

COMPARATIVE EVALUATION OF SCIENCE COMMUNICATION ACTIVITIES AND THEIR IMPACTS

Chapter 1



INTRODUCTION

1.0	THESIS OVERVIEW	2
1.1	ATTITUDES TOWARDS SCIENCE	3
1.1.1	Attitudes towards science among the adult British public	3
1.1.2	Attitudes towards science among young people	5
1.1.3	Attitudes towards science and physics among school students	6
1.2	SCIENCE AND PHYSICS EDUCATION	9
1.2.1	How do individuals learn?	9
	Cognition	10
	Affect	10
	Behaviour	11
1.2.2	Science education in England	11
1.2.3	Factors affecting science subjects' uptake	12
1.3	SCIENCE COMMUNICATION: A BRIEF HISTORY	14
1.4	SCIENCE COMMUNICATION THEORIES AND PRACTICE	16
1.4.1	Public understanding of science and scientific literacy	16
1.4.2	Public engagement with science and technology	18
1.4.3	Science communication activities	19
1.4.4	Potential benefits of science communication activities	20
1.4.5	Learning in informal settings	21
1.5	FOCUS OF THE CURRENT RESEARCH	22
	Selection of activities	24

EVALUATION METHODOLOGIES

2.1	INTRODUCTION	27
2.2	EVALUATION THEORY	27
2.2.1	Normative evaluations	28
2.2.2	Causative evaluations	29
2.2.3	Relationships between domains	30
2.2.4	Approaches used in the current research	31
2.3	EVALUATION RESEARCH METHODS	32
2.3.1	Experimental study design	32
2.3.2	Methods of data collection	32
2.3.3	Sampling	34
2.3.4	Data collection methods and sampling techniques used in the research	34
2.4	DATA COLLECTION INSTRUMENTS	35
2.4.1	The questionnaires for school groups	35
	Cover sheet	36
	Affective impact	37
	Cognitive impact	38
	Evaluation questions	39
	Survey of teachers	39
2.4.2	Questionnaire administration	39
2.4.3	Structured interviews used for publics	41
2.5	DATA ANALYSIS	42
2.5.1	Descriptive analyses	42
	Tests for association	43
	Tests for differences	43
2.5.2	Meta-analysis	44

**EVALUATION OF THE IMPACT OF A SPACE CENTRE VISIT
ON THE COGNITIVE AND AFFECTIVE DOMAINS OF KEY
STAGE 3 STUDENTS**

<i>Research Axes</i>	47
3.1 INTRODUCTION	48
3.1.1 The National Space Centre	48
The planetarium show ‘ <i>The Planets</i> ’	49
The galleries	49
The Challenger Learning Centre	49
3.2 METHODOLOGY	50
3.2.1 Data collection	50
3.2.2 Data collection materials	50
3.2.3 Pilot study	51
3.3 RESULTS	51
3.3.1 The study cohort	51
3.3.2 Associations between attitudes, perceived ability and museum visits	52
3.3.3 Impact of the visit on students’ affective domains	54
3.4.4 Impact of the visit on students’ cognitive domains	56
3.4.5 Evaluation questions	58
3.4.6 Students’ impressions of the visit	58
3.5 DISCUSSION	60
3.5.1 Results summary	60
3.5.2 Impact on Key Stage 3 students	61
<i>Appendix 3.1</i>	63

EVALUATION OF THE IMPACT OF A DEMONSTRATION LECTURE ON THE COGNITIVE AND AFFECTIVE DOMAINS OF KEY STAGE 4 STUDENTS

<i>Research Axes</i>	75
4.1 INTRODUCTION	76
The ‘ <i>Science is Cool</i> ’ lecture	76
4.2 METHODOLOGY	77
4.2.1 Lecture tour	77
4.2.2 Data collection materials	77
4.2.3 Piloting	78
4.3 RESULTS	78
4.3.1 The study cohort	78
4.3.2 Associations between attitude, perceived ability and museum visits	78
4.3.3 Impact of the lecture on students’ affective domain	80
4.3.4 Impact of the lecture on students’ cognitive domain	83
4.3.5 Evaluation of lecture by students	84
4.3.6 Students’ impressions of the lecture	84
4.3.7 Evaluation of lecture by teachers	86
4.4 DISCUSSION	87
4.4.1 Summary of results	87
4.4.2 Affective impact	87
4.4.3 Cognitive impact	89
<i>Appendix 4.1</i>	<i>91</i>
<i>Appendix 4.2</i>	<i>104</i>

EVALUATION OF THE IMPACT OF OUTREACH ACTIVITIES ON THE COGNITIVE AND AFFECTIVE DOMAINS OF AS- AND A2-LEVEL PHYSICS STUDENTS

<i>Research Axes</i>	<i>107</i>
5.1 INTRODUCTION	108
5.1.1 Activity provider	108
5.1.2 Outreach Activities at Culham Science Centre	109
5.1.3 The ‘ <i>Great Balls of Fire</i> ’ lecture	109
5.1.4 Visits to Culham Science Centre	110
5.2 METHODOLOGY	111
5.2.1 Survey of students	111
5.2.2 Survey of teachers	111
5.3 RESULTS	112
5.3.1 The study cohort	112
5.3.2 Associations between attitude, perceived ability and museum visits	113
5.3.3 Impact of the lecture	114
Impact of the lecture on students’ affective domains	114
Impact of the lecture on students’ cognitive domains	116
Students’ evaluation of the lecture	118
5.3.4 Impact of the visit	118
Impact of the visit on students’ affective domains	118
Impact of the visit on students’ cognitive domains	120
Students’ evaluation of the visit	121
5.3.5 Opinions of teachers	122
5.4 DISCUSSION	124
5.4.1 Students’ attitudes, perceived ability and museum visits	124
5.4.2 Impact of interventions	125
Affective impact	125
Cognitive impact	126

Comparison of interventions	126
<i>Appendix 5.1</i>	<i>128</i>

Chapter 6

EVALUATION OF THE IMPACT OF A SCIENCE FESTIVAL ON ITS VISITORS

<i>Research axes</i>	<i>158</i>
6.1 INTRODUCTION	159
6.1.1 Science festivals in the UK	159
6.1.2 Cheltenham Festival of Science	160
6.1.2 Festival description	160
6.1.3 Festival aims	161
6.2 METHODOLOGY	162
6.2.1 Data collection	162
Exit and general interviews	163
Audience survey questionnaires	164
Personal response system	164
Follow-up survey	164
6.3 RESULTS	165
6.3.1 Attendance and ticket sales	165
6.3.2 The study cohort	165
Sample demographics	166
Attitude towards science, science media usage and science leisure activities	167
6.3.3 The nature of a festival visit	168
6.3.4 Impact of individual events	169
6.3.5 Opinions of the festival	171
Quantitative Rating	171
Qualitative rating	173

Popularity of festival events	174
Scientific level of festival events	175
6.3.6 Impact of the festival on visitors	176
6.3.7 Dialogue	178
6.3.8 Longer-term impact	178
6.4 DISCUSSION	179
6.4.1 Festival successes	179
6.4.2 Festival impact	180
6.4.3 Festival limitations	181
<i>Appendix 6.1</i>	<i>183</i>
<i>Appendix 6.2</i>	<i>199</i>

Chapter 7

EVALUATION OF THE IMPACT OF AN ACTIVITY IN A GENERIC VENUE ON 'INATTENTIVE' PUBLICS

<i>Research Axes</i>	<i>203</i>
7.1 INTRODUCTION	204
7.1.1 Why generic venues?	204
7.1.2 Examples of generic venues activities	205
7.1.3 The '<i>Science in the Fast Lane</i>' project	206
7.1.4 The science tricks	207
7.2 METHODOLOGY	208
7.2.1 Structured interviews	209
7.2.2 Questionnaire items	209
7.3 RESULTS	210
7.3.1 Observations from Gordano Services	210
7.3.2 Observations from Exeter Services	211

7.3.3	The study cohort	213
7.3.4	Pre-existing attitudes towards science	214
7.3.5	Opinions of the activity	214
	Opinions of the science tricks	214
	Opinions of the activity packs	215
7.3.6	Project website	216
7.3.7	Opinions of the project aims	216
7.3.8	Cognitive impact	217
7.3.9	Affective impact	217
7.3.10	Activity media coverage	217
7.4	DISCUSSION	218
	<i>Appendix 7.1</i>	<i>221</i>

Chapter 8

META-ANALYSIS: COMPARISON OF THE IMPACTS OF DIFFERENT ACTIVITIES

8.1	INTRODUCTION	227
8.2	METHODOLOGY	227
8.2.1	Comparison of pre-existing attitudes	227
8.2.2	Comparison of activities	227
8.2.3	Relationships between indicators	228
8.3	RESULTS	229
8.3.1	Attitudes towards physics of year 8, 10, 12 and 13 students	229
	The study cohort	229
	Self-perceived ability and museum visits	229

Nature of the subject	230
Academic demands of the subject	231
Types of student	232
Communication of the subject	233
8.3.2 Comparison of impact of activities	234
Change in perceptions of physics	234
Change in physics understanding	238
8.3.3 Relationships between direct and indirect indicators	238
Year 8 students	238
Year 10 students	240
AS- and A2-Level students	242
8.3.4 Comparing all activities	245
8.3.5 Comparison of activities along research axes	249
Target audience	249
Venue	250
8.4 DISCUSSION	252
8.4.1 Pre-existing attitudes towards physics	252
8.4.2 Comparison of schools activity impacts	253
8.4.3 Comparison of all activities and further work	254

Chapter 9

TOWARDS AN ALTERNATIVE FRAMEWORK FOR MAPPING SCIENCE COMMUNICATION ACTIVITIES

9.1 INTRODUCTION	254
Why map activities?	254
9.2 DIMENSIONS	255
9.2.1 Engagement dimension	256
Maximum level of engagement	256

Minimum level of engagement	259
9.2.2 Avoidance dimension	261
9.2.3 Intensity dimension	262
9.2.4 Activity reach and audience size dimensions	264
Potential audience size	264
Activity reach	266
9.2.5 Direction of knowledge transfer	267
9.2.6 Topicality dimension	268
9.2.5 From dimensions to axes	269
9.3 DISCUSSION	273
9.3.1 Application of axes	273
9.3.2 Limitations of axes	274
9.3.3 Further work	275
9.4 CONCLUSIONS	276
Activities and their impacts	276
Axes and mapping	276
<i>Appendix 9.1</i>	<i>277</i>