils' religious development are indicative of the grave problems faced by this subject in Croatian elementary education.

6.3 THE RELATIONSHIP BETWEEN SCIENCE AND RELIGION

Pupils' conceptualisations and attitudes regarding science and religion have been considered in this chapter, but what remains to be explored is the intersection of these two domains in the next chapter. As an introduction to a discussion of the relationship between scientific and religious worldviews, a brief description of the views of older pupils and teachers on the relationship between science and religion is necessary.

Participants framed this relationship within topics in which the two worldviews intersect. Pupils consistently named life's origin and sexuality as two themes where science and religion provide differing explanations, a somewhat expected finding in light of the fact that both themes are included in elementary curricula in the context of each respective worldview. These intersecting points were also offered by teachers, as the first RE teacher explains:

'Connection? Hmmmm…I do not think there is much connection. Well, there is the teaching of creation and evolution, but I need to emphasise there is no conflict there. I constantly repeat to them that the Bible is not a scientific book and cannot be viewed like that.'

When questioned about the topic of sexuality, this teacher responded:

'Why would that be a conflict? I mean it's a problem, but…you know it is not easy living like a Christian in today's world but you have to accept it if it is your choice.'

In contrast, the second RE teacher perceived sexuality as a topic of serious discrepancy:

'When covering the human body, biology states that pupils should develop their sexuality by exploring and probing what is good for them. In this respect, the Church knows that if you start with such exploration of your sexuality this may result in unwanted consequences like premarital sexual relationships, or sexual abuse like masturbation.'

The biology teacher offered her perspective on the issues:

'They have their own thing and I teach my own. I don't poke in theirs and I don't expect that they will at mine.'

Pupils generally describe the relationship between science and religion as one of two associations: as separate and not connected or as entities in conflict. The first position is characterised by statements like *'I don't think they are connected'* or '*they don't have any connecting points*'. The second position was more elaborate and resulted in differing positions amongst pupils:

'They are in conflict now but I think they should be separated in order not to fight each other even more.'

Or in the words of another pupil:

'They fight because two opposite explanation can't be equally correct.'

One pupil, who expressed the highest levels of intrinsic religiosity, stated:

'They contradict each other only in the way of presentation, but actually they are saying the same thing. However religion is not science and it cannot be compared with sciences.'

All of these suggest that pupils have some conceptualisation of the relationship between the two domains. According to teachers, this association is transferred to the classroom, as explained by the second RE teacher:

'They come to me and say we learned it differently in biology and then go to biology and say the RE teacher said you are wrong. The programmes have contradictory contents and I think a lot more should be done in order to raise the level of connectivity between the two spheres.'

The biology teacher further reflected on this in the context of the introduction of RE into mainstream schooling 15 years ago:

'Fifteen years ago pupils did not ask any questions regarding these issues as I guess those who attended RE attended it outside of school. Then came a period where some pupils were aggressive about that and I found their questions provocative. They would ask me 'How can you say the evolution took place?' Now children try to reconcile the two positions.'

Together, these excerpts suggest that pupils and teachers are aware of the complex relationship between the two worldviews, which is reflected in the teaching of contradictory explanations in elementary education. As an illustrative example of the intersection of these views, a thorough consideration of the teaching of life's origin in Croatian elementary education and pupils' attitudes towards and reconciliation of religious and scientific explanations will be provided in the following chapter.

CHAPTER SEVEN: PERSPECTIVES ON THE COEXISTENCE OF RELIGIOUS AND SCIENTIFIC EXPLANATIONS FOR THE ORIGIN OF LIFE

It has long been debated whether a coherent educational system should incorporate, and even promote, contradictory or incompatible factual claims as a part of its curriculum. Proponents often state that, by being exposed to the discrepancy of coexisting claims, pupils are presented with a more complex and realistic depiction of specific issues and themes existing in society. Those opposed often emphasise that such presentation could produce confusion in pupils' cognitive framework, a position of particular importance considering that pupils' understanding of coexisting and discrepant stances may demand a certain level of cognitive development. For these reasons, such presentation is often purposely avoided at the elementary education level. However, the appearance of incompatible positions on certain issues is often not a result of a designed pedagogic plan, but rather the somewhat random and unintentional reflection of the coexisting worldviews already present in a specific society. What is important for the purposes of the present work is that, in Croatian elementary education, both religious and scientific domains offer knowledge claims and stances that exist at varying levels of discrepancy with each other.

This is perhaps most vivid in the teaching of topics on personal development and sexuality, offered in both biology and Catholic RE curricula in Croatian education. This readily apparent but complex discrepancy is not so much the result of the difference between scientific discoveries and knowledge claims and religious teachings, but a reflection of specific cultural standpoints and inherent ideological stances occurring in Croatian society. A more subtle, and for the present work more central, incongruity is evident in the teaching of the origin of life, as offered by both science subjects and RE. As part of its curriculum, RE covers creation as one of its key concepts from the first grade and in each subsequent grade. In contrast, biology covers the theory of evolution in the first and last lessons of the 7th grade and then again in the final lesson of the 8th grade. Elements of evolutionary theory are additionally covered in the sixth grade in geography, namely through teaching on geological development and eras, as well as through the mention of both chemical and physical evolution in 7th grade chemistry and physics.

It should emphasised that education is not the only medium through which differing explanations of life's origin became apparent and inform pupils' stances on the issue, with the media and, more importantly, family and peers serving as sources of information for pupils. Nevertheless, education represents a unique platform where concepts embedded in both explanations are presented in a systematic manner with clearly defined aims, contents and expected learning outcomes.

It seems clear that the coexistence of such contradictory explanations has the potential to result in pupils' confusion over certain aspects of this important issue, eventually leading to the rejection of a specific explanation. As the concept of origin is central to both religious and scientific worldviews, this rejection may be perceived as a failure of the educational efforts of each respective subject to foster a specific worldview. The following analysis will indicate that, in the Croatian case, the content of the explanation is not the only divergent feature of these two positions, but that the presentation of each respective explanation of origin is carried out in opposing pedagogical manners.

In order to establish the nature and scope of the explanation of the origin of life and to illustrate the difference in teaching approaches between scientific and religious education for this topic, the content of both explanations in the respective subject plans and programmes will be presented through a documentary analysis of the subject curricula of RE and biology. In addition, two vignettes depicting RE and biology teachers' views on the issue will be presented. This will be followed by an exploration, using both quantitative and qualitative data, of pupils' attitudes and inclinations towards creationist or evolutionary explanations of the origin of human and other life.

7.1. WHAT DOES THE SYSTEM SAY?

The discussion on the inclusion of scientific and religious explanations of the origin of life at the system level will first be discussed through a consideration of their presence in the respective subject curricula. This will be followed by a consideration of teachers' perspectives on the issue.

7.1.1. The origin of life in the subject curricula

Key concepts, recommendations for pedagogical approach as well as expected learning outcomes are provided in the plans and programmes for each lesson of all subjects, allowing a subject comparison of the educational process at various levels. The following tables present such a comparison for the lessons covering the teaching of evolution in biology (Table 7.1) and the teaching of creation in RE (Table 7.2 – grades 1 to 4; Table 7.3 – grades 5 to 8).

Table 7.1: Teaching of evolutionary theory in biology

Grade	Theme	Key concepts	Recommendations for teaching method	New terminology	What pupil needs to accomplish
7th	Emergence of life on Earth	Chemical and biological evolution, fossils, geological eras	Based on what we know, raise a question: every life form is created by the parental form, but how have the first organisms originated? Employ discussion, debate and demonstration of diversity of life forms, experiment: life only from living.	Organic connections needed for development of life, geological eras, fossils, palaeontology, geology	Knowledge: • to know and understand that nature is in a constant process of change • Explain the appearance and development of life on Earth as a fundamental part of evolution
7th	Evolution	Proofs of evolution, Darwin's notion of changeability of organisms, elements of evolution	Systematization of proofs of evolution, work with fossils, pictures, textbook Use examples of adaptability, the results of selection With natural materials, explain modification and mutation Use practical work – emergence of modification	Developmental line, comparative anatomy, development of embryo, transitional forms, fossils, changeability of organisms, natural selection, isolation, mutation, modification	Knowledge • Know that biological evolution is the gradual development of the live world • Explain the ways scientific notions constantly expand, complement and some of them change Skills • Critical thinking and logical reasoning as well as linking new knowledge
8th	Origins of Man	Bipedal movement, development of human's brain through evolution	Project tasks: library, internet, visit to a natural or archaeological museum, visit to the archaeological site in Croatia	Primates, Homo sapiens	Knowledge • understand the similarities between humans and hominoid monkeys because of common, although not direct, origin of first humans • differentiate human characteristics from those of hominoid monkeys and first humans

Table 7.2: Teaching of creation and other Biblical stories in RE – grades 1 to 4

Grade	Theme	Key concepts	What pupil needs to accomplish
1st	Wonderful God's world sings praise to God	God, creation, world, Earth	• discover and know that all that exists was created by God • recognise the size and beauty of nature around us • recognise the beauty of living God's creatures • thank God for gifts he provides us with • recognise the need and importance of the protection of nature and life creatures
	God, you have miraculously created humans	creation of humans, first humans, Adam, Eve, guardian angel	• retell, with the help of illustration, biblical report on creation of world and humans • name first humans • experience and communicate the feeling of gratitude to God for the gift of God • notice the importance of preserving the gift of God • learn the prayer Guardian Angel
2nd	Bible is the most beautiful book	Bible, Old testament, New testament	• name the holy book of Christians • understand that the Bible is the holy book which speaks about God and humans • recognise the Bible as a book which preaches about God's great actions • recognise and differentiate two main parts of the Bible: Old and New testament • get a first notion of the outspread of the Bible in the world
	The world is marvellous and miraculous	God is Creator, beauty of the created, care for nature, trust	• recognise and name some of the beauties of the created world (in us and around us) • marvel at the created world • notice the importance of trust in God the Creator • relate faith in God the Creator and need to protect everything created (care for nature)
	Man is God's wonderful creation	God's creation, diversity, equality, connectedness, gratitude to God	• recognise life as a gift • recognise and explain how humans, through their work, build the world • recognise and name differences and similarities among humans • note that all humans, despite differences, are equal and inter connected • recognise and name situations in which you can see that humans are directed towards each other
3rd	In unity we recognise the mysteries of God's goodness	Mystery of creation, loyalty, honesty, unity	• notice and recognise God the Creator in everything created
4th	Creating and protecting the world in unity	God's wisdom, God's goodness, man as-co creator, ecology	• notice the miraculousness and beauty of our planet Earth and whole Universe • know biblical report on creation of the world • discover and understand almightiness of God the Creator who creates everything wisely and well • retell biblical report of creation • understand concepts of Creator and co-creator • understand that God trusts upon man to be a master and a protector of nature
	Harmony of nature and the world - encounter with a good God	God is invisible and almighty, order in nature, God's traces and his announcement in nature, gratitude to God	• discover order and harmony in nature's beauty • understand that human is a special creature in comparison with all other life creatures because of his ability to think, feel and freedom of choice • develop ability to recognise God's traces in nature's order and harmony • understand that humans cannot see God with their eyes • learn and name some of God's characteristics (invisible, almighty, wise, good)
	Man in God's mirror and his gratitude to God	Human – miraculous being, human – a picture of God, gratitude to God	• get to know human as a special and miraculous being • describe similarities of human to God • understand that everything around us, especially humans, is proof that God exists • recognise that humans and all created world are God's gift and develop feeling of gratitude to God • in accordance with the psalms in the Old testaments, thank God and praise God

Table 7.3: Teaching of creation and other Biblical stories in RE – grades 5 to 8

Grade	Theme	Key concepts	What pupil needs to accomplish
5th	Bible: the special book of words and life	Bible, Old testament, New testament, author of the Holy Scripture	• describe the meaning of the word Bible • recognise that the Bible is the main source of the Christian faith but also the document of the Jewish religion • recognise and explain the specificity of the Bible in comparison to all other books • name the main parts of the Bible • name the fundamental parts of the Old and New testaments • compare and note the difference between Old and New testaments
6th	How to know, understand and use the Bible	World in which the Bible was created, literary forms in the Bible (historical books, law books, letters, prophet books, poems), Bible - The Word of God, biblical abbreviations, Chapters and lines	• show on the geographical map a region in which Bible originated • count the literary forms in the Bible and name some of the examples • recognise that the Bible is the mini library which incorporates many books • explain why the Bible is different than any other book • know biblical abbreviations and with the use of them find specific parts of the New testament
7th	Each one of us is unique and in need of another	Human as the pinnacle of creation, human as a unique person, human as a social being	• recognise yourself and others as the pinnacle of God's work of creation • experience and live your life in similarity with God
8th	Biblical and present picture of the world	Announcement, origins of the world, God the Creator, evolution	• differentiate natural and supernatural announcement • shortly interpret the meaning of the biblical notion of the creation of the world • name and shortly explain selected biblical texts about the creation of the world • explain the relationship between biblical and scientific notions of the world • with various means of creative expression, express feelings of admiration and gratitude for the created world • notice and explain humans' responsibility for the created world and its development
	Human is God's image	creation of man, man as an image of God, man's dignity, equality of man and woman	• shortly interpret selected texts on the creation of humans • explain the meaning and message of biblical talk on the creation of humans • understand why humans are the crown of God's creation • discover the beauty and dignity of man as a picture of God • explain the differences and equality of men and women • with various means of creative expression, express feelings of admiration and gratitude for the given life

In the curricular plan, biology presents evolutionary theory as a general framework in the 7th grade, placing lessons entitled *'Emergence of life on Earth'* and *'Evolution'* as the first and last lesson, respectively. Similarly, a lesson on *'The origins of humankind'* is presented as the last lesson of the 8th grade, thus serving as a concluding point for this subject in elementary education. Although restrained to grades seven and eight, the key concepts and expected outcomes articulated in the plans and programmes suggest that the theory of evolution is covered thoroughly and in sufficient detail for the elementary level. While evolutionary theory as an overarching framework comes to fore only in the 7th grade, material on the different forms of and relations between both flora and fauna are presented in grades 1 through 6 in the 'nature and society' and 'nature' subjects. Thus, the teaching of life's origins in science appears to be envisaged inductively from the presentation of specific knowledge claims up to the 7th grade to a teaching of the more general and overarching theoretical and empirical framework of evolutionary theory.

The teaching of creation, central to the catechesis of Catholicism, starts from the 1st grade. Here, the concepts of God the Creator and his creation of both the natural world and humankind, as it is written in the Bible, are introduced early and revisited in each grade. The presentation of these concepts is deductive, where general ideas are presented at the outset of the subject and then gradually complemented and diversified to more specific claims. In general, an analysis of the content, key concepts and expected learning outcomes of lessons on creation and the Bible reveals a thorough consideration of these topics in detail while taking into account pupils' cognitive development. Before the 8th grade, RE's account of origin is characterised exclusively by a literal understanding of the Biblical account. In the 8th grade, in a lesson entitled *'Biblical and present picture of the world',* this literal teaching is replaced by the suggestion that the Biblical account of creation should be considered symbolically. Consistent with this transfer in teaching are pupils' learning outcomes, where students are expected to know and retell the biblical account of the creation in literal terms up to the 7th grade but, from the 8th grade, the concept of biblical symbolism is introduced. As the following analysis indicates, this sudden switch in the teaching of creation and the understanding of the Bible represents an influential element in development of pupils' attitudes towards RE and their adoption of a specific worldview.

As expected, there is very little interaction between the teachings of these two explanations. Biology and other science subjects do not mention the religious explanation of origin at any point while the only mention of the coexistence of two different interpretations in RE appears in the 8th grade. Here, in the aforementioned lesson *'Biblical and present picture of the world'* the religious account of creation is related to science and the scientific account of evolution, stating that the two explanations do not contradict each other, but rather coexist in their effort to explain the origin of life and humankind. In many ways, this is a simplification of the Holy See's stance on the issue as discussed in the Chapter Three. While the theory of evolution is named as one of the key concepts of this singular lesson in the RE plan and programme manual, evolution is not specifically named in the RE textbook used by all RE teachers across Croatia.

7.1.2. Interacting explanations: teacher perspectives

As further illustration of the complexity associated with the teaching of life's origin, the following two vignettes describe the RE and biology teachers' views on this issue.

BOX 7.1: SECOND RE TEACHER

With three years of teaching practice, this RE teacher viewed herself as on the verge of shedding her inexperience. Throughout the research, she was cooperative and outspoken, exposing these same characteristics when speaking about the differing explanations for the origin of life. She initially referred to this topic when speaking about the RE content that pupils experienced problems comprehending, stating they had problems with some aspects of the catechetic teaching of creation. The following interview excerpt depicts this discussion in more detail:

'T: They have problems in understanding and accepting creation until you clarify things for them. When I tell them that evolution is necessary and it happened and that it took millions of years for everything then they can accept it.

I: Does, and in what manner, the fact that they have spent years learning this story differently contribute to their misconceptions?

T: Yes, it seems that it is hard for them to go from the literal understanding of seven days to a more symbolic one.

I: In your opinion, how should it be taught?

T: I used to have first graders and from the outset I would mention the symbolic understanding of the creation story, that it represents something else actually. I think the symbolism of the Bible should be properly explained so that it does not turn it into just a collection of stories.

I: Would that be in the catechetic spirit?

T: I think yes, but it depends on who is the teacher. If the teacher is a nun, I guess it would not be so, but I am from the younger generation with university education. You can see that, if you teach kids that Moses split the Red Sea, in the 8th grade he will laugh at that and then he will come to me and ask me how come the Church lies and how can they tell stories like that. And when I say it is symbolic, he then says that the Bible was inaccurate from the outset. The result is the same: the Church is lying again and tells stories for children.'

This excerpt illustrates the differing perspectives towards teaching not only creation, but RE in general. Describing her personal conceptualisation of creation and its relation to evolution, this teacher comes close to a position of theistic evolution stating:

'The world has not been created in seven days, but through evolution. However, the initial thing, that first atom of creation is God's work. The work of a creator, after which, evolution and everything else came. The Church also recognises all of these scientific discoveries but you need to know that without God and his direction nothing would be like it is. The creation of the world has symbolically been described in seven days in order to show that there was some rule which directed everything and to show people they should rest on the seventh day.'

Although the teacher stated her belief in evolution and emphasised the Church's acceptance of the theory, it became apparent that she had some problems with the acceptance of the evolutionary explanation as discussion progressed:

'I: Would you say that you accept all parts of evolutionary theory?
T: Hmmm…Humans.
I: What about them?
T: …that we have originated from monkeys. Maybe first prehistoric men were similar to monkeys, but…Church does not recognise that we have originated from monkeys and I share that view completely.'

This teacher's words indicate a relative acceptance of evolution within the boundaries determined by the Church's stance and in a way that does not endanger core Catholic concepts. It might be argued that this stance, presented to pupils through RE, further supplements an already confusing and inconsistent presentation of the origin of life and might contribute to pupils' confusion.

The case of the biology teacher is similarly illustrative.

BOX 7.2: BIOLOGY TEACHER

The words of the more experienced biology teacher did not offer any more consistency, where she also expressed doubts about the evolutionary account of life's origin that she teaches:

'The things science have proven, those evidences of evolution such as fossil remains, developmental orders etc… that is firm, but if you used that to conclude that amphibians have originated from fish that is just an assumption, just a philosophy. And I tell them openly that it is an assumption.'

She further added:

'For the origin of the planet and life, there is no material evidence. Even for the development of life on Earth you have limited evidence, 90% of it is what Darwin philosophised.'

Whilst the above quotes illustrate a personal position regarding evolution, this teacher is obliged by the subject plan and programmes to teach evolution in a prescribed manner. However, her frank answers suggest that she does so in a half-hearted manner:

'I teach in the manner asked from me and within the limitations of my own understandings and conceptualisations. I can't teach well things I do not understand well, things which are unclear and abstract. And for me, in many ways, evolution is abstraction.'

Although firmly believing in evolutionary processes backed by physical evidence, this teacher emphasised that she had problems accepting the evolutionary background of humans:

'I can sincerely confess that I do not believe in it. I mean there is no evidence. It is a hypothesis.'

These excerpts reveal a significant discrepancy between what the teacher is asked to teach and what she personally believes. In her description of her own beliefs, she stated:

'I do not believe in a creationistic stance myself either. I am in absolute doubt about these things…see, I don't know what to believe. I have spent years trying to find a compromise, to reconcile the two positions, but there is no reconciliation between the two.'

Both the elements presented from subject curricula and teachers' views offer a multitude of perspectives central to the discussion of the present chapter. First, it is evident that the two subjects, reflecting two worldviews, offer different explanations for the origin of life. Secondly, they approach the presentation of this topic in two different manners: while the teaching of evolution in elementary science instruction is inductive, the approach to teaching the story of creation is best described as deductive. Thirdly, there appears to be very little interaction between the two explanations, resulting in the coexistence of these two positions without any mutual consideration of the other explanation. Further, there exists the somewhat problematic transfer from a literal to symbolic presentation of creation and other catechetic teaching in RE. Finally, teachers' practices regarding these contents often contradict the programmed message in their respective subjects and are influenced by their own stance on the issues. Arguably, all of these factors might have a direct influence on pupils' adoption of a specific explanation for life's origin with respect to cohort and other grouping variables. More specifically, the coexistence of the two positions in the absence of any interaction has the potential to result in pupils' personal accommodation of the two explanations, resulting in new forms of understanding, or more dangerously, to contribute to their confusion. These ideas will be explored next in a discussion of both qualitative and quantitative findings concerning the nature of pupils' understanding of these coexisting explanations.

7.2. WHAT DO PUPILS SAY? (QUANTITATIVE RESULTS)

7.2.1. Cohort differences in Biblical literalism

As stated, teaching of the creation story is envisaged exclusively in literal terms in the first seven grades. For this reason, the younger cohort in the present research has only been taught this way of understanding the Biblical account of creation. The older pupils, in addition to being exposed to both the story of creation and evolutionary theory, have been instructed on the symbolic account of the Biblical texts. While the level of cognitive development of the younger pupils might further contribute to their stance on the correctness and factual accuracy of the literal account of creation, the higher level of cognitive development amongst older pupils might cause them to be less inclined to accept biblical literalism. As such, both curricular and developmental elements might result in a greater prevalence, among younger participants, of a literal explanation of creation.

The results presented in Table 7.4 confirm this by indicating a statistically significant difference between cohorts on the scale of Biblical literalism, where younger participants show greater belief in a literal version of Biblical accounts than their older colleagues.

Table 7.4: Biblical literalism – Cohort differences

Biblical literalism	M	SD	T	df	p	r
6th grade	16.44	4.86	3.22	385	0.001	0.16
8th grade	14.88	4.62				

The results suggest that the levels of biblical literalism decrease with pupils' progression to the higher grades. Relatively high levels of biblical literalism in the younger cohort, expressed by a mean of 16.44 on a scale ranging from 4 to 24, is indicative of this groups' inclination towards a literal understanding of the story of creation.

7.2.2. Between groups differences in Biblical literalism

In addition to cohort differences, the present research included a consideration of between group differences in relation to Biblical literalism, as presented in Table 7.5.

Table 7.5: Biblical literalism – Between group differences

Biblical literalism						
Variable	**6th grade**			**8th grade**		
	value	**df**	**r**	**value**	**df**	**r**
Self-Reported Religiosity	**F=20.33**	**2,193**	**0.42**	**t=6.30**	**183**	**0.42**
Parents' Church Attendance	**t=4.08**	**197**	**0.28**	**t=4.81**	**183**	**0.34**
Satisfaction from Church Attendance	**t=5.58**	**198**	**0.37**	**F=29.96**	**2,182**	**0.50**
Gender	t=0.97	199	0.07	t=1.14	184	0.08
Academic Achievement	F=0.45	2,194	0.06	F=0.18	2, 179	0.04
Achievement in Science				F=0.72	2,182	0.09

* p < 0.01

In both cohorts, there are no statistically significant differences between academic achievement and gender groups. However, for the other three variables, statistically significantly differences between groups existed for both cohorts in the same direction. Namely, those reporting lower levels of religiosity express lower levels of biblical literalism and vice versa. Furthermore, those experiencing higher levels of satisfaction from Church attendance express higher levels of belief in and accuracy of the biblical account. Finally, the same can be claimed for those whose parents more frequently attend Church services and events.

7.2.3. Pupils' understanding of the Bible

In addition to the scale of Biblical literalism, two further questionnaire items probed pupils' understanding of the Bible and the story of creation in particular. The first dealt specifically with pupils' opinion on the ways in which the Bible should be considered and understood. Here, three positions of this understanding were taken into account. The results, expressed as percentages of frequencies, are presented in Table 7.6.

Table 7.6: Pupils' understanding of the Bible

Which statement better describes your opinion	6th grade	8th grade
Bible is the word of God and should be understood literally	37.9*	17.3
Bible is the word of God, but should not be taken literally	43.0	59.9
Bible is a book written by men and is not a word of God	3.7	9.9
I cannot decide/I do not know	15.4	12.9

*Numbers in this and future tables in this chapter are expressed in percentages of pupils responding, unless otherwise noted.

Chi square testing revealed a statistically significant difference between participants from the two cohorts ($\chi^2=27.84$, $df=3$, $p<0.001$, $r=0.26$). Visual inspection of the frequencies reveals that while more than a third of younger pupils hold the position that the Bible should be understood literally, a slightly higher percentage of respondents in this cohort incorporate both catechetic stances expressed by God's authority over the Bible and an attitude that its contents should not be taken literally. In the older cohort, this latter position is dominant, with almost three fifths of older pupils responding as such, whereas the percentage of those who read the Bible's contents in a literal fashion drops to approximately 1/6th. It is interesting to note that, in the older cohort, one in every ten pupils does not believe that the Bible is the word of God, whereas this stance is very rare amongst the younger participants. As was the case for the scale of biblical literalism, with age, the notion that the Bible should be understood literally is replaced by either a stance of more symbolic understanding on one side, or a stance of negation of God's authority over the Bible on the other.

Chi square testing of between groups differences on this item yielded results similar to those for the scale of Biblical literalism, and are presented in Table 7.7.

Table 7.7: Pupils' understanding of the Bible – Group differences

Understanding of The Bible						
Variable	**6th grade**			**8th grade**		
	value	**df**	**Cramer's V**	**Value**	**df**	**Cramer's V**
Self-Reported Religiosity	**14.70**	**6**	**0.19**	**23.67**	**3**	**0.34**
Parents' Church Attendance	7.02	3	0.18	**13.30**	**3**	**0.26**
Satisfaction from Church Attendance	**22.56**	**3**	**0.33**	**29.73**	**6**	**0.27**
Gender	0.27	3	0.04	1.73	3	0.09
Academic Achievement	9.93	6	0.15	8.91	6	0.15
Achievement in Science				**16.83**	**6**	**0.21**

* p < 0.01

Response distributions for each answer, expressed as percentages, on variables that have reached statistically significant differences are presented for each cohort in Table 7.8.

Table 7.8: Pupils' understanding of the Bible – Response distribution

	Bible is the word of God and should be understood literally	Bible is the word of God, but should not be taken literally	Bible is the book written by men and is not a word of God	I cannot decide/I do not know
6th grade				
Religiosity				
High	51.3	25.6	0.0	23.1
Medium	40.2	45.5	2.7	11.6
Low	26.7	46.7	8.3	18.3
Satisfaction				
High	49.2	34.7	0.8	15.3
Low	21.3	55.1	7.9	15.7
8th grade				
Religiosity				
High	25.7	63.3	4.6	6.4
Low	7.7	56.0	15.4	20.9
Parental Attendance				
High	25.8	59.6	4.5	10.1
Low	9.8	60.7	14.3	15.2
Satisfaction				
High	24.7	56.5	2.9	15.9
Medium	19.2	68.5	4.1	8.2
Low	6.8	52.5	25.4	15.3
Achievement in Science				
High	15.2	71.2	10.6	3.0
Medium	15.2	66.1	6.8	11.9
Low	21.1	44.7	11.8	22.4

In the younger cohort, the majority of pupils in the category of higher self reported religiosity and higher satisfaction with Church attendance were inclined towards the statement *'The Bible should be understood literally'*. In the medium religiosity group, along with this position, pupils chose the position of *'The Bible is the word of God, but should not be taken literally'*. This position was dominant for those expressing lower levels of satisfaction with Church attendance and lower levels of religiosity, groups in which approximately eight percent of pupils agree with the position *'The Bible is a book written by men and is not the word of God'*, a stance almost non-existent amongst pupils in the other two categories.

The results for the older cohort reveal similar patterns, but due to the cohort difference, the most prevalent response has shifted to the *middle* position. Once again, those with higher levels of religiosity agreed more with a position of literal understanding whilst those in the group of lower religiosity more readily agreed with the position that the Bible is a book written by men or were more unable to choose a stance on the issue. Those expressing highest levels of satisfaction gave the relatively highest percentage of answers in the literal position, while those in the lower satisfaction group more readily chose the third option. In this cohort, the frequency of parents' Church attendance also featured as a variable in which a statistically significant difference was established. Although the middle position was dominant in both groups, those whose parents attend Church services more frequently were more inclined towards a literal position whereas those whose parents attend services less frequently were relatively more inclined towards a belief that the Bible was not the word of God. Finally, there is a statistically significant difference between groups according to scientific achievement, the core of which lies in the percentage of pupils who do not have an established stance or cannot make up their mind on the issue. Here, pupils from the lower achieving group were more likely to report an undecided response than those from the medium achieving group who, in turn, were more likely than the high achieving group to report the same.

7.2.4. Responsibility for the emergence of life

The focus of the second item exploring this issue probed pupils' views on the authority and responsibility over the emergence of life on Earth. In a straightforward fashion, pupils were asked about their views on the issue and results, expressed as percentages, are presented in Table 7.9.

Table 7.9: Responsibility for the emergence of life – Pupil responses

Responsibility for the emergence of the life on the Earth	**6th grade**	**8th grade**
God is exclusively responsible	36.9	22.2
God is responsible, but in the process of the creation of life, natural forces also took part.	39.3	54.5
Natural forces, and not God, are exclusively responsible	8.4	10.4
I cannot decide/I do not know	15.4	12.9

Once again, there was a statistically significant difference between the views of participants from the two cohorts (χ^2=13.53, df=3, p<0.01, Cramer's V=0.19). The results suggest that the opinion of exclusive responsibility of God's authority over the emergence of life declines with progression to higher grades, and is replaced by a more inclusive view of coexisting efforts of both supernatural and natural forces. It is interesting to note the almost unchanging percentage of those holding the opinion of the exclusive responsibility of natural forces in both cohorts, suggesting a stable number of pupils holds a naturalistic stance on the issue. Chi square testing of between groups differences on this item yielded the results presented in Table 7.10.

Response distributions for each answer on variables that have reached a statistically significant difference are presented for each cohort in Table 7.11.

Table 7.10: Responsibility for the emergence of life – Group differences

Responsibility for the emergence of life						
Variable	**6th grade**			**8th grade**		
	value	**df**	**Cramer's V**	**Value**	**df**	**Cramer's V**
Self-Reported Religiosity	**29.43**	**6**	**0.27**	**18.93**	**3**	**0.31**
Parents' Church Attendance	**29.32**	**3**	**0.37**	**26.18**	**3**	**0.36**
Satisfaction from Church Attendance	**36.27**	**3**	**0.41**	**46.65**	**6**	**0.34**
Gender	5.45	3	0.16	2.60	3	0.11
Academic Achievement	11.29	6	0.16	5.70	6	0.12
Achievement in Science				7.88	6	0.14

Table 7.11: Responsibility for the emergence of life – Response distributions

	God is exclusively responsible	God is responsible, but in the process of the creation of life, natural forces also took part	Natural forces, and not God, are exclusively responsible	I cannot decide/I do not know
6th grade				
Religiosity				
High	61.5	15.5	5.1	17.9
Medium	35.5	47.3	3.6	13.6
Low	25.0	38.3	20.0	16.7
Satisfaction				
High	50.4	31.2	1.6	16.8
Low	18.2	50.0	18.2	13.6
Parental attendance				
High	56.4	27.7	3.2	12.7
Low	21.4	47.9	12.8	17.9
8th grade				
Religiosity				
High	31.2	52.3	3.7	12.8
Low	12.1	57.1	18.7	12.1
Parental Attendance				
High	35.6	47.8	2.2	14.4
Low	10.8	60.4	17.1	11.7
Satisfaction				
High	43.5	44.9	1.4	10.2
Medium	13.7	68.5	6.8	11.0
Low	8.5	47.5	25.4	18.6

As with the two previous measures, statistical significance was achieved on the same variables and in the same direction. In the younger cohort, those expressing higher levels of self reported religiosity were more inclined towards a position of God's exclusive responsibility for the emergence of life. The groups of participants expressing medium and lower self reported religiosity was more disposed to a position of a combined responsibility. Finally, those with lower levels of self reported religiosity were more inclined to state that responsibility lies upon natural and not supernatural forces. Similarly, those with higher levels of satisfaction were more inclined to place responsibility for the emergence of life on God, whereas those with lower levels of satisfaction more frequently held a shared position or placed exclusive responsibility on natural forces. On this item, differences amongst groups according to parental Church attendance also reached statistical significance: those whose parents attended Church more frequently held the position of God's responsibility more often than those whose parents frequented Church less often. In contrast, this latter group more often reported a belief in the shared or exclusive responsibility of natural forces.

Although the *'shared responsibility'* position was dominant in both groups, those with higher levels of self reported religiosity in the older cohort more readily chose God as responsible and less readily chose natural forces. This pattern is repeated for the parental Church attendance variable, where those whose parents attend more frequently accepted the position of God's exclusive responsibility more readily, while the reported frequencies are in the opposite direction for the natural forces response. Finally, the same pattern is visible for the elicited satisfaction variable. The shared responsibility position is the most prevalent response in the medium satisfaction group with approximately equal prevalence in the other two groups.

All three of the above reported measures suggest that the understanding of the Bible and creation changes as pupils progress to higher grades of elementary education, where a literal understanding of Biblical accounts decreases and a more relative and symbolic understanding of the Bible and its texts emerges. Finally, with age, a predominantly supernatural explanation for the responsibility for the emergence of life on Earth is replaced by a view of a combined effort of natural and supernatural forces. In both cohorts, there are no differences between groups of participants on all three measures according to gender and academic achievement variables. In contrast, statistically significant differences did emerge between groups according to self reported religiosity, satisfaction with Church attendance and frequency of parents' Church attendance for both age groups. In general, those with higher self reported religiosity, higher levels of elicited satisfaction and more frequent parental attendance tend to report higher levels of biblical literalism, hold a position that the Bible should be understood literally and place the authority and responsibility for the emergence of life exclusively on God's creation. Unsurprisingly, those in groups expressing lower levels on the aforementioned dimensions elicit lower levels of biblical literalism, transfer the understanding of the Bible to a more relative and symbolic stance and assign the responsibility and authority of the emergence of life to a shared role of both natural and supernatural forces.

7.2.5. Evolution

The previous discussion suggested that a certain percentage of pupils hold a naturalistic stance towards the emergence of life on Earth. This finding was confirmed by several mirrored questionnaire items devised to probe the occurrence of such a stance among pupils, including the following general item presented in Table 7.12:

Table 7.12: Probing a naturalistic stance – Pupil responses

Item	Strongly disagree		Disagree		Agree		Strongly agree	
	6th	8th	6th	8th	6th	8th	6th	8th
Everything in this world is a product of natural forces and not God and other supernatural forces	46.0	19.9	30.3	49.5	15.6	21.4	8.1	9.2

Purposefully stated in a somewhat extreme and absolute manner, the responses to this item might be indicative of the existence and adoption of a scientific worldview. The results in Table 7.12 reveal that almost one third of older pupils and a quarter of the younger participants express some level of agreement with this statement. Once again, there exists a statistically significant difference in the responses of participants from the two cohorts (U=15851.5, z=4.31, p<0.001, r=0.22), characterised by higher levels of disagreement amongst the younger participants. Perhaps of even greater interest are the results of chi square testing between groups, presented in Table 7.13, illustrating those groups of pupils who tended to adopt this worldview more readily.

Table 7.13: Pupils' adoption of a naturalistic stance – Group differences

Adoption of Naturalistic stance				
Variable	**6th grade**		**8th grade**	
	Value	**r**	**Value**	**r**
Self-Reported Religiosity	**H(2)=24.12**	**0.41**	**U=2816**	**0.37**
Parents' Church Attendance	**U=3796**	**0.27**	**U=2669**	**0.40**
Satisfaction from Church Attendance	**U=2826**	**0.43**	**H(2)=22.11**	**0.39**
Gender	U=4956	0.12	U=4666	0.01
Academic Achievement	H(2)=0.19	0.03	H(2)=0.04	0.02
Achievement in Science			H(2)=0.46	0.05

*p<0.01

Frequencies, reported as percentages, for each answer on variables that have reached a statistically significantly difference are presented for each cohort in Table 7.14.

Table 7.14: Pupils' adoption of a naturalistic stance – Response distributions

Everything in this world is a product of natural forces and not God and other supernatural forces	**Strongly disagree**	**Disagree**	**Agree**	**Strongly agree**
6th grade				
Religiosity				
High	71.8	20.5	5.1	2.6
Medium	45.0	36.7	11.0	7.3
Low	27.6	25.8	32.8	13.8
Satisfaction				
High	60.2	32.5	5.7	1.6
Low	26.4	27.7	28.7	17.2
Parental attendance				
High	60.2	25.8	9.7	4.3
Low	34.8	33.9	20.0	11.3
8th grade				
Religiosity				
High	29.5	53.3	14.3	2.9
Low	9.0	43.8	30.3	16.9
Parental Attendance				
High	36.1	50.0	8.1	5.8
Low	7.3	48.6	32.2	11.9
Satisfaction				
High	27.1	56.1	10.6	6.2
Medium	23.6	50.0	22.2	4.2
Low	7.0	40.4	33.3	19.3

In both cohorts, no statistically significant differences existed between groups according to the gender and academic achievement variables. In the younger cohort, almost half of those in the lower self reported religiosity group expressed some form of agreement with the statement, with significantly smaller proportion of pupils in the two other groups reporting the same. This finding is strengthened by the fact that more than two thirds of pupils in the high self reported religiosity group strongly disagreed with the item. This response pattern was also evident with respect to parents' Church attendance, where almost one third of those in the lower attendance group and only every seventh pupil in the higher attendance group agreed with the statement. Furthermore, almost half of those reporting lower levels of Church satisfaction agreed with the statement in comparison to only 7.3 percent of those pupils reporting higher levels of satisfaction.

A similar blueprint is evident in the older cohort, where almost half of those in the lower self reported religiosity group expressed agreement with the item in comparison to one sixth of those in the group of higher self reported religiosity. The difference is even more evident with respect to parents' Church attendance, where 44.0 percent of those reporting less frequent parental attendance take a more naturalistic stance in comparison with 13.9 percent of those reporting more frequent parental attendance. Group differences are perhaps most evident between pupils with differing levels of satisfaction elicited by Church attendance, where more than half of participants reporting low levels of satisfaction, a quarter of those with moderate levels of satisfaction and only a sixth of those reporting high levels of satisfaction agreed with the statement.

Together, these results suggest that the occurrence of a naturalistic stance increases with age. It also seems that, in both cohorts, this stance becomes more prevalent with lower reported levels of self reported religiosity, less satisfaction with Church services and less frequent Church attendance by pupils' parents.

While the previous item examined the existence of a general atttitude towards a naturalistic stance characteristic of a scientific worldview, the older cohort, who are introduced to these concepts in their science curricula, was also presented with an additional item probing the role of evolution more specifically. The distribution of pupils responses, expressed as response percentages, is presented in Table 7.15.

Table 7.15: Probing an evolutionary position – 8th grade pupil responses

	Strongly disagree	Disagree	Agree	Strongly agree
Everything has been formed through the natural process of evolution over millions of years	12.8	31.5	37.8	17.9

Perhaps somewhat surprisingly, more than half of the respondents expressed some level of agreement with this statement. Between groups differences for this item are presented in Table 7.16.

Table 7.16: 8th grade pupils' adherence to evolution – Group differences

Adherence to evolution		
Variable	**Value**	**r**
Self-Reported Religiosity	**U=3066***	**0.32**
Parents' Church Attendance	**U=3090***	**0.31**
Satisfaction from Church Attendance	**H(2)=19.12***	**0.36**
Gender	U=4258	0.09
Academic Achievement	H(2)=2.96	0.08
Achievement in Science	H(2)=3.34	0.11

*p<0.01

Frequencies, expressed as percentages for each answer on variables that have reached a statistically significant difference are presented in Table 7.17.

Once again, grouping according to the variables of gender and academic achievement did not yield statistically significant differences. In contrast, the difference between groups based on reported religiosity are clear, where more than two thirds of those reporting lower levels of religiosity tended to agree with the statement in comparison with two fifths of those expressing higher levels of self reported religiosity. Agreement with this statement was also more characteristic for those reporting less frequent parental Church attendance and less elicited satisfaction with Church attendance. Together, these results suggest that a scientific explanation for the emergence of life and the process of evolution is more acceptable for pupils reporting lower levels of religiosity, lower levels of satisfaction with Church attendance and whose parents attend Church services less frequently.

Table 7.17: 8th grade pupils' adherence to evolution – Response distribution

Everything has been formed through the natural process of evolution over millions of years	**Strongly disagree**	**Disagree**	**Agree**	**Strongly agree**
Religiosity				
High	19.0	40.0	28.6	12.4
Low	5.6	21.1	48.9	24.4
Parental Attendance				
High	19.8	41.9	26.7	11.6
Low	6.4	23.9	46.8	22.9
Satisfaction				
High	19.7	40.9	27.3	12.1
Medium	13.9	30.5	43.1	12.5
Low	3.5	21.1	43.9	31.5

7.2.6. Integrating the quantitative results

The quantitative results reveal that the prevalence of biblical literalism is reduced as pupils advance to higher grades of elementary education, a process also evident with respect to pupils' understanding of the Bible. Here, a literal understanding is replaced by a more symbolic consideration of the biblical text and, in some cases, total negation of the supernatural authority of the material. Similarly, pupils' views on the responsibility for the emergence of life on Earth shifts from the supernatural to a more inclusive position of the joint effort of natural and supernatural forces. While the prevalence of this naturalistic stance also increases with age, the older participants remain divided on the role of and responsibility for evolution. Between groups statistical procedures indicated that, in both cohorts, the variables of gender and academic achievement produced no statistically significant differences on any of the items. In contrast, grouping according to self reported religiosity, elicited satisfaction with Church attendance and frequency of parental Church attendance resulted in statistically significant differences on all measures and in both cohorts. In general, for both cohorts, pupils who report higher levels of religiosity, satisfaction with Church attendance and whose parents more frequently attend Church expressed higher levels of Biblical literalism, place responsibility for the emergence of life with God and believe that the Bible should be understood literally. Those pupils with the opposite profile on these variables are more inclined towards a naturalistic stance, report lower levels of biblical literalism, shift responsibility for the emergence of life to an inclusive stance and believe in the natural foundations of evolution.

These results reveal the complexity of pupils' opinions on this already multifaceted issue, which is further complicated by the previously described educational differences in the teaching of these two positions in the Croatian case. The following section will provide findings from the qualitative part of the study that will shed some light onto these complex results.

7.3. CONTRASTING VIEWS: WHAT DO PUPILS SAY? (QUALITATIVE RESULTS) - '*Well God made them…from monkeys. I am not sure.*'

Questions about the emergence of life on Earth were posed over the course of three sessions during the qualitative part of the research, on two occasions around the midpoint of the research process and once at the very end. During interviews, the central issues of interest were pupils' position on and the ways they envisage, understand and elaborate the emergence of human life on Earth. The decision to focus on this theme was made for several reasons. First, the concept of man is central to the Catholic teaching presented in RE, as both the pinnacle of God's creation and co-creator of the world. Due to its centrality, catechetic teaching places much stronger emphasis on its explanation of the creation of human life than on that of other forms of life. In addition, the evolutionary explanation of the origin of mankind specifically evokes the biggest criticism from opponents of evolutionary theory, including the Catholic Church. Although the official catechetic stance does not necessarily oppose evolutionary theory regarding plants and animals and in its most general terms, as evidenced in the lesson *Biblical and present picture of the world*, there is no mention of the evolutionary development of humans in any of its teachings. Finally, an interest amongst pupils for discussion of this issue immediately became apparent during interviews and the term 'evolution' was often identified specifically in terms of the evolution of humans, most especially for the younger cohort.

In an effort to obtain a spontaneous, preliminary response, pupils were posed a straightforward question at the outset of discussion: *How do you envisage the way human life emerged?* While responses to this question were taken to be pupils' initial stance on the issue, elements of both religious and scientific explanations were discussed in much further detail in this and subsequent sessions where the emphasis was on clarifying elements of both explanations which seemed either plausible or problematic for pupils' stated position. Finally, the topic was revisited in the last interview session where each pupil formulated and confirmed his or her personal stance on the issue. In Tables 7.18 and 7.19, excerpts from the interviews illustrating pupils' initial stance, views on religious and evolutionary explanations for the emergence of life as well as an established personal stance represented throughout interviews are presented for 6th and 8th grade pupils, respectively. Most pupils in both cohorts are represented through exemplary quotes illustrating their positions, understanding and adherence to specific positions over the course of the research. Pupils' responses have been grouped according to their established profile of interest in science and religion. A consideration of the results will first be presented for each cohort separately, followed by a comparison of emerging conclusions from both cohorts and triangulation with the quantitative data.

Table 7.18: Views of 6th grade pupils concerning religious and scientific explanations for the emergence of life on Earth

Profile	Initial position	Religious explanation - Creation	Scientific explanation - Evolution	Personal stance
High RE Low Sci	We have originated from some form of monkeys.	Although religion says that God has created everything, I do not believe all that is said in RE.	I would more readily accept that humans have developed gradually and we look like monkeys.	**EVOLUTIONARY**
	God created them after he created Earth. Just like it is written in the Bible.	I believe in it strongly, but I wonder how come everything was created so quickly and what was before that. I also find the thing with the snake weird, because how come you can touch it.	I do not find it probable because how could man develop from monkey.	**CREATIONIST**
	I do not know…some tell us they have originated from monkeys through evolution. The others say God created them and then expelled them from Paradise because they tried the apple.			**UNDECIDED** I do not know, somehow it is logical that they have originated from monkeys as I saw in the encyclopaedia, but I also believe in God.
	Some say from monkeys and some say from Adam and Eve. I personally think from Adam and Eve, through Cain and Abel, although at times I think the monkey story is ok because humans looked like monkeys ages ago.	It is all written in the Bible and it was told from generation to generation.	The whole theory originated because scientists spotted similarities between monkeys and humans.	**UNDECIDED** I really can't decide at this point
	Well God made them…from monkeys. I am not sure.	God created the world and Adam, and then for him not to be alone he created a woman, and then they had offspring. I find it strange that God created man so suddenly out of nothing.	I do not know how humans could have evolved if they are so superior to everything else.	**THEISTIC EVOLUTIONARY** I am not sure, but I am closer to thinking that God created humans. Maybe the two stories are connected: God created animals and then from them humans evolved.

Profile	Initial position	Religious explanation - Creation	Scientific explanation - Evolution	Personal stance
Med RE Med Sci	God created them. I guess he was bored and then he created Adam and Eve and animals. Then who knows what happened as they were in that garden and Eve ate the apple.	It is strange that the snake speaks and that if you eat an apple you become all cursed, but I believe that the two of them existed	Yes I know about the theory that we originated from monkeys but I find it a bit stupid. I am not sure. Those people say that humans are similar to monkeys and now that means they have originated from them. I find it both possible and impossible. It is impossible that man is so developed and smart, the smartest in the world and he has originated from some monkey somewhere.	**CREATIONIST** I find the first (creation) more probable although it also has some strange parts.
	God has created them; first Adam and then Eve and then they had children.		I know that some people say we have originated from the monkeys	**EVOLUTIONARY** I think it is more probable we have developed from monkeys.
	God created them, Adam and Eve but Eve ate an apple and they were expelled from the garden of Eden and they started to procreate.	I find the snake quite problematic in the whole story	I do not find the monkey theory probable. I mean there was some development, but from a monkey? I don't think so.	**CREATIONIST**
	Well God created humans.	First he created Adam and Eve and then they had kids.	Some people say that some monkeys somewhere transformed into humans. Bollocks.	**CREATIONIST**
	God created them. He sent them to Earth.		The one that we originated from monkeys. Maybe it is true but it sounds silly that we have originated from animals.	**UNDECIDED** I am not sure about these things. Sometimes I doubt in this God theory, but despite it I believe in it.

Profile	Initial position	Religious explanation - Creation	Scientific explanation - Evolution	Personal stance
Low RE High Sci	Monkeys and all that story…	God created the world, Adam and from his rib, Eve. I don't get how Church thinks dinosaurs, Adam and Eve lived in harmony together. And the story that we are all children of Adam and Eve is a bit spooky as according to science mixing of the same genes leads to malformations.	There was nothing, elements collided and exploded and from these collisions, planets were formed. In this environment, chemical processes flourished which resulted in animal life and dinosaurs. Then the comet hit, ice age appeared and animals died. All of that cleared and new species emerged including Australopithecus.	**EVOLUTIONARY** I don't believe anything RE says, and especially not creation.
	From monkeys, but I am not sure. Or maybe from Adam and Eve.	First God created Adam and Eve and they had Abel and Cain and so on. There are some doubts I have about this story. How could they procreate if there were no more females? That is very suspicious. And also six days is way too short.	It is a theory of gradual development and this progress was very slow.	**UNDECIDED** I'm split here. They both seem ok to me.
	God created them, Adam and Eve first as we learned it in RE.	How come everything came out of nothing?	Maybe this theory is possible but how can animal become a human.	**UNDECIDED**
	From Adam and Eve and not from monkeys.	They were the first people but the problem was that they took the apple.	Some crazy people say that first there were monkeys who gradually became humans.	**CREATIONIST**

Table 7.19: Views of 8th grade pupils concerning religious and scientific explanations for the emergence of life on Earth

Profile	Initial stance	Religious explanation - Creation	Scientific explanation - Evolution	Personal stance
High R Low S	I guess from monkeys.	I am not sure God exists. There is no evidence for it and it makes me doubt the whole thing.	This theory of gradual development from monkeys seems most probable to me.	**EVOLUTIONARY**
	I do not know. I am a Christian and I should believe that God has created us. Now in the 8th grade teacher says we should take it figuratively.	Religion says it is all metaphorical, that it was not seven days but lasted longer. Also about Adam and Eve: the metaphor there is that Adam loved Eve so he did what she did. And she was awful and tasted a fruit=).	Scientists say that we have developed from monkeys but I think even if that is true it is God's creation because he created Big Bang and all animal forms.	**THEISTIC EVOLUTIONARY** God created Big Bang so it is all connected and evolution is also his creation.
	After the fall of the comet, bacteria came to Earth with DNA which sparked development of life on Earth and evolution started.	I know all about creation but it is very hard for me to believe in it because there is no evidence for it.	Science claims that small organisms have gradually evolved to reach humans. It is much more probable and there are many more evidences for evolution.	**EVOLUTIONARY**
	First there was a Big Bang. Forces reacted and conditions on Earth got better and slowly life emerged. Through evolution humankind was developed.	Religion depicts the same but in a more pictorial way. People do not believe in God because of this depiction but they do not understand the point. Adam and Eve were made up through centuries in order for children to understand faith easily.	For now it is the only explanation and there is no better evidence.	**THEISTIC EVOLUTIONARY** It is not known what happened and religion should not be compared with science as it is not science itself.
	I do not have a clue. The story of Adam and Eve is stupid in my opinion as well as the story that we have originated from monkeys. That story is just a bit less stupid.	God could not create things out of nothing. It is weird.	There is just more evidence for the evolution.	**EVOLUTIONARY**

Profile	Initial stance	Religious explanation - Creation	Scientific explanation - Evolution	Personal stance
Med R Med S	God created them. He created Adam and Eve and from them other humans were made.	How could they, if they were alone, make the whole humanity?	I find it stupid that we could have originated from monkeys. I just do not get it.	**UNDECIDED**
	I think they have evolved from micro-organisms that were brought to Earth by meteors. I do not think God created them, He could have given them soul.	The Church symbolises the origin of humans through the story of Adam and Eve. And they say it is a metaphor but you really need to ask them in order to get this answer. I am not sure how much you can trust the Church as they cheated a lot through history.	I find it quite probable. It is a fact that through centuries we have lost a lot of body hair. The common ancestor of us and monkeys is probably the same.	**EVOLUTIONARY** Although I am believer, I find the scientific explanation more appropriate. I trust it more because the scientific explanation is modified by the emergence of new discoveries and the Church holds its theory for centuries.
	They had sex. Aha, you mean first people. How would I know? I guess God created them	I wonder how God could create Adam out of nothing.	It is more ok for me, although it also has some weird parts	**EVOLUTIONARY**
	I am really not sure.	I heard about evolution in RE classes, they told us that all about Adam and Eve is just a story. First I thought this was true, although I thought it would be impossible because of incest.		**UNDECIDED** Both explanations are very weird. I do not know what to believe in.

Profile	Initial stance	Religious explanation - Creation	Scientific explanation - Evolution	Personal stance
Low R High S	Nature, Biology. They have procreated, not in any way God has created them. It was all natural.	I do not find the story realistic. How did he create Earth? What did he make it from?	Big Bang, expansion of the universe, galaxies are formed and then Earth. There is emergence of life on Earth after the establishment of the atmosphere. From the single cell organisms, the more complicated structures evolve and then much later, humans from monkeys.	**EVOLUTIONARY**
	Through evolution from some form of animal.	I do not believe it a bit. How come there are so many people from just two of them? How can man be created from nothing? The point of everything is that you must listen and fear God. Now in the eighth grade, the teacher says the story of creation is metaphorical. It is so strange that she tells us this now after years of telling differently.	I find it more probable because there is an abundance of evidence for it and I like when there is evidence.	**EVOLUTIONARY**
	Monkeys developed and then humans evolved. It is all part of the process of the evolution.	It is complete nonsense. Eve was created from Adam's rib and they had two sons. How could they make humanity if they had two sons?	It is a bit spooky and hard to understand but it is much more logical than the Adam and Eve story	**EVOLUTIONARY**
	Through evolution. I trust science more than religion. I do not believe that God created humankind.	It is very hard for me to believe in the Adam and Eve theory. I also find it stupid.	The only thing that I find doubtful about evolution is how all life in the world originated from one micro-organism.	**EVOLUTIONARY**
	Evolution via development from monkeys.	Teacher told us that the story of creation is symbolic, but until I heard about evolution I believed in that story factually.		**EVOLUTIONARY/ THEISTIC EVOLUTIONARY** I believe in evolution, although I still think God had his small finger in it too.
	Evolution. I think we have originated from monkeys but I am not 100% sure. There is no other explanation.	In the seventh grade I thought the Church wanted us to think it happened like it is written in the Bible. Now the teacher tells us it should be taken symbolically.	There is a multitude of evidence for it.	**EVOLUTIONARY**

7.3.1. The younger cohort - *How could you touch a snake if it is poisonous?*

It is immediately important to note that, among the younger cohort, responses suggested that all pupils were aware of both religious and scientific explanations of the emergence of human life. Although this awareness might seem conventional or unsurprising, it must be considered in the context of the subject plans and programmes, where pupils in the fifth and sixth grades have not yet been exposed to any systematic teaching on evolution. In fact, for these pupils, the only systematically presented material on the emergence of human life was that offered through RE teaching of creation. Thus, it seems that pupils' conceptualisations and understanding of evolution come from sources other than formal education, such as family, peers and media. As such, most pupils in the younger cohort envisage human evolution in its most simplistic form, as a direct progression from monkeys to humans, often characterising it as *'…the one that we originated from monkeys'* or even more directly *'the monkey theory'*.

Pupils' initial responses, as outlined in the tables, suggest that a majority of pupils take a creationist position in response to the opening question. However, there was also a substantial number of pupils who, being aware of the two coexisting explanations, appeared confused and reported thinking that both explanations were valid (*'We come from monkeys, but I am not sure…or maybe from Adam and Eve.'*). In this cohort, only two pupils indicated the evolutionary position as their initial stance on the issue.

When the religious explanation of the emergence of human life was further discussed, most pupils accurately retold the Biblical account of creation in a literal manner. Their statements suggest a conceptualisation characterised exclusively by a literal understanding of this account, with no pupils considering a symbolic meaning of the biblical text. As such, the most often identified problems with the religious stance were typically those connected to difficulties understanding and internalising concrete elements of the Biblical account in a manner that would be accurate and in correspondence with their experience of life. For example, pupils posed questions such as *'snake that talks'*, *'how* *could you touch a snake if it is poisonous*', '*what kind of apple was that*'. Perhaps most interesting is the fact that, while pupils often identified such challenges to comprehending and adopting a creationist position, most positioned themselves in the creationist, literal sphere in the end.

Some of the more fundamental problems pupils identified for understanding and accepting this explanation included ideas on the rapidity of the process of God's creation, procreation to the present global population from just two individuals and the creation of everything from nothing.

It seems that, for some pupils, the timeframe of creation represents a problem: *'And also six days is way too short.'* and *'How come everything was created so quickly.'* Once again, a literal understanding of creation's timeframe seems at odds with pupils' own experience and perceptions of creating in their own life. For some pupils, the more problematic element in this explanation was the process of procreation, where again there seemed to be a discrepancy between pupils' literal understanding of the biblical account and their knowledge and experiences from life:

'How could they procreate if there were no more females? That is very suspicious.'

Or in the words of another pupil, armed with some scientific knowledge:

'And the story that we are all children of Adam and Eve is a bit spooky as according to science mixing of the same genes leads to malformation.'

Finally, some pupils identified a problem in understanding the emergence of everything out of nothing: *'I find it strange that God created man so suddenly out of nothing.'* Arguably, this position is connected with a scientific worldview, which explicitly states that any life form can only be produced from another living organism. Indeed, this idea is one of the key concepts in the '*Emergence of life on Earth*' lesson, the first lesson in 7th grade biology.

Amongst pupils who defined their personal stance as undecided or evolutionary, all three of the above problematic issues were predominantly present. In all cases, obstacles for adopting a catechetic stance came from the discrepancy between a literal understanding of the biblical account and pupils' knowledge and experience of everyday life.

In this cohort, pupils' stance towards evolutionary theory could best be described as cautious and, in many cases, negative. In light of the previously mentioned narrow understanding of evolutionary processes connected with the emergence of human life, pupils identified the idea of a link between animal and human as *'silly'*, *'stupid'* or, in most cases, *'improbable'*. Challenges to pupils' understanding of evolution are explicitly evident in their inability to comprehend the relationship between and transition from other life forms to human existence (*'Maybe this theory is possible, but how can animal become human?'*). One element contributing to this problem seems to be pupils' perceptions of the hierarchical superiority of the human in relation to all other life forms. This idea, central to Catholic catechetic teaching, is typified by the following pupils' comments:

'I do not know how humans could have evolved if they are so superior to everything else?'

Or even more illustratively:

'It is impossible that a man is so developed and smart, the smartest in the world, and that he has originated from some monkey somewhere.'

It is evident here that catechetic content presents an obstacle for pupils' acceptance of a naturalistic explanation of the emergence of human life. In contrast, those who expressed their personal stance as evolutionary appeared to be better informed about evolutionary theory. Unlike the idea of a straightforward transition *'from monkey to human'*, the pupils in this group more readily identified the idea of gradual development: *It is a theory of gradual development and this progress was very slow.'*

While pupil responses at the outset of the research suggested a majority tendency towards creationist positioning, pupils appeared to diversify their positions by the end of the research process. Here, a relative majority of pupils were unable to clearly decide on the issue, as the following excerpts suggest:

'I do not know, somehow it is logical they have originated from monkeys as I saw in the encyclopaedia, but I also believe in God.'

And,

'I am not sure about these things. Sometimes I doubt in this God theory, but despite it I believe in it.'

In certain cases, this confusion resulted in pupils' attempt to reconcile the two positions in a manner of theistic evolution:

'I'm not sure but I am closer to the option that God created humans. Maybe the two stories are connected: God created animals and then from them humans evolved.'

The second dominant stance at this point in the research process was a literally creationistic one, where pupils continued to adopt a literal understanding of the creation story, despite their emerging doubts about their factual understanding:

'I find the first (creation) more probable although it has some strange parts.'

Finally, three pupils in this cohort adopted an evolutionary position, rejecting the creationistic explanation for the origin of human life. While there are no clear differences in the occurrence of personal positions with respect to the religion/science interest groups, with all three groups including pupils from all three positions, pupils in the low religion/ high science group seemed most knowledgeable about the scientific explanation of the emergence of both life in general and human life.

7.3.2. The older cohort - *There is just more evidence for evolution.*

Analysis of pupils' initial responses in the older cohort revealed not only an awareness of the coexistence of two explanations, but also a personal engagement, from a number of participants, in relating the two explanations with each other:

'I do not have a clue. The story of Adam and Eve is stupid in my opinion as well as the story that we have originated from monkeys. That story is just a bit less stupid.'

From the outset, it was also evident that the older participants were far more knowledgeable regarding evolutionary explanations for the emergence of human life. This was not surprising when both the general framework and some specific aspects of evolutionary theory had already been presented to them in biology. It was also evident that a considerable shift towards more naturalistic responses to initial questions on this topic had occurred, while the occurrence of a creationistic position decreased amongst older pupils. In some cases, a naturalistic position was complemented by a consideration of more physical and astronomical details:

'First there was a Big Bang. Forces reacted and conditions on Earth got better and slowly life emerged. Through evolution humankind developed.'

In this cohort, there was no mention of the literal elements of the creation story that were posed as challenges to understanding by the younger pupils, such as the snake or apple. Instead, problematic ideas for understanding the religious explanation were those of the procreation from Adam and Eve *('How could they, if they were alone, make all humanity?')* and creation of everything out of nothing *('God could not have created things out of nothing. It is weird.').* In this and subsequent interviews, a considerable number of pupils recounted such issues that were characterised by both greater knowledge and the adoption of a more symbolic understanding of the religious account of the emergence of life. This shift is much in line with the respective contents of RE, and the development of a symbolic understanding of the creation story became one of the main issues discussed with this cohort. For some pupils, the introduction of this idea was a welcome clarification of previously held doubts and problematic issues:

'She told us that everything about Adam and Eve is just a story. First I thought this was true, although I thought it would be impossible because of incest.'

Or:

'Religion says it is all metaphorical, that it was not seven days but that it lasted longer. Now I can understand some things I really had problems with.'

For some pupils, the introduction of symbolic understanding also meant the possibility for the accommodation of two explanations in a theistic evolutionary position, a feature that was not possible prior to this feature of the RE curriculum in the eighth grade.

'Scientists say that we have developed from monkeys but I think even if that is true it is God's creation because he created Big Bang and all animal forms.'

Some pupils were aware of the symbolism incorporated into their elaborated belief even before it was presented to them:

'Religion depicts the same (as evolution) but in a more pictorial way. People do not believe in God because of this depiction but they do not understand the point. Adam and Eve were made up through centuries in order for children to understand faith easier.'

However, for other pupils, this switch in teaching added to their confusion:

'I do not know. I am a Christian and I should believe that God has created us. Now in the 8th grade, our teacher says we should take it figuratively.'

For a substantial number of pupils, this change did not promote the adoption of a religious account of the emergence of life, but only served to increase the likelihood of pupils' rejection of such an explanation:

'Now in the 8th grade, the teacher says the story of creation is metaphorical. It is so strange that she tells us this now after years of telling differently.'

In the case of another pupil, this switch served to amplify his criticism towards the Church:

'Church symbolises the origin of humans through the story of Adam and Eve. And they say it is a metaphor but you really need to ask them in order to get this answer. I am not sure how much you can trust the Church as they cheated a lot through history.'

This shift in teaching approach seems to have most significantly affected those who already had a weaker inclination towards a religious worldview. Among other potentially negative effects, such a sudden change has the potential to not only promote pupils' distrust in the Church, but also to diminish the teachers' role and authority.

Although they demonstrated a more elaborated knowledge for evolutionary processes, the older pupils also expressed certain reservations about the evolutionary explanation. Once again, most pupils viewed the evolution of humankind as a direct transfer from monkeys to humans. For a small number of pupils, this pure notion of transfer from animal to human life presented a problem: *'I find it stupid that we could have originated from monkeys. I just don't get it.'* Other pupils doubted specific elements of the evolutionary explanation: *'how did all life in the world originate from one micro-organism'*. However, for almost all pupils, the evolutionary explanation offered a plausible explanation for the emergence of human life.

Throughout discussions on the two explanations, pupils repeatedly mentioned the role of evidence:

'I find it more probable because there is an abundance of evidence for it and I like when there is evidence.'

Or in the case of another pupil speaking of the evolutionary explanation:

'For now it is the only explanation, as there is no better evidence.'

For some pupils, the abundance of evidence for evolutionary theory and the lack of it for the religious explanation represented a problem for the adoption of the latter:

'I know all about creation but it is very hard for me to believe in it because there is no evidence for it.'

Or in the case of another pupil:

'I am not sure God exists. There is no evidence for it and it makes me doubt the whole thing.'

This idea of evidence or proof became so prominent that even the most religious pupils were susceptible to a reconciliation of their position:

'It is not known what happened and religion should not be compared with science as it is not science itself.'

However, some pupils were unable to either bring together the two positions or elevate their understanding of the religious explanation to a completely symbolic, theological and metaphysical level:

'Although I am believer, I find the scientific explanation more appropriate. I trust it more because scientific explanation is modified by the emergence of new discoveries while the Church holds its theory for centuries.'

By the final interview, none of the pupils in this cohort positioned themselves in a wholly creationistic stance towards the emergence of human life. Several pupils were completely undecided on the issue. Three participants adopted a theistic evolutionary position encompassing the two coexisting explanations. The largest number of participants defined themselves in terms of an evolutionary stance towards this issue, though not without reservations.

The prevalence of the naturalistic stance was evident in all three categories of interest profiles. While some pupils with strong religious affinities were able to fully incorporate a symbolic understanding of the biblical account, this caused confusion for others. Among pupils with a prominent scientific interest, the acceptance and understanding of the evolutionary explanation was at its highest level. In addition, their criticism of religious accounts for the emergence of life, often expressed in literal terms, were the most severe.

7.3.3. Comparing the two cohorts

The acceptance, awareness and knowledge of both explanations are at qualitatively different levels for the two cohorts. Although younger pupils are aware of both explanations, their initial stance towards the emergence of human life is largely literally creationistic. This is replaced by a more inclusive, theistic evolutionary or exclusively evolutionary stance in the older cohort, characterised not only by an awareness of both explanations but also by a personalized explanation of the interaction between them. Although they do not always internalise it, older pupils demonstrate elements of a symbolic understanding of the religious explanation, as well as an emerging understanding of the connection between evolution and knowledge from astronomy, physics and chemistry. Problematic issues for the acceptance of a religious explanation in the younger cohort arise from the discrepancy and incompatibility between a literal understanding of the characters and events in the Biblical account of creation and their personal experience of life. In the older cohort, some of these remain present but gain additional complexity characteristic of a more advanced cognitive level. In addition, the sudden switch in teaching from a literal to symbolic understanding of the creation story has varying results. For some pupils, it signifies relief in its accommodation of the problematic points of a literal understanding. However, for a majority of pupils, it adds further confusion, and, for some, presents additional reason for the rejection of any form of religious explanation. In contrast, the majority of younger pupils express their rejection of evolutionary theory due to an anthropocentric stance and an inability to properly comprehend the relations between life forms. This anthropocentrism, directly taught in RE, is one of the biggest obstacles for the adoption of the evolutionary explanation. On the other hand, the scientific explanation is readily accepted amongst the older participants, although not without some reservation. This acceptance is largely due to the abundance of evidence for evolution, which pupils emphasise is not present for the religious explanation. By the end of the research process, the majority of the younger pupils were either undecided on this issue or maintained a creationistic position. However, by the final grade of elementary education, a large majority of participants have accepted evolutionary explanations for the emergence of life, with some adopting a theistic evolutionary stance, some remaining undecided and no pupils stating a creationistic stance. Together, these findings suggest that the approach in RE to switch teaching of the creation story from a literal to symbolic understanding is largely unsuccessful.

CHAPTER EIGHT: CONCLUSIONS

The previous three chapters have presented and discussed research findings in an attempt to answer the research questions posed in Chapter Three. Rather then revisiting each individual research question separately, this concluding chapter will return to the principal research question:

What is the nature of pupils' attitudes to, and self-expressed experience of, the study of two contrasting intellectual domains, namely science and RE, in Croatian Elementary Education?

First, the results concerning pupils' perspectives towards science and religion will be revisited and discussed briefly. This will be followed by a consideration of pupils' views on the interaction between these two domains in Croatian elementary education. Finally, implications for educational practice, and also Croatian society, will be put forward, followed by a discussion of the limitations of the study as well as ideas for future research.

8.1 THE SCIENCE DOMAIN

Older pupils' evaluations of science education are characterised by a heterogeneous attitudinal scheme for the three science subjects. Both quantitative and qualitative analyses indicated that biology is perceived most positively, chemistry unanimously evokes negative attitudes amongst most pupils, while physics falls somewhere in between these subjects, thus confirming the general findings from international literature (e.g. Lamanauskas, 2004; Osborne & Collins, 2000). Three dimensions at the foundation of pupils' attitudes towards and self expressed experiences with science subjects emerged from an in-depth exploration of the qualitative data: level of abstractness, relevance for and visibility in pupils' everyday life and mathematical foundation. In biology, a marginal difference with regards to gender (where girls evaluated the subject more positively) was attributed to girls' higher perceptions of its relevance. In chemistry, both genders recorded negative evaluations, but boys were more critical than girls. Both qualitative and quantitative data indicated that boys evaluate physics much more positively. While the educational contexts differ, these findings further confirm those from the literature (e.g. Lannes et al., 2002; Osborne & Collins, 2001; Salta & Tzougraki, 2004). In all three subjects, attainment levels were closely related to attitudes, with higher achieving pupils expressing more positive views. Interestingly, in the case of biology, there was no effect regarding its salience and utility, confirming the positive status of this subject. Grouping of pupils according to a science/religion interest profile did not result in qualitatively different evaluations of biology and chemistry, however it seemed that the participants with the higher science profile were more knowledgeable and intrinsically interested in physics.

Younger pupils expressed positive attitudes and experiences towards 'nature', perceiving it in manner similar to older pupils' evaluations of biology. Their evaluations indicate a high level of homogeneity across different groups of participants, but their positive preconceptions of physics and chemistry compared with older pupils' attitudes reveals an intriguing discrepancy. The younger pupils' optimism, despite a lack of knowledge, for the content of these subjects is in stark contrast to the older pupils' lack of enthusiasm and resignation towards these subjects and, in some cases, a complete rejection of the subjects' teachings. This contrast was greatest in the case of chemistry. In some respects, these findings confirm the notion arising from the literature of the decline in enthusiasm for science with age (e.g. Barmby et al., 2008; George, 2006).

Pupils in both cohorts hold certain conceptualisations and understandings of science as a holistic concept, although in most cases these are not overly elaborate. The younger cohort's conceptualisations were simpler, offering less eloquent and less personal responses, describing science and generally identifying it in connection to other school subjects. The older cohort had more complex and articulate conceptualisations and was more aware of the various divisions of science and scientific disciplines. The two cohorts have qualitatively different understandings of science's purpose and utility, with younger pupils giving significantly higher estimates of the utility of science. While both cohorts were aware of science's negative aspects, this was not a predominant feature of their attitudes towards the concept of science. Older participants' answers indicated lower levels of scientism, prompting the positive suggestion that they conceptualise science in a balanced manner and as a non-fixed and changing enterprise. There were no drastic gender differences in either cohort, nor any achievement differences in the younger cohort in attitudes towards science. However, in the older cohort, the less successful pupils were less positive about the relevance and utility of science. In both cohorts, the pupils in a high science/low religion profile were more knowledgeable and balanced about the general concept of science and its role and relevance.

The general feeling emerging from interviews, in contrast to pupils' perspectives on science subjects, is a relative lack of engagement and personal connection with the concept of science. While pupils perceived science in a positive manner, their conceptualisation of this concept might best be described as detached, uninformed but benign.

This detachment, albeit positive, begs the question: given their aims of fostering appreciation and positive attitudes towards the scientific endeavour, to what extent does actual educational practice in science subjects influence such attitudes? The earlier discussion on pupils' attitudes towards science subjects, the respective teachers and their practices suggests that science instruction in Croatian elementary education is far from ideal. As presented, the science curricula are characterised by a relatively early division into specific subjects and, despite their lofty aims, a strong orientation towards content and knowledge acquisition, rather than the development of scientific competence, which also includes skills and attitudes. This is amplified by the apparent financial and infrastructural obstacles which hinder any significant orientation towards experimentation and inquiry learning. Arguably, these characteristics of the science curricula and the system itself limit the potential for presenting science as a holistic, attractive and meaningful concept, and result in incomplete pupil understandings of science and their detached personal stance.

In general, Croatian elementary science education appears to be failing to achieve its own aims. Unfortunately, it also fails pupils, whose detached acceptance of science is all that can be expected when their experience is one of high demand, low comprehensibility, low interest and, most importantly, low relevance and salience for their lives. Another fundamental failure of Croatian elementary science education is that it manages to eradicate, rather than build upon, pupils' enthusiasm. Only a highly inefficient system and instruction could generate such a waste of potential. Furthermore, the finding that pupils, and most especially those with low achievement levels, do not always perceive science affirmatively or with intrinsic relevance hints at a dangerous elitism, with many pupils alienated from both science subjects and a scientific worldview. There are grave individual, societal and economic implications if science becomes the practice of a gifted, talented and hard working few at this early stage in education. In general, it seems that, for a majority of pupils, the present approach to science education is failing to encourage a substantial scientific interest or make science more acceptable.

8.2. THE RELIGIOUS DOMAIN

Analysis of the older pupils' attitudes and experiences with Catholic confessional RE suggests that it occupies a peculiar position in pupils' attitudinal schemata, characterised by extremely low levels of demand, elevated comprehensibility and average levels of interest, salience and relevance. In both research phases, it was apparent that older participants were less affirmative with regards to the various aspects of this subject than their younger colleagues, confirming the findings from other social, religious and educational settings (e.g. Francis, 1989; Taminnen, 1996). Three dimensions seemed to influence pupils' attitudes here. First, lenient assessment in combination with the instrumentality of the RE grade in the context of overall achievement elicits positive reactions. Secondly, exposure to religious influences at home is likely the most prominent element behind pupils' attitudes towards RE. Those exposed to such influences seem to be more positively oriented towards the content of the subject and those lacking this influence seem to be disinterested in it. These two dimensions are equally present in both cohorts. Thirdly, teenage rebelliousness and a questioning of authority, characteristic for the older cohort, seem to contribute to a more critical stance towards the subject. In both cohorts, there was no difference in attitudes and self expressed experience with regards to gender and attainment, but as expected, those in a higher religion/lower science profile were more positive about RE while those in a higher science/lower religion profile were more critical.

Pupils' perceptions concerning RE's aim towards pupil induction into the Catholicism and acceptance of its teachings were additionally probed. Almost all participants in both cohorts in the qualitative part of the study unanimously expressed their Catholic faith. Identification of a sense of belonging to the Catholic Church and satisfaction with Church attendance was significantly higher among younger participants. Furthermore, younger pupils expressed higher levels of self reported religiosity and more positive attitudes towards Christianity. In contrast, older pupils more readily expressed a need and readiness to re-examine their own beliefs and the Church's teachings. Likewise, they also expressed strong, elaborated and diversified criticism of the Catholic Church, which was almost non-existent among younger participants. In general, younger pupils expressed higher levels of identification and belonging to the Catholicism and Catholic Church. Their expression of belief is more in tune with the catechetic elements currently embedded in Catholic RE. Older pupils' beliefs are characterised by greater personalisation, as well as doubting and criticism towards the Catholic Church and the catechetic teachings offered in RE.

Younger pupils' higher levels of belonging and synchronisation with the catechetic nature of the subject triangulates with their higher estimations of RE. Together, these findings indicate that the mission and content of Croatian RE seem better adjusted to the younger cohort. Analysis indicated that younger pupils more readily accepted the programmed message of the subject's catechetic curriculum.

In this case, the aim of the subject is fulfilled as there is congruence between religious belonging and expression of religious believing in the spirit of the subject's catechetic contents. However, older pupils' answers and perspectives indicate, as in the case of science, inadequate fulfilment of the subjects' aims. This is alarmingly obvious in two instances: the low religious and personal importance of the sacrament of Confirmation and the critical stance towards the role of the Church in Croatian society. If nothing else, these two elements indicate the inefficiency of RE and its educators to adequately channel and explain the Church's stance and, even more importantly, make Confirmation, this most special event in the religious life of Christian believers, more relevant and important.

Older pupils' personalisation of belief, apparently lower religiosity and critical reflexivity towards the subject and its religious teachings presented a problem for RE teachers. This raises questions about the nature of a subject that does not take into account these elements of pupils' religious, moral and personal development as well as their critical consideration of the presented material and the world around them. Is the nature of this subject primarily educational? What kind of religious development does it foster? The analysis suggests that RE is best perceived and its aims most realised amongst pupils from religious families. For their sense of Catholic belonging, beliefs and religious development, school catechesis is probably ultimately unnecessary as its foundations are their home and parish. From the catechetic point of view, for those less religious and those coming from a more traditional Catholic background characteristic for Croatia, this form of RE is particularly inept. The results indicate that these pupils do, and probably will in the future, express their belonging to the Catholic confession, but it is very questionable how 'Catholic' their beliefs are. Arguably, this form of 'belonging but not believing' would be sufficient for some in the Catholic Church, although for many others this would be unsatisfactory.

8.3. THE INTERACTION BETWEEN THE TWO DOMAINS

Expectedly, the relationship between science and religion is not at the forefront of pupils' interests and thinking. However, when probed, they express their conceptualisation of this relationship as a conflict. Science education and confessional RE are taught as 'independent magisteria' without substantial dialogical or conflicting elements. They present creation and evolutionary theory, central concepts of catechetic teaching and biology, independently and in different manners. Teaching of evolutionary theory, as an overarching framework, is limited to the last two grades, whereas creation is taught from the first grade onwards, with a sudden change from literal to symbolic understanding in the eighth grade. Whereas younger pupils express elevated levels of biblical literalism, the perspective of the older cohort is characterised by a shift to more symbolic understanding of biblical texts, thus reflecting the change in RE curriculum. In light of the emergence of the critical examination of religious beliefs and authority, this sudden switch has varying results. For some pupils, it brings relief, while for others it fuels an already present tendency to distance themselves from the religious worldview.

The older cohort also showed signs of an emerging naturalistic worldview. The acceptance, awareness and knowledge of both explanations are substantially different for the two cohorts. Although aware of both explanations, younger pupils tended to adopt a literally creationistic stance, while a more inclusive, theistic evolutionary or exclusively evolutionary stance in the older cohort was characterised not only by an awareness of both explanations but also by a personalized explanation of the interaction between them. There were no differences with respect to gender or attainment here, but there were clear differences with respect to different variables probing religious experience. Those who were more religious and from religious families were more likely to expose higher levels of biblical literalism, less likely to adopt a naturalistic stance and more reserved about evolutionary theory. Others tended to show lower levels of biblical literalism, a higher prevalence of a naturalistic stance and substantial rejection of creation. Science/religion profiling of pupils suggested that the catechetic teaching of creation in Croatia cannot 'convert' pupils who have higher scientific/lower religious interest, as these pupils remained firmly tied to an evolutionary explanation of origin. In contrast, it seems that evolutionary theory and general scientific thinking, with its emphasis on evidence (an idea central in the pupils' voice), was able to shift more literal religious understanding to a position of theistic evolution or even pure evolution. The aftermath of this coexistence is that pupils are left alone to construct their conceptualisations and understandings of man's origin, which is clearly not a favourable result of any educational endeavour.

With these conclusions, the present research aims to align itself with previous work such as that of Roth and Alexander (1997), Vehey (2005) and

Lawson and Wornsop (1992). As such, it hopes to provide a modest contribution to this developing field of study of the interaction between scientific and religious worldviews.

8.4. STUDY LIMITATIONS AND INDICATIONS FOR FURTHER RESEARCH

In this section, the limitations of the present study will be placed in the context of potential future research. First, the research is clearly specific to the Croatian educational and social context to which it offers its biggest contributions. Therefore, the transferability of the results to other contexts is restricted, but there is potential for research into the explored issues and problems in a comparative research setting. Secondly, this 'Croatian' sample is confined to an exploration of the problems in Zagreb, exposing a clear need for the enlargement of the research to include both more traditional and liberal settings than are represented in the Croatian capital, which incorporates more than one fifth of Croatian population. Thirdly, while the decision to focus the qualitative phase of the research in a single school was made on the grounds of relative depth, immersion and feasibility rather than superficiality, it might have been beneficial to include more than one school. These limitations represent threats to both the transferability and generalisability of the findings. However, as this study was an initial exploration of these issues in the Croatian context, these threats can only be speculated upon and tested in further research.

The development of instrumentation in the present study was in many ways challenging, and, as explained previously, should be seen as an initiation of the construction of metrically more sound instruments to examine pupils' attitudes and conceptualisations of such educational matters.

Finally, perhaps the biggest limitation of the present research was its scope. Its complex design, striving for complementarity at all levels of the research process, its interdisciplinary nature and the fact that it is the product of a single researcher presented significant challenges. Paradoxically, this characteristic could also be a strength, where the somewhat ambitious scope adopted seemed necessary in order to open up several important topics for future research in Croatia while simultaneously enabling the researcher to trace and articulate his own research interests.

The present mixed model design was adopted in response to the imbalance of quantitative to qualitative research in this field, but future research needs to expand this focus to other cohorts and levels of education. The fundaments of many of the issues investigated here have already been established before the age of the participants in this study and are likely to follow different developmental patterns afterwards. Therefore, the application of a longitudinal design would be extremely valuable in future research. Furthermore, this study has attempted to provide foundations for the separate exploration of two intellectual domains as well as the differentiation between them. Each of these levels merits a more detailed focus. In doing so, special attention needs to be given to the identified differences with respect to gender and attainment. Similarly, further exploration of the interaction between and within the domains of pupils' scientific and religious worldviews and their understanding of concepts from the other worldview is needed. Finally, despite its scope, this study could not consider the potential effects of pedagogical strategies and styles of teaching, such as ways of engendering more discursive or dialogic classroom interactions, on pupils' attitudes and self expressed experiences towards science and RE. In other words, the present study, while unable to probe as many aspects of its research problem as would be ideal, opens numerous possibilities for future educational research, and, ultimately, a less perplexing and more fulfilling experience for Croatian elementary school pupils.

8.5. IMPLICATIONS FOR EDUCATIONAL POLICY AND PRACTICE

Through its mixed model design and focus on pupils' attitudes and experiences, neither of which have been adequately explored in Croatian education, the present research offers numerous and significant implications for educational policy and practice. These will be discussed first at the level of each school subject, then at the more general domain level, and finally, true to the contextual framework within which this study was conceived, speculation on the wider implications for society will be presented.

Although most positively perceived, biology would benefit from further opportunities for field study and the inclusion of content to which boys could more readily relate. However, these recommendations for change are miniscule in comparison to the reform needed in the other two science subjects. The main implication for physics stems from the evident gender gap in pupil evaluations, where the content and delivery demand adjustment in order to address girls' disenchantment with the subject. The level of abstractness of the lesson content and lower perceived relevance for some groups of pupils must also be addressed. The most radical reform, however, is needed in chemistry where pupils' perspectives imply complete rejection of the subject in its present form. In the case of both subjects and elementary education in general, the development of mathematical competence and its relation to other subjects needs to be more carefully attuned. More practical work, experimentation and group work in both chemistry and physics is an absolute imperative to foster greater interest, relevance and salience for pupils. Further, all three subjects need to address the high level of cognitive demand and promoted approaches to learning styles to better accommodate and improve the attitudes and experiences of less successful pupils. In the 5th grade, pupils' lack of interest in science content and confusion over technical terminology also deserve attention, thus building upon pupils' positive preconceptions of science subjects prior to their introduction. Furthermore, a more holistic concept of science and its relevance should be presented to pupils in an understandable and appealing manner from the earlier grades.

Exploration of pupils' perspectives on Catholic RE also imposes serious implications for the subject. Educationally, RE is characterised by extremely lenient assessment practices which are, in a wider scheme of current overall pupil assessment, still instrumental for pupils. It is unclear what effect a change towards more strict criteria both within the subject and on a general educational level would have on pupils' attitudes and perspectives. Furthermore, pupils' current expectations of being 'subscribed' to the highest grade places severe obstacles on teachers and the delivery of the subject. Subject content and the ways in which it is taught needs to address and also embrace older pupils' resentment, criticality and apparent 'deterioration' of religiosity.

It is implausible and educationally erroneous not to follow this development and conclude that religious development stops at an earlier age. Furthermore, due to its inefficiency to adequately communicate the Church's stance on various issues, RE needs to make this message more understandable and plausible for pupils. On the specific topic of creation, RE needs a radical change, where the present switch from a literal to symbolic understanding is completely inappropriate. In many cases, it not only fuels pupils' critical stance towards the Catholic Church and RE, but is inconsistent from both educational and theological perspectives. If the Catholic Church's stance on the theory of evolution is some form of theistic evolution, then it should be presented in that manner from the outset of religious instruction. This, however, evokes the main problem of this subject, which is its predominantly catechetic nature. Indeed, certain theological circles in the Catholic Church in Croatia propagate the decatechisation of the subject (Razum, 2008), an idea that pupils' perspectives indicate would be welcomed. As it stands, the subject and its contents are archaic and fail to respect the religious diversity of pupils. A change in approach might allow those who are less religious a better chance of developing a more positive relationship to Catholic teachings. This point of differing levels of pupils' religious experiences is crucial and needs to be further emphasised. In many ways, the catechetic nature of the subject implies that pupils' religiosity is understood in purely dichotomous terms, but as the research has shown, regardless of the uniformity of belonging, there is a much larger heterogeneity of believing which RE needs to take into account.

On a general level, it is clear that subjects in both domains incorporate aims which are incongruent to both subject content and, in the case of science education, infrastructural circumstances. As such, there is a strong imperative for revision of either aims or subject curricula. Finally, the Ministry and curriculum developers in both domains need to address discrepant knowledge claims by engaging with and not ignoring them. One of the ways of doing this is by employing Reich's (1991) model of reducing cognitive dissonance between science and religious education. RE should clearly indicate that religion is not in competition with science in its explanation of natural occurrences. Both science and religious education should acknowledge and promote the idea of the coexistence of various truths, levels of symbolism and transcendence in both fields. Finally, both religious and science education should acknowledge that pupils have different worldviews which may at times incorporate elements contrary to the teaching of the specific domains. In these cases, pupils' worldviews should be treated with respect and as a platform of learning possibilities rather than obstacles. By doing so, educational structures will ensure that pupils will not be left alone to make sense of issues of great importance.

Both the findings and their implications hint towards the wider social context of Croatia. Currently, elementary science education does not provide a sufficient impetus for the development of scientific competence as a motor of economic development and competitiveness. It fails to increase the appeal, intrinsic motivation and patterns of relevance of science, with some results even signifying that it diminishes this potential in pupils. The present detachment, utilitarian perspective and technologically driven understanding of scientific enterprise poses grave limitations on the education of a sufficiently scientifically literate and competent society and economically stable country to compete in global markets. Catechetic RE, meanwhile, seems to reproduce traditional patterns of religiosity, that of religious belonging but questionable belief in religious teachings. This surely cannot be desirable for the Church or society itself. In conclusion, if there is realism and sincere political and social determination behind this dualism of Croatian society, it has largely failed at the level of elementary education and in the minds of elementary school pupils. What is left, much like the pupils themselves, is a society in the grip of contradictory knowledge claims and worldviews.

REFERENCES

Andre, T., Whigham, M., Hendrickson, A., & Chambers, S. (1999). Competency beliefs, positive affect, gender stereotyping of elementary students and their parents about science versus other school subjects. Journal of Research in Science Teaching, 36, 719-747.

Apple, M. (1990). Ideology and Curriculum (2nd Edition). New York: Routledge.

Argyle, M. & Beit-Hallahmi, B. (1975). The Social Psychology of Religion. London and Boston: Routledge and Kegan Paul.

Argyle, M. (2000). Psychology and Religion: An Introduction. London: Routledge.

Argyle, M. (2002). State of the art: Religion, The Psychologist, 15(1), 22-36.

Ashton, E (2000). Religious Education in the Early Years. London: Routledge.

Astley, J. (2001). From religion to science: Religious education and scientific understanding. In L. J. Francis, J. Astley, & M. Robbins (Eds.), The Fourth R for the Third Millenium: Education in religion and values for the global future (pp. 17-46). Dublin, UK: Lindisfarne Books.

Bakan, D. (1996). Orientation, self-determination, and psychology. Journal of Humanistic Psychology, 36, 9-20.

Baranović, B. (2006). Nastavni programi iz perspektive nastavnika i učitelja. In B. Baranović (Ed.), Nacionalni kurikulum za obvezno obrazovanje u Hrvatskoj: Različite perspektive. Zagreb, Croatia: Institut za društvena istraživanja u Zagrebu.

Barbour, I. (1997). Religion and Science: Historical and Contemporary Issues. San Francisco, CA: Harper San Francisco.

Barbour, I. G. (2000). When Science Meets Religion. New York: Harper Collins.

Barker, E. (1999). Quo vadis? The pursuit of understanding church-state relationships. In I. Borowik (Ed.), Church - State Relations in Central and Eastern Europe after the Collapse of Communism (pp.99-118) Krakow, Poland: Zaklad Wydawniczy Nomos.

Barmby, P., Kind, P. M. & Jones, K. (2008). Examining changing attitudes in secondary school science. International Journal of Science Education, 30, 8, 1075-1093.

Batson, C. D. & Ventis, W. L. (1982). The Religious Experience: A Social-Psychological Perspective. New York: Oxford University Press.

Bausor, J. & Poole, M. W. (2003). Science education and religious education: possible links? School Science Review, 85, 311, 117-24.

Bazler, J. A. & Simonis, D. A. (1991). Are high school chemistry textbooks gender fair? Journal of Research in Science Teaching, 28, 4, 353-362.

Becker, B. J. (1989). Gender and science achievement: A re-analysis of studies from two meta-analyses. Journal of Research in Science Teaching, 26, 141-169.

Bennett, J. (2001). The development and use of an instrument to assess students' attitude to the study of chemistry. International Journal of Science Education, 23, 8, 833-845.

Beyer, P. (1999). Privatisation and Pliticisation of Religion in Global Society. In Borowik, I. (Ed.), Church - State Relations in Central and Eastern Europe after the Collapse of Communism (21-41). Krakow, Poland: Zaklad Wydawniczy Nomos.

Bižaca, N. (2007). Papa i evolucija. Crkva u Svijetu,42, 3, 4-8.

Blalock, C. L., Lichtenstein, M. J., Owen, S., Pruski, L., Marshall, C. & Toepperwein, M. A. (2008). In pursuit of validity: A comprehensive review of science attitude instruments 1935-2005. International Journal of Science Education, 30, 7, 961-977.

Borowik, I. (1999). Religion and politics in Central and Eastern Europe. In I. Borowik (Ed.), Church - State Relations in Central and Eastern Europe after the Collapse of Communism (pp. 7-20). Krakow, Poland: Zaklad Wydawniczy Nomos.

Boyer, P. (2004). Why is religion natural? Skeptical Inquirer Magazine, March 2004. Accessed: http://www.csicop.org/si/2004-03/religion.html.

Boyer, S. & Walker, P. (2000). Intuitive ontology and cultural input in the acquisition of religious concepts. In K. S. Rosengren, C. N. Johnson, & P. L. Harris (Eds.) Imagining the Impossible. University of Cambridge Press.

Braund, M. & Reiss, M. (2006). Validity and worth in the science curriculum: learning school science outside the laboratory. The Curriculum Journal,17, 3, 213-228.

Brooke, J. H. & Cantor, G. (2000). Reconstructing Nature: The Engagement of Science and Religion. Edinburgh: T. and T. Clark, University of Oxford Press.

Brooke, J. H. (1991). Science and Religion: Some historical perspectives. Cambridge, UK: Cambridge University Press.

Bruner, J. S. (1999). The culture of education. Cambridge, MA: Harvard University Press.

Cantor, G. (1991). Michael Faraday, Sandemanian and Scientist: A Study of Science and Religion in the Nineteenth Century. Basingstoke: Macmillan.

Christensen, P. & James, A. (2003). Research with children: Perspectives and practices. London: Falmer Press.

Clarke, C. (1972). A determination of commonalities of science interests held by intermediate grade children in inner-city, suburban and rural schools. Science Education, 56, 125-136.

Cobern, W. W. (1993). College students' conceptualizations of nature: An interpretive world view analysis. Journal of Research in Science Teaching, 30, 935-951.

Cohen, L., Manion, L., & Morrison, K. (2000). Research Methods in Education (5th Edition). London: Routledge Falmer.

Colley, A., Comber, C. & Hargreaves, D. J. (1994). School subject preferences of pupils in single sex and co-educational schools. Educational Studies, 20, 379-385.

Collins, S., Reiss, M. & Simon, S. (2006) A Literature Review Conducted on Young People's Attitudes towards Science and Biomedical Science. London: Wellcome Trust.

Cortazzi, M. (1993). Narrative analysis. Washington, DC: Falmer.

Creswell, J. W. (2003). Research Design: Qualitative, Quantitative, and Mixed Method Approaches (2nd Edition). Thousand Oaks, CA: Sage Publications.

Creswell, J. W. & Clark, V. L. P. (2007). Designing and Conducting Mixed Methods Research. London: Sage Publications.

Davie, G. (2000). Religion in Modem Europe: A Memory Mutates. Oxford: Oxford University Press.

Dawkins, R. (2007). The God Delusion. London: Black Swan.

Dawkins, R. (2003) You can't have it both ways: Irreconcilable differences? In P. Kurtz, B. Karr, & R. Sandhu (Eds.), Science and Religion: Are They Compatible? Amherst, NY: Prometheus Books.

Dawson, C. (2000). Upper primary boys' and girls' interests in science: Have they changed since 1980? International Journal of Science Education, *22*, 6, 557-570.

Dixon, T. (2005). Religion and science. In J. R. Hinnells (Ed.), The Routledge Companion to the Study of Religion (pp. 456-472). Abingdon, UK: Routledge.

Dos Santos, F. M. & Mortimer, E. F. (2003). How emotions shape the relationship between a chemistry teacher and her high school students. International Journal of Science Education, 25, 9. 1095–1110.

Drees, W. B. (2003). 'Religion and science' without symmetry, plausibility, and harmony. Theology and Science, 1, 113-128.

Drees, W. B. (1996). Religion, Science, and Naturalism. Cambridge, UK: Cambridge University Press.

Dugandžija, N. (1986). Religija i nacija. Zagreb: Stvarnost.

Eagly, A. H., & Chaiken, S. (1993). The psychology of attitudes. Fort Worth, TX: Harcourt Brace.

Ebenezer J. V. & Zoller U. (1993). Grade 10 students perceptions of and attitudes toward science teaching and school science. Journal of Research in Science Teaching, 30, 2, 175-186.

Encyclopaedia Britannica (2003). Encyclopaedia Britannica Complete 32 Volume Print Set. New York: Encyclopaedia Britannica Inc.

Evans, J. H. & Evans, M. S. (2008). Religion and science: Beyond the epistemological conflict narrative. Annual Review of Sociology 34, 1, 87-105.

Field, A. (2005). Discovering Statistics Using SPSS (2nd Edition). London: Sage.

Flick, U. (2006) An Introduction to Qualitative Research. London: Sage Publications.

Fontana, A. & Frey, J. (1998). Interviewing: The art of science. In N. Denzin & Y. Lincoln (Eds.), Collecting and Interpreting Qualitative Materials. London: Sage.

Fowler, J. W. (1987). Faith, Development and Pastoral Care. Philadelphia, PA: Fortress.

Francis, L. J. (1996). Religious education. In P. Gordon (Ed.), A Guide to Educational Research (pp. 105-146). London: Woburn Press.

Francis, L. J. (1992a). Is psychoticism really a dimension of personality fundamental to religiosity? Personality and Individual Differences, 13, 645-652.

Francis, L. J. (1992b). Monitoring attitudes towards Christianity: The 1990 study. British Journal of Religious Education, 14, 178-182.

Francis, L. J. (1989). Drift from the churches: Secondary school pupils' attitudes in England toward Christianity. British Journal of Religious Education, 11, 76-86.

Francis, L. J. (1987). The decline in attitudes toward religion among 8-15 year olds. Educational Studies, 39, 99-108.

Francis, L. J. (1982). Measurement reapplied: research into the child's attitude towards religion. In J.M. Hull (Ed.), New Directions in Religious Education, (pp. 23-33). Barcombe, Falmer Press Ltd.

Francis, L. J. (1978). Attitude and longitude: A study in measurement. Character Potential, 8, 119–130.

Francis, L. J. (1976). An enquiry into the Concept 'Readiness for Religion'. Unpublished PhD dissertation, University of Cambridge, 1976.

Francis, L. J., & Enger, T. (2002). The Norwegian translation of the Francis Scale of Attitude toward Christianity. Scandinavian Journal of Psychology, 43, 363–367.

Francis L. J., Gibson, H. M. & Fulljames, P. (1990). Attitude towards Christianity, creationism, scientism and interest in science among 11-15 year olds. British Journal of Religious Education, 13-17.

Francis, L. J., & Greer, J. E. (2001). Shaping adolescents' attitudes towards science and religion in Northern Ireland: The role of scientism, creationism and denominational schools. Research in Science and Technological Education, 19, 1, 39-54.

Francis, L. J., & Greer, J. E. (1999a). Attitudes toward science among secondary school pupils in Northern Ireland: Relationship with sex, age and religion. Research in Science and Technological Education, 77,1, 67-74.

Francis, L. J., & Greer, J. E. (1999b). Measuring attitude towards science among secondary school students: The affective domain. Research in Science & Technological Education, 17, 2, 219-226.

Francis, L. J., & Greer, J. E. (1990). Measuring attitudes toward Christianity among pupils in Protestant secondary schools in Northern Ireland. Personality and Individual Differences, 11, 853– 856.

Francis, L. J., Greer, J. E., & Gibson, H. M. (1991). Reliability and validity of a short measure of attitude toward Christianity among secondary school pupils in England, Scotland, and Northern Ireland. Collected Original Resources in Education, 15(3), fiche 2, G09.

Francis, L. J., Gibson, H. M. & Fulljames, P. (1991). Attitude towards Christianity, creationism, scientism and interest in science among 11-15 year olds. British Journal of Religious Education, 13, 4-17.

Francis, L. J. & Greer, J. E. (2001) Shaping adolescents' attitudes toward science and religion in Northern Ireland: the role of scientism, creationism and denominational schools. Research in Science and Technological Education, 19, 175-189.

Francis, L. J. &.Kay, W. K. (1984) Attitude towards religion: definition, measurement and evaluation. British Journal of Educational Studies, 32, 45-50.

Francis L. J. & Kay, W. K. (1995). Teenage Religion and Values. Leominster: Gracewing.

Francis, L. J., Lewis, J. M., Philipchalk, R., Brown, L. B., & Lester, D. (1995). The internal consistency, reliability and construct validity of the Francis Scale of Attitude towards Christianity (adult) among undergraduate students in the UK, USA, Australia and Canada. Personality and Individual Differences, 19, 949–953.

Fulljames, P. (1996). Science, creation and Christianity: A further look. In L.J. Francis, W. K. Kay, & W. S. Campbell (Eds.), Research in Religious Education (pp. 257-266). Macon, GA: Smyth & Helwys Publishing, Inc.

Fulljames, F. & Francis, L. J. (1989) The measurement of attitudes toward Christianity among Kenyan secondary school students. Journal of Social Psychology, 127, 407-409.

Fulljames, P. & Francis, L. J. (1988). The influence of creationism and scientism on attitudes towards Christianity among Kenyan secondary school students. Journal of Social Psychology, 127, 407-409.

Fulljames, P. & Francis, L. J. (1987). Creationism and student attitudes towards science and Christianity. Journal of Christian Education, 90, 51-55.

Fulljames, P., Gibson, H. M. & Francis, L. J. (1991). Creationism, scientism, Christianity and science: A study in adolescent attitudes. British Educational Research Journal, 17, 171-190.

Fulljames, P., & Stolberg, T. L. (2000). Consonance, assimilation or correlation?: Science and religion courses in higher education. Science & Christian Belief, 12, 35-46.

Galton , M. , Gray, J. & Rudduck, J. (2003) Transfer and transitions in the middle years of schooling (7–14): continuities and discontinuities in learning. Queen's Printer: University of Cambridge, Research Report no. 443.

Galton, M., Hargreaves, L. & Pell, T. (2003). Progress in the middle years of schooling: Continuities and discontinuities at transfer. Education 3-13, 14, 9-18.

Gardner, P. L. (1995). Measuring attitudes to science. Research in Science Education, 25, 3, 283-289.

Gardner, P. L. (1975). Attitudes to science. Studies in Science Education, 2, 1-41.Gardner, 1975;

George, R. (2006). A cross-domain analysis of change in students' attitudes toward science and attitudes about the utility of science. International Journal of Science Education, 28, 6, 571-589.

Germann, P. J. (1988). Development of the attitude toward science in school assessment and its use to investigate the relationship between science achievement and attitude toward science in school. Journal of Research in Science Teaching, 25, 8, 689-703.

Gogolin, L., & Swartz, F. (1992). A quantitative and qualitative inquiry into the attitudes toward science of nonscience college students. Journal of Research in Science Teaching, 29, 5, 487-504.

Goldman, R. (1964). Religious Thinking from Childhood to Adolescence. London: Routledge and Kegan Paul.

Gopnik, A., Meltzoff, A. N. & Patricia K. K. (1999). The Scientist in the Crib: Minds, Brains, and How Children Learn. New York: William Morrow.

Gopnik, H. M. & Wellman, G. H. M. (1994). The theory theory. In L. Hirschfeld & S. Gelman (Eds.), Mapping the Mind: Domain specificity in Cognition and Culture, (pp. 257-293). Cambridge, UK: Cambridge University Press.

Gorard, S. & Taylor, C. (2004). Combining Methods in Educational and Social Research. Maidenhead, England: Open University Press.

Gorsuch, R. L. (1988). Psychology of religion. Annual Review of Psychology, 39, 201-221.

Gottlieb, E. (2006). Development of Religious Education. Religious Education, 101, 2, 242-260.

Gould, S. J. (1999). Rock of Ages: Science and Religion in the Fullness of Life. New York: Ballantine Publishing Group.

Grace, G. (2003). Educational studies and faith-based schooling: Moving from prejudice to evidence-based argument. British Journal of Educational Studies, 51, 2, 149-167.

Greene, J. C., Caracelli, V. J., & Graham, W. F. (1989). Toward a conceptual framework for mixed-method evaluation designs. Educational Evaluation and Policy Analysis, 11, 255–274.

Greer, J. E. (1983). Attitude to religion reconsidered. British Journal of Educational Studies, 31, 1 18-28.

Greer, J. E. (1982). A companion of two attitudes to religion scales. Educational Research, 24, 3, 226-227.

Greer, J.E. (1972). The child's understanding of creation. Educational Review, 24, 94-110.

Greer, J. E. & Francis, J. L. (1991). Measuring attitudes towards Christianity among pupils in Catholic secondary schools in Northern Ireland. Educational Research, 33, 1, 70 – 73.

Guba, E. G. & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), Handbook of Psychological and Educational Assessment of Children (Vol. 2). New York: Guilford.

Hadden, R. A. & Johnstone, A. H. (1983). Secondary school pupils' attitudes to science: The year of decision. International Journal of Science Education, 5, 4, 429-438.

Hadden, R. A. & Johnstone, A. H. (1983b). Secondary school pupils' attitudes to science: The year of erosion. European Journal of Science Education, 5, 309-318.

Hadden, R. A. & Johnstone, A. H. (1982). Primary school pupils' attitudes to science: the years of formation. International Journal of Science Education, 4, 4, 397 – 407.

Harding, J. & Parker, L. H. (1995). Agents for change: Policy and practice towards a more gender-inclusive science education. International Journal of Science Education, 17, 537-553.

Hargreaves, L. & Galton, M. (2002). Transfer from the Primary Classroom: Twenty years on. London: Routledge/Falmer.

Harris, P. (2000). On not falling down to earth. In K. S. Rosengren, C. N. Johnson, & P. L. Harris (Eds.), Imagining the Impossible. Cambridge: Cambridge University Press.

Harrison, P. (2003). The Bible, Protestantism, and the Rise of Natural Science. Cambridge: Cambridge University Press.

Harvey, T. J. (1984). Gender differences in subject preference and perception of subject importance among third year secondary school pupils in single-sex and mixed comprehensive schools. Educational Studies, 10, 243-252.

Haste, H. (2004). Science in my future: A study of values and beliefs in relation to science and technology amongst 11-21 year olds. London: Nestle Social Research Programme.

Haught, J. F. (1995). Science and Religion: From Conflict to Conversation. Mahwah. N. J.: Paulist Press.

Havard, N. (1996). Student attitudes to studying A-level sciences. Public Understanding of Science, 5, 321-330.

Hefner, P. (2008). Religion-and-science: Never alone, always in a crowd. Zygon: Journal of Religion and Science 43, 291–96.

Hendley, D., Stables, S. & Stables, A. (1996). Pupils subject preferences at Key Stage 3 in South Wales. Educational Studies, 22, 177-187.

Hood, R. W., Spilka, B., Hunsberger, B. & Gorsuch, R. (1996). The Psychology of Religion. New York: Guilford Press.

Howe, K. R. (1988). Against the quantitative-qualitative incompatibility thesis or dogmas die hard. Educational Researcher, 17, 10-16.

Howitt, D. & Cramer, D. (2005). An Introduction to Statistics for Psychology. London: Prentice Hall.

Hull, J. (2001). The contribution of religious education to religious freedom: A global perspective. In Z. T. Caldwell (Ed.) Religious Education in Schools: Ideas and Experiences from Around the World. Oxford: International Association for Religious Freedom.

Hull, J. M. (1994). Atheism and the future of religious education. In S. E. Porter, P. Joyce & D. E. Orton (Eds.), Crossing the Boundaries: Essays in Biblical Interpretation in Honour of Michael D. Goulder. Leiden: E. J. Brill.

Hull, J. (1984). Studies in Religion and Education. Lewes, UK: Falmer Press.

Hyde, K. E. (1990). Religion in Childhood and Adolescence. Birmingham, AL: Religious Education Press.

James, W. (1995). The Varieties of Religious Experience: A Study in Human Nature. New York: New American Library. Originally published 1907.

Jarvis, T. & Pell, A. (2005). Factors influencing elementary school children's attitudes toward science before, during, and after a visit to the UK National Space Centre. Journal of Research in Science Teaching , 42, 1, 53-83.

Jenkins, E. W. (2006). Student opinion in England about science and technology. Research in Science & Technological Education, 24, 1, 59-68.

Jenkins E. W. (2005). Important but not for me: Students' attitudes towards secondary science in England. Research in Science and Technological Education, 23, 1, 41-57.

Jenkins, E. W. (1994). Public understanding of science and science education for action. Journal of Curriculum Studies, 26, 601-612.

Johnson, R. B. & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. Educational Researcher, 33, 7, 14-26.

Jokić, B. (2007). Uvod u istraživanje o ključnim kompetencijama. In B. Jokić (Ed.), Ključne kompetencije učiti kako učiti i poduzetništvo u osnovnom obrazovanju Republike Hrvatske. Turin, Italy: European Training Foundation.

Jokić, B. & Ristić Dedić, Z. (2007). U sjeni: Pojava privatnih instrukcija u Republici Hrvatskoj. Zagreb, Croatia: Institut za društvena istraživanja u Zagrebu.

Jokić, B. (2005). Religious Education in Croatia: A Case to Be Opened, Unpublished Mphil Thesis, University of Cambridge.

Jones, G., Howe, A., & Rua, M. (2000). Gender differences in students' experiences, interests and attitudes toward science and scientists. Science Education, 84, 180–192.

Jones, L. & Reiss, M. J. (Eds.) (2007). Teaching about Scientific Origins: Taking Account of Creationism. New York: Peter Lang.

Jones, L. & Reiss, M. J. (2007). Cultural authority and the polarized nature of the evolution/creationism controversy. In L. Jones & M. J. Reiss (Eds.), Teaching about Scientific Origins: Taking Account of Creationism, (pp. 1-10). New York: Peter Lang.

Jones, M. G. & Wheatley, J. (1989). Gender influence in classroom displays and student-teacher behaviour. Science Education, 73, 535-545.

Jovanovic, J. & King, S. S. (1998). Boys and girls in the performance-based science classroom: Who's doing the performing? American Educational Research Journal, 35, 477-496.

Kahle, J. B. & Lakes, M. K. (1983). The myth of equality in science classrooms. Journal of Research in Science Teaching, 20, 131-140.

Kay, W. K. & Francis, L. J. (1996). Drift from the Churches: Attitude toward Christianity during Childhood and Adolescence. Cardiff, UK: University of Wales Press.

Kelly, A. (1986). The development of girls' and boys' attitudes to science. European Journal of Science Education, 8, 399–412.

Kelly, A.,Whyte, J. & Smail, B. (1987). Girls in science and technology: Final report. In Kelly, A. (Ed.) Science for Girls. Milton Keynes: Open University Press.

Kemper, E., Stringfield, S. & Teddie, C. (2003). Mixed methods sampling strategies in social science research. In A. Tashakkori & C. Teddlie (Eds.), Handbook of Mixed Methods in Social & Behavioral Research. New York: Sage.

Kind, P., Jones, K. & Barmby, P. (2007) Developing attitudes towards science measures, International Journal of Science Education, 29, 7, 871-893.

Koballa, T. R. & Glynn, S. M. (2007). Attitudinal and motivational constructs in science learning. In S. K. Abell & N. G. Lederman (Eds.), Handbook of Research on Science Education. Philadelphia, PA: Lawrence Erlbaum Associates.

Kodelja, Z. & Bassler, T. (2004). Religion and Schooling in Open Society: A Framework for Informed Dialogue. Ljubljana, Slovenia: Open Society Institute.

Kuhn, D. (2004). What is scientific thinking, and how does it develop? In U. Goswami (Ed.), Blackwell Handbook of Childhood Cognitive Development (pp. 371-393). London: Blackwell.

Kuhn, T.S. (1970). The Structure of Scientific Revolutions. Chicago, IL: Chicago University Press.

Kühnast, C. & Neuhäuser, M. (2008). A note on the use of the non-parametric Wllcoxon-Mann-Whitney test in the analysis of medical studies. GMS German Medical Science, 6, 1-5.

Lakatos, I. (1981). History of science and its rational reconstructions. In I. Hacking (Ed.), Scientific Revolutions (pp. 107-127). Oxford, UK: Oxford University Press.

Lamanauskas, V., Gedrovics, J., & Raipulis, J. (2004). Senior pupils‘ views and approach to education in Lithuania and Latvia. Journal of Baltic Science Education, 1, 5, 13-23.

Lannes, D., Rumjanek, V., Velloso, A. & de Meis, L. (2002). Brazilian schools: Comparing students’ interests with what is being taught. Educational Research, 44 (2), 157- 179.

Lawson, A. & Worsnop, W. (1992). Learning about evolution and rejecting a belief in special creation: Effects of reflective reasoning skill, prior knowledge, prior belief, and religious commitment. Journal of Research in Science Teaching, 29, 143-166.

Lepkowska, D. (1996). The non-appliance of science. Evening Standard, 3rd September, 1996, 33-34.

Leslie S. J. & Michael, R. (2007) Cultural authority and the polarized nature of the evolution/creationism controversy. In L. S. Jones & M. J. Reiss (Eds). Teaching about scientific origins: Taking Account of Creationism. New York: Peter Lang.

Lewis, J. M. & Francis, L. J. (2004) Reliability and validity of a French translation of a short scale of attitude toward Christianity. Pastoral Psychology, 52, 6, 459-464.

Lewis, J. M. & Francis, L. J. (1996). Personality and attitude toward religious education among adolescents. In L. J. Francis, W. K. Kay, & W. S. Campbell (Eds.), Research in Religious Education (pp. 229-238). Leominister, UK: Gracewing.

Lewis, C. A., Shevlin, M., Lloyd, N. S. V., & Adamson, G. (1998). The Francis Scale of Attitude Towards Christianity (Short Scale): Exploratory and confirmatory factor analysis among English students. Journal of Social Behavior and Personality, 13, 167–175.

Lincoln, Y. & Guba, E. (1985). Naturalistic Inquiry. London: Sage Publications.

Long, D., Elkind, D., & Spilka, B. (1967). The child's conception of prayer. Journal for the Scientific Study of Religion, 6, 101-109.

Lunney, G. H. (1970). Using analysis of variance with a dichotomous dependent variable: An empirical study. Journal of Educational Measurement, 7, 263-269.

Maltby, J. & Lewis, C. A.(1997). The reliability and validity of a short scale of attitude towards Christianity among U.S.A., English, Republic of Ireland, and Northern Ireland adults. Personality and Individual Differences, 5, 649–654.

Marinović Bobinac, A. & Marinović Jerolimov, D.(2006). Religious education in Croatia. In Kuburić, Z. & Moe, C. (Eds.), Religion and Pluralism in Education: Comparative approaches in the Western Balkans. Novi Sad: CEIR.

Marušić, I. (2006). Motivacija i školski predmeti: spolne razlike u kontekstu teorije vrijednosti i očekivanja. In B. Baranović (Ed.), Nacionalni kurikulum za obvezno obrazovanje u Hrvatskoj: Različite perspektive. Zagreb, Croatia: Institut za društvena istraživanja u Zagrebu.

Maxwell, J. A. (1996). Qualitative Research Design: An Interactive Approach. Thousand Oaks, CA: Sage.

Menis, J. (1989). Attitudes towards school, chemistry, and science among upper secondary chemistry students in the United States. Research in Science & Technological Education, 7, 2, 183-190.

Merkur, D. (2005). Psychology of religion. In J. R. Hinnells (Ed.), The Routledge Companion to the Study of Religion (pp. 164-181). Abingdon, UK: Routledge.

Merriam Webster (2005). Merriam Webster Collegiate Dictionary. Springfileld, MA: Author.

Miles, M. B., & Huberman, A. M. (1984). Qualitative Data Analysis: A Source Book of new methods. Beverly Hills, CA: Sage.

Miles, M. B. & Huberman, A. M. (1994). Qualitative Data Analysis (2nd Edition). Thousand Oaks, CA: Sage Publications Inc.

Minium, E. W., King, B. M. & Bear, G. (1993). Statistical Reasoning in Psychology and Education. New York: John Wiley and Sons.

Moore, R. (2007). The history of the creationism/evolution controversy and likely future developments. In L. Jones & M. J. Reiss (Eds.), Teaching About Scientific Origins: Taking Account of Creationism. New York: Peter Lang.

Moore, R. (2001). The lingering impact of the Scopes trial on high school biology textbooks. Bioscience, 51, 9, 790-796.

Morse, J. M. (2006). The Politics of Evidence. In N. Denzin & M. Giardina (Eds.), Qualitative Inquiry and the Conservative Challenge (pp. 79-92). Walnut Creek, Ca: Left Coast Press.

Murphy, N. (1990). Theology in the Age of Scientific Reasoning. Ithaca, NY: Cornell University Press.

Nanna, M. J. & Sawilowsky, S. S. (1998). Analysis of Likert scale data in disability and medical rehabilitation research. Psychological Methods, 3, 55-67.

Oliver, J. S. & Simpson, R. D. (1988). Influences of attitude toward science, achievement motivation, and science self concept on achievement in science: A longitudinal study. Science Education, 72, 143-155.

Ormerod, M. B. (1975). Subject preference and choice in co-educational and single-sex secondary schools. British Journal of Educational Psychology, 45, 257-267.

Ormerod, M. B. (1971). The 'social implications' factor in attitudes to science. British Journal of Educational Psychology, 41, 335-338.

Osborne, J. F. & Collins, S. (2001) Pupils' views of the role and value of the science curriculum: a focus-group study. International Journal of Science Education 23, 5, 441-468

Osborne, J. F. & Collins, S. (2000). Pupils' and parents' views of the school science curriculum. London: King's College London.

Osborne, J. F., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and its implications. International Journal of Science Education. 25,1050-1079.

Palmer, D. (1997). The effect of context on students' reasoning about forces. International Journal of Science Education, 19, 681-696.

Parkinson, J., Hendley, D., Tanner, H. & Stables, A. (1998). Pupils' attitudes to science in Key Stage 3 of the National Curriculum: A study of pupils in South Wales. Research in Science and Technological Education, 16, 2, 165-176.

Patton, M. Q. (1990) Qualitative Evaluation and Research Methods (2nd Edition),. Nebury Park: Sage.

Patton, M. Q. (2002). Qualitative Research and Evaluation Methods. (3rd edition) Thousand Oaks, CA: Sage Publications Inc

Pell, T., Galton, M., Steward, S., Page, C. & Hargreaves, L. (2007). Promoting group work at Key Stage 3: Solving an attitudinal crisis among young adolescents? Research Papers in Education, 22, 3, 309-332

Pell, T. & Jarvis, T. (2001). Developing attitude to science scales for use with children of ages from five to eleven years. International Journal of Science Education, 23, 847-862.

Pennock, R. (1999).Tower of Babel: The Evidence Against the New Creation. Cambridge MA: The MIT Press.

Perloff, R. (2003). The Dynamics of Persuasion. Mahwah, NJ: Lawrence Erlbaum Associates.

Petty, R. E., & Cacioppo, J. T. (1981). Attitudes and Persuasion: Classic and Contemporary Approaches. Dubuque, IA: Wm. C. Brown.

Piburn, M. D. & Baker, D. R. (1993). If I were a teacher…A qualitative study of attitude toward science. Science Education, 77, 393-406.

Polkinghorne, J. (1998). Belief in God in an Age of Science. New Haven: Yale University Press.

Polkinghorne, J. (1994). Science and Christian Belief: Theological Reflections of a Bottom-up Thinker. London: SPCK Publishing.

Poole, M, (2007) The Scientific Enterprise and Teaching about Creation. In L. Jones & M. J. Reiss (Eds.), Teaching About Scientific Origins: Taking Account of Creationism, pp. 75-89. New York: Peter Lang.

Poole, M. (1998). Teaching about Science and Religion: Opportunities Within Science in the National Curriculum. Abingdon, England: Culham College Institute.

Pope John Paul II (2002). Pope John Paul II: In My Own Words. New York: Gramercy Publishing.

Popper, K. (1969). Conjectures and Refutations: The Growth of Scientific Knowledge. London: Routledge.

Potter, J. & Wetherell, M. (1987). Discourse and Social Psychology: Beyond Attitudes and Behaviour. London: Sage.

Qualter, A. (1993). I would like to know more about that: A study of the interest shown by girls and boys in scientific topics. International Journal of Science Education, 15, 307-317.

Ramsden, J. M. (1998). Mission impossible?: Can anything be done about attitudes to science? International Journal of Science Education, 20, 2, 125-137.

Rani, G. (2006). A cross-domain analysis of change in students' attitudes toward science and attitudes about the utility of science. International Journal of Science Education, 28, 6, 571-589.

Razum, R. (2008). Vjeronauk između tradicije i znakova vremena: suvremeni izazovi za religijskopedagošku i katehetsku praksu. Zagreb, Croatia: Glas Koncila.

Reich, K. H. (1996). Relational and contextual reasoning in religious education: A theory-based empirical study. In L. J. Francis, W. K. Kay, & W. S. Campbell (Eds.), Research in Religious Education (pp. 129-144). Leominster, UK: Gracewing.

Reich, K.H. (1991). The role of complementarity reasoning in religious development. In F. K. Oser & W. G. Scarlett (Eds.), Religious Development in Childhood and Adolescence (pp. 77-89). San Francisco, CA: Jossey-Bass.

Reid, N. (2006). Thoughts on attitude measurement. Research in Science & Technological Education, 24, 1, 3-27.

Reid, N. & Skryabina, E. A. (2003). Gender and physics. International Journal of Science Education, 25, 509-536.

Reiss, M. J. (2000). Understanding Science Lessons: Five years of Science Teaching. Milton Keynes: Open University Press.

Reiss, M. J. (2007). Teaching about origins in science – where now? In L. Jones & M. J. Reiss (Eds.), Teaching about Scientific Origins: Taking Account of Creationism (pp. 197-208). New York: Peter Lang.

Reiss, M. J. (2004). Students' attitudes towards science: a long term perspective. Canadian Journal of Science, Mathematics and Technology Education, 4, 97-109.

Robson, C. (2002). Real World Research: A Resource for Social Scientists and Practitioner-Researchers (2nd Edition). Oxford, UK: Blackwell Publishers Ltd.

Rosengren, K. S., Johnson, C. N. & Harris, P. L. (2000). Preface. In S. Rosengren, C. N. Johnson, & P. L. Harris (Eds.), Imagining the Impossible. Cambridge: Cambridge University Press.

Rosenstein, D. & Oster, H. (1997). Different facial responses to four basic tests. In P. Ekman & E. Rosenberg (Eds.), Newborns in What The Face Reveals: Studies of Spontaneous Expression Using the Facial Action Coding System (FACS) (Series in Affective Science) (pp. 302-331). New York, Oxford University Press.

Roth, W. M. (2007). Fundamentalist and scientific discourse: Beyond the war metaphors and rhetoric. In L. Jones & M. Reiss (Eds.), Teaching about scientific origins: Taking account of creationism. New York: Peter Lang.

Roth, W. M. & Alexander, T. (1997). The interaction of students' scientific and religious discourses: two case studies. _International Journal of Science Education, 19_, 125-146.

Ruse, (2005). _The Evolution/Creation Struggle._ Cambridge, MA: Harvard University Press.

Ryan, A. G., & Aikenhead, G. S. (1992). Students' preconceptions about the epistemology of science. _Science Education, 76_, 559-580.

Salta, K. & Tzougraki, C. (2004). Attitudes toward chemistry among 11th grade students in high schools in Greece. _Science Education, 88, 4,_ 535-547.

Schreiner, C. & Sjøberg, S. (2004). _ROSE: The Relevance of Science Education: Sowing the Seeds of ROSE_. Oslo: Department of Teacher Education and School Development, University of Oslo.

Schreiner, P. (2002). Religious education in the European context. In L. Broadbent & A. Brown (Eds.), _Issues in Religious Education._ London: Routledge.

Schweitzer, F. (2006). Research in religious education: Perspectives for the future. _Religious Education, 101, 2,_ 166-169.

Scott, E. C. (1997). Antievolution and creationism in the United States. _Annual Reviews in Anthropology, 26_,263–289.

Scott, E. (2003). The Science and religion movement: An opportunity for improved public understanding of science. In P. Kurtz, B. Karr, & R. Sandhu (Eds.), _Science and Religion: Are They Compatible?_ Amherst, NY: Prometheus Books.

Shulha, L., Wilson, R. & Teddlie, C. (2003). Collaborative mixed methods. In A. Tashakkori & C. Teddlie (Eds.), _Handbook of Mixed Methods in Social & Behavioral Research_. New York: Sage.

Siegel, M. A. & Ranney, M. A. (2003). Developing the changes in attitude about the relevance of science (CARS) questionnaire and assessing two high school science classes. _Journal of Research in Science Teaching, 40, 8,_ 757-775.

Simpson, R. D., Koballa, T. R., Oliver, J S. & Crawley, F. E. (1994). Research on the affective dimension of science learning. In D. Gabel (Ed), _Handbook of Research on Science Teaching and Learning_. New York: Macmillan.

Simpson, R. D. & Oliver, J. S. (1990). A summary of the major influences on attitude toward and achievement in science among adolescent students. Science Education, 74, 1-18.

Siraj-Blatchford, J. & Siraj-Blatchford, I. (2001). An ethnographic approach to researching young children's learning. In G. MacNaughton, S. Rolfe, & I. Siraj-Blatchford (Eds.) Doing Early Childhood Research: International Perspectives on Theory and Practice. Buckingham: Open University Press.

Sjøberg, S. (2006). Young people and science: Attitudes, values and priorities. Evidence from the ROSE project. Paper presented at the EU's Science and Society Forum 2005, Brussels. http://www.ils.uio.no/english/rose/publications/english-presentations.html

Slee, N. (1986) Goldman yet again: An overview and critique of his contribution to research. British Journal of Religious Education, 8, 2, 84 – 93.

Smithers, A. & Hill, S. (1987). Science teaching. Education, 170, 3-21.

Strassberg, B. (2005). Magic, religion, science, technology, and ethics in the postmodern world. Zygon: Journal of Religion and Science 40, 307–22.

Strauss, A. & Corbin, J. (1998). Basics of Qualitative Research (2nd Edition). Thousand Oaks, CA: Sage Publications.

Strauss, A. & Corbin, J. (1990). Basics of Qualitative Research: Grounded Theory Procedures and Techniques. London: SAGE Publications.

Stravinskas, P. M. J. (Ed.) (2002). Catholic Dictionary. Huntington, IN: Our Sunday Visitor Publishing.

Sue, C., Mohael, R. & Shirley, S. (2006) A literature Review of Research Conducted on Young People's Attitudes to Science Education and Biomedical Science. London: Institute of Education, University of London.

Tabachnick, B. G. & Fidell, L. S. (2001). Using Multivariate Statistics. Boston, MA: Allyn and Bacon.

Tamminen, K. (1996). Gender differences in religiosity in children and adolescents. In L. J. Francis, W. K. Kay, & W. S. Campbell (Eds.), Research in Religious Education (pp. 163-188). Macon, GA: Smyth & Helwys Publishing, Inc.

Tashakkori, A. & Teddlie, C. (2003). Handbook of Mixed Methods in Social and Behavioral Research. Thousand Oaks, CA: Sage Publications Inc.

Tashakkori, A. & Teddlie, C. (1998). Mixed methodology: Combining qualitative and quantitative approaches. Thousand Oaks, CA: Sage Publications, Inc.

Tomka, M. (1999). Religion, church, state and civil society. In I. Borowik (Ed.), Church - State Relations in Central and Eastern Europe after the Collapse of Communism. Krakow: Zaklad Wydawniczy Nomos. 42-63.

Verhey, S. D. (2005). The effect of engaging prior learning on students' attitudes towards creationism and evolution. BioScience, 55, 996-1003.

Vrcan, S. (2001) Vjera u vrtlozima tranzicije. Split, Croatia: Dalmatinska akcija.

Vrcan, S. (1998). Transition, war and religion. Archives de Sciences Sociales, 103.

Weinburgh, M. (1995). Gender differences in student attitudes toward science: A meta-analysis of the literature from 1970 to 1991. Journal of Research in Science Teaching, 32, 387-398.

Whitfield, R. C. (1980). Educational research and science teaching. School Science Review, 6, 411-430.

Wooley, J. (2000). The development of beliefs about direct mental-physical causality in imagination, magic and religion. In S. Rosengren, C. N. Johnson, & P. L. Harris (Eds.), Imagining the Impossible. Cambridge: Cambridge University Press.

Wulff, D. M. (1997). Psychology of Religion (2nd Edition). New York: Wiley.

Živkovic, I. (2007). Koncept Boga i religioznosti kod djece i adolescentata. Sociologija i prostor, 45, 177-178 (3-4), 321-337.

Zrinščak, S. (1999a). Church and state in new social circumstances. In I. Borowik (Ed.), Church - State Relations in Central and Eastern Europe after the Collapse of Communism. Krakow: Zaklad Wydawniczy Nomos. 119-135.

Zrinščak, S. (1999b). Sociologija religije – hrvatsko iskustvo. Zagreb, Croatia: Sveučiliste u Zagrebu.

Croatian educational laws and policy documents

Plan razvoja sustava odgoja i obrazovanja 2005.-2010, Ministarstvo znanosti, obrazovanja i športa RH, Zagreb 2005.

Nastavni plan i program za osnovnu školu, Ministarstvo znanosti, obrazovanja i športa RH, Zagreb 2006.

Vodič kroz Hrvatski nacionalni obrazovni standard (HNOS) za osnovnu školu, Ministarstvo obrazovanja i športa, Zagreb, 2005.

Ugovor o katoličkom vjeronauku u javnim školama i vjerskom odgoju u predškolskim ustanovama, Narodne Novine, 3/99.

Zakon o potvrđivanju ugovora između Svete Stolice i Republike Hrvatske o suradnji na području odgoja i kulture, Narodne Novine, Međunarodni ugovori, 2/97.

Nacionalni katehetski ured HBK: Bez pohađanja vjeronauka u školi nema ni pripuštanja na sakramente?!, In Katehetski glasnik, 2 (2000) 2(3),184-185.

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